



## Oban Flood Study

### Report 3C: Conceptual Designs & Factsheets



December 2019

# Oban Flood Study

## Report 3C: Conceptual Designs & Factsheets

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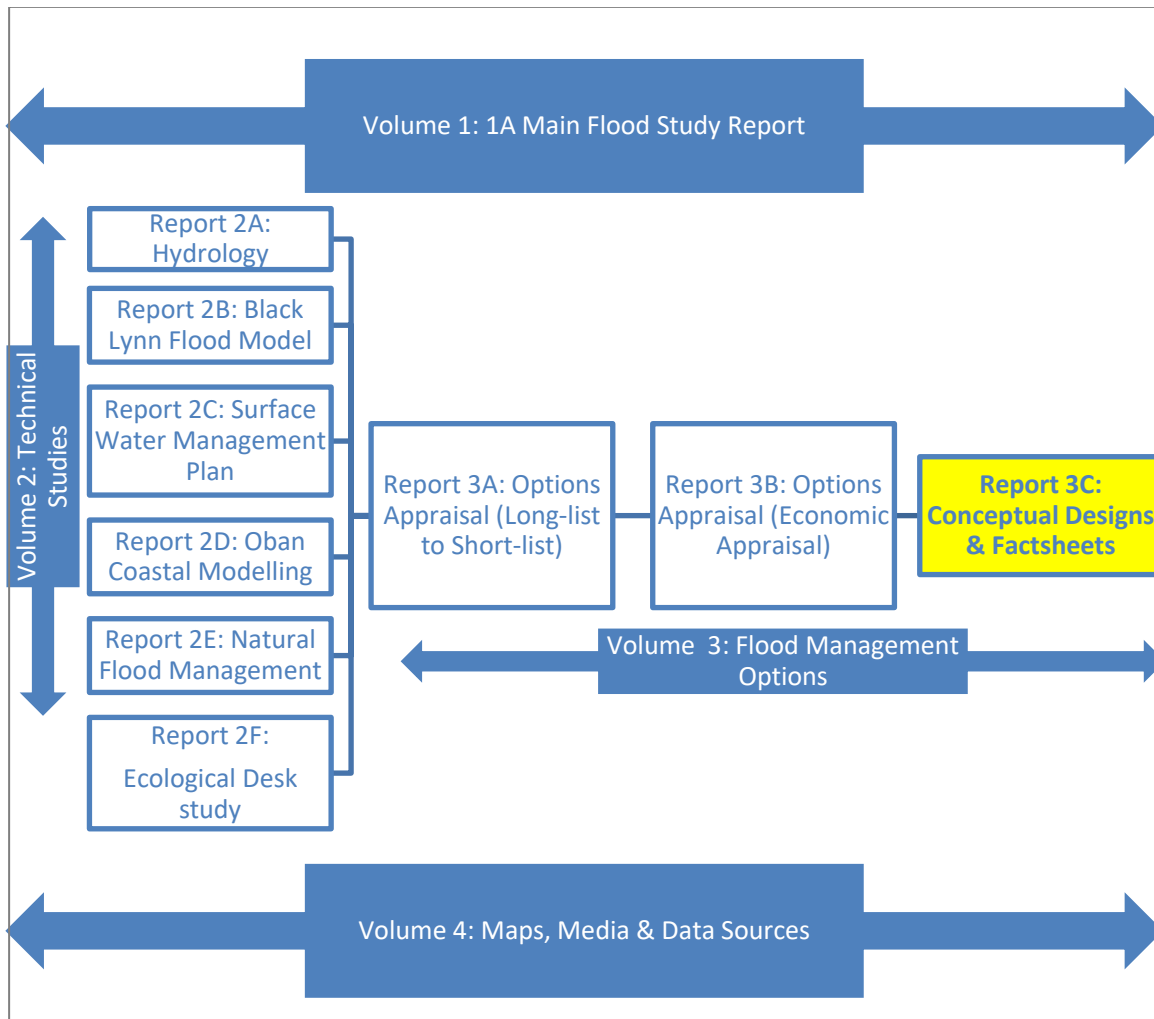
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## OBAN FLOOD STUDY REPORT MAP



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# **1 INTRODUCTION**

## **1.1 Terms of Reference**

The conceptual design of flood mitigations presented in this report have been carried out as part of the Oban Flood Study, which has been commissioned by Argyll & Bute Council.

## **1.2 Scope of Report**

The options appraisal process to identify appropriate flood mitigation measures has resulted in the development of conceptual designs to mitigate flood risk. This report contains these short-listed conceptual flood mitigation design measures, and for the preferred options, factsheets have also been produced to inform future detail design and to highlight any potential physical or cost constraints on the implementation of the proposed mitigation options for the Oban Flood Study.

The Oban study area comprises of Oban town centre and the surrounding suburbs of Longsdale, Dunollie, Glencruitten, Pulpit Hill, Glenshellach, and Soroba.

## **1.3 Report Usage**

This report has been prepared as part of the Oban Flood Study commissioned by Argyll & Bute Council and should not be used beyond this context without their permission.

If this report is to be submitted for regulatory approval more than 12 months following the report date, it is recommended that it is referred to EnviroCentre Ltd for review to ensure that any relevant changes in data, best practice, guidance or legislation in the intervening period are integrated into an updated version of the report.

## 2 CONCEPTUAL DRAWINGS FOR SHORT-LISTED OPTIONS

### 2.1 Short Listed Options

Short listed options are detailed in *Report 3B: Options Appraisal - Economic Appraisal*.

### 2.2 Option Labelling

The option numbering scheme set out in Table 2.1 has been used to categorise option types examined as part of economic appraisal.

**Table 2.1: Option labelling system**

Option Series	Type
1	Bridge widening options
2	Attenuation storage options
3	Conventional flood defence (wall or embankment) options
4	Other options, not within any of the above categories
5	Combinations of two or more categories of options
6	Coastal defence options

### 2.3 Conceptual Flood Mitigation Option drawings

The short-listed flood mitigation option conceptual design drawings are summarised in Table 2.2, with the drawings contained in Appendix A.

**Table 2.2: Short listed conceptual design drawings**

Option Reference	Drawing Number	Drawing Title
1B	170506-069	Market Street Bridge Replacement
2A	170506-059	Lon Mor Attenuation
2C	170506-058	Mossfield Stadium Attenuation
2D	170506-065	Rugby Pitches Attenuation
3A	170506-071	Black Lynn Flood Defence Walls (up to 3.8m AOD)
3B	170506-105	Black Lynn Flood Defence Walls (up to 4.0m AOD)
3C	170506-070	Millpark Corridor Flood Defences
4A	170506-068	Miller Road Culvert Dualing
4B	170506-064	Miller Road Floodwater Routing
6A	170506-055	Extensive Coastal Defence
6B	170506-101	Reduced Extent Coastal Defence
6C	170506-126	Coastal Property Level Protection

## 3 PREFERRED OPTIONS FACTSHEETS

### 3.1 Preferred Options

Recommendations detailed in *Report 3B: Options Appraisal - Economic Appraisal* indicate preferred options that are recommended for further consideration, design and optimisation as part of a strategy for managing this risk.

### 3.2 Factsheets

Factsheets have been prepared for the preferred options as detailed in Table 3.1 and the factsheets are contained in Appendix B.

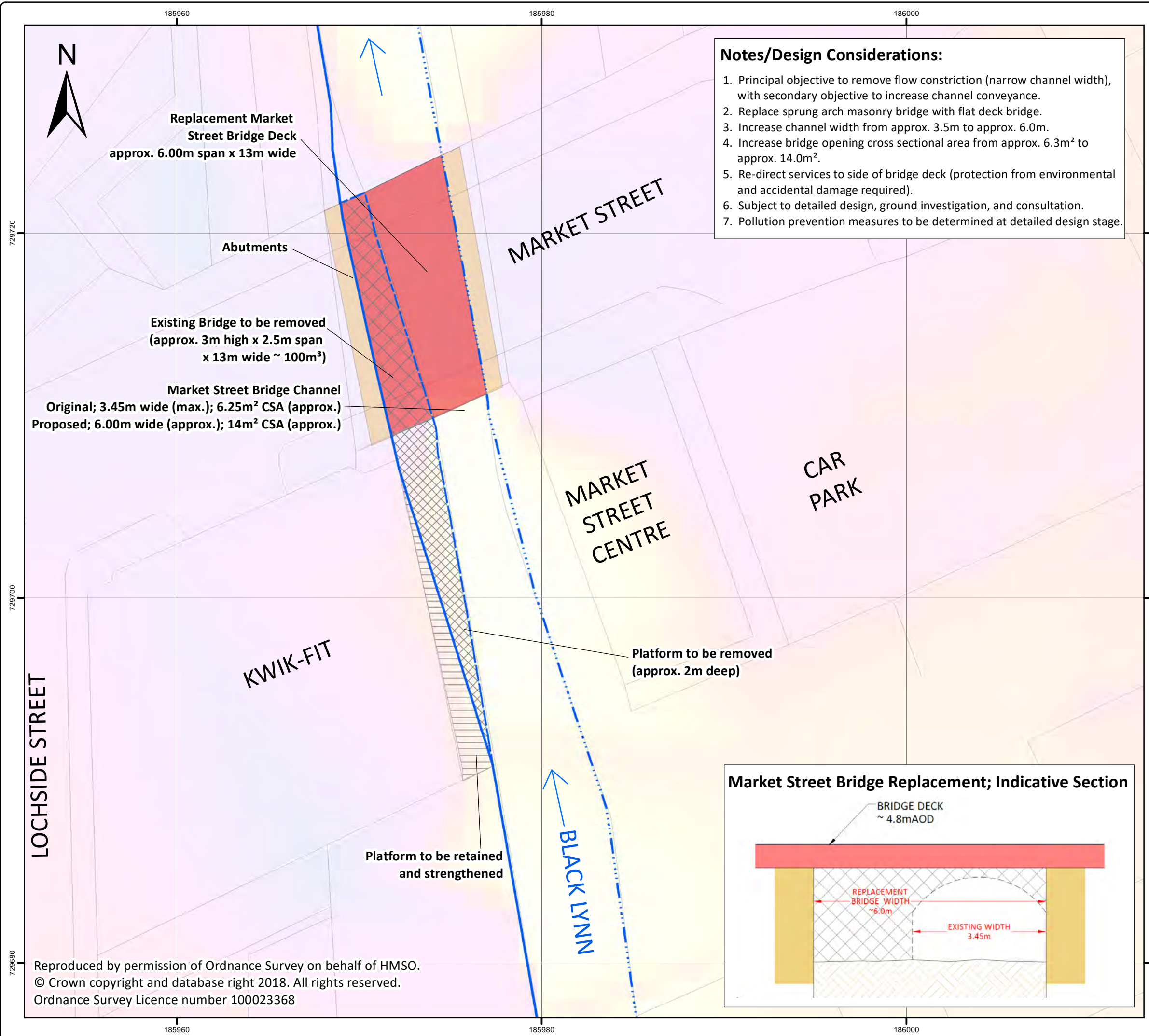
**Table 3.1: Preferred option factsheets**

Option Reference	Detail
1B	Market Street Bridge Replacement
2A	Lon Mor Attenuation
2C	Mossfield Stadium Attenuation
3B	Black Lynn Flood Defence Walls (up to 4.0m AOD)
4A	Miller Road Culvert Dualing
6B	Reduced Extent Coastal Defence
6C	Coastal Property Level Protection

# APPENDICES



# **A      SHORT-LISTED OPTIONS: CONCEPTUAL FLOOD MITIGATION DRAWINGS**



- Notes/Design Considerations:**
1. Principal objective to remove flow constriction (narrow channel width), with secondary objective to increase channel conveyance.
  2. Replace sprung arch masonry bridge with flat deck bridge.
  3. Increase channel width from approx. 3.5m to approx. 6.0m.
  4. Increase bridge opening cross sectional area from approx. 6.3m<sup>2</sup> to approx. 14.0m<sup>2</sup>.
  5. Re-direct services to side of bridge deck (protection from environmental and accidental damage required).
  6. Subject to detailed design, ground investigation, and consultation.
  7. Pollution prevention measures to be determined at detailed design stage.

**Legend**

- Black Lynn; Existing Left Bank
- Black Lynn; Proposed Left Bank
- Black Lynn; Existing Right Bank
- Proposed New Abutment
- Bridge Material to be Removed
- Platform to be Removed
- Proposed New Bridge
- Platform to be Retained and Strengthened
- Levels greater than 5.0mAOD
- Levels less than 2.5mAOD

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Client		
Argyll and Bute Council		
Project		
Oban Flood Study		
Title		
Conceptual Flood Mitigation; Option 1B Market Street Bridge Replacement		
Status		
FINAL		
Drawing No.	Revision	
170506-069		
Scale	A3	Date
1:200		08 Nov 2019
Drawn	Checked	Approved
CM	NG	KMD

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**Market Street Bridge Replacement; Indicative Section**

BRIDGE DECK  
~ 4.8mAOD

REPLACEMENT BRIDGE WIDTH  
~ 6.0m

EXISTING WIDTH  
3.45m

Platform to be retained and strengthened

Platform to be removed (approx. 2m deep)

BLACK LYNN

MARKET STREET

MARKET STREET CENTRE

CAR PARK

KWIK-FIT

LOCHSIDE STREET

Abutments

Replacement Market Street Bridge Deck approx. 6.00m span x 13m wide

Existing Bridge to be removed (approx. 3m high x 2.5m span x 13m wide ~ 100m<sup>3</sup>)

Market Street Bridge Channel  
Original; 3.45m wide (max.); 6.25m<sup>2</sup> CSA (approx.)  
Proposed; 6.00m wide (approx.); 14m<sup>2</sup> CSA (approx.)

**Notes/Design Considerations:**

1. Subject to detailed structural, geotechnical and drainage design, ground investigation, and consultation.
2. Flow from the Glenshellach Burn to be impounded to level up to 8.0m AOD.
3. Bund level to be set to 8.0m AOD. Height varies with topography (~1.8m above ground level at outflow culvert). Bund slopes to be no steeper than 1:3.
4. Reinstated cyclepath to be tarmacked with bearing capacity to allow maintenance vehicle access.
5. Flow to be controlled within the Glenshellach Burn by replacement of existing bund culverts with a single Ø600mm culvert pipe.
6. Engineered spill to be installed, south-east of discharge, at 7.55m AOD (spill width to be determined).
7. Water level monitoring station with wired/wireless telemetry to be installed.
8. Detailed design, construction, management and maintenance to comply with the Reservoirs (Scotland) Act 2011. A maximum storage of 10,000m<sup>3</sup> of flood water to be impounded to level of 7.55m AOD.

**Bund crest lowered to 7.55m AOD  
Engineered spill added  
Spill width to be determined**

**Rock armoured spill path  
to return water to the  
Glenshellach Burn**

**Lon Mor Cyclepath Access  
at Glenshellach Road  
Tie-in to Existing Cyclepath  
at 8.0m AOD level.**

**Existing Ø900mm plus two minor  
culverts to be replaced with single  
Ø600mm conduit.**

**Culvert inlet arrangement & potential  
screening measurement to be designed**







**Existing Cyclepath Bund  
raised from approx.  
7.2m AOD to 8.0m AOD  
over 250m length**

**Tie-in to Existing  
Cyclepath at  
8.0m AOD level.**

**Lon Mor Cyclepath Access  
at Glengallan Road**


**Glenshellach Burn**

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- Legend**
-  Spill (7.55m AOD)
  -  Lon Mor Cyclepath
  -  Lon Mor Attenuation Outflow Spill (7.55m AOD)
  -  Lon Mor Attenuation extent (to 8.0m AOD)
  -  Cyclepath/Bund to be raised to 8.0m AOD
  -  Reported Scottish Water Surface Water Outfalls

Client <b>Argyll and Bute Council</b>	Status <b>FINAL</b>
Project <b>Oban Flood Study</b>	Drawing No. 170506-059
Title <b>Conceptual Flood Mitigation; Option 2A Lon Mor Attenuation</b>	Scale 1:1,500
	Date 08 Nov 2019
Drawn CM	Checked NG
	Approved KMD

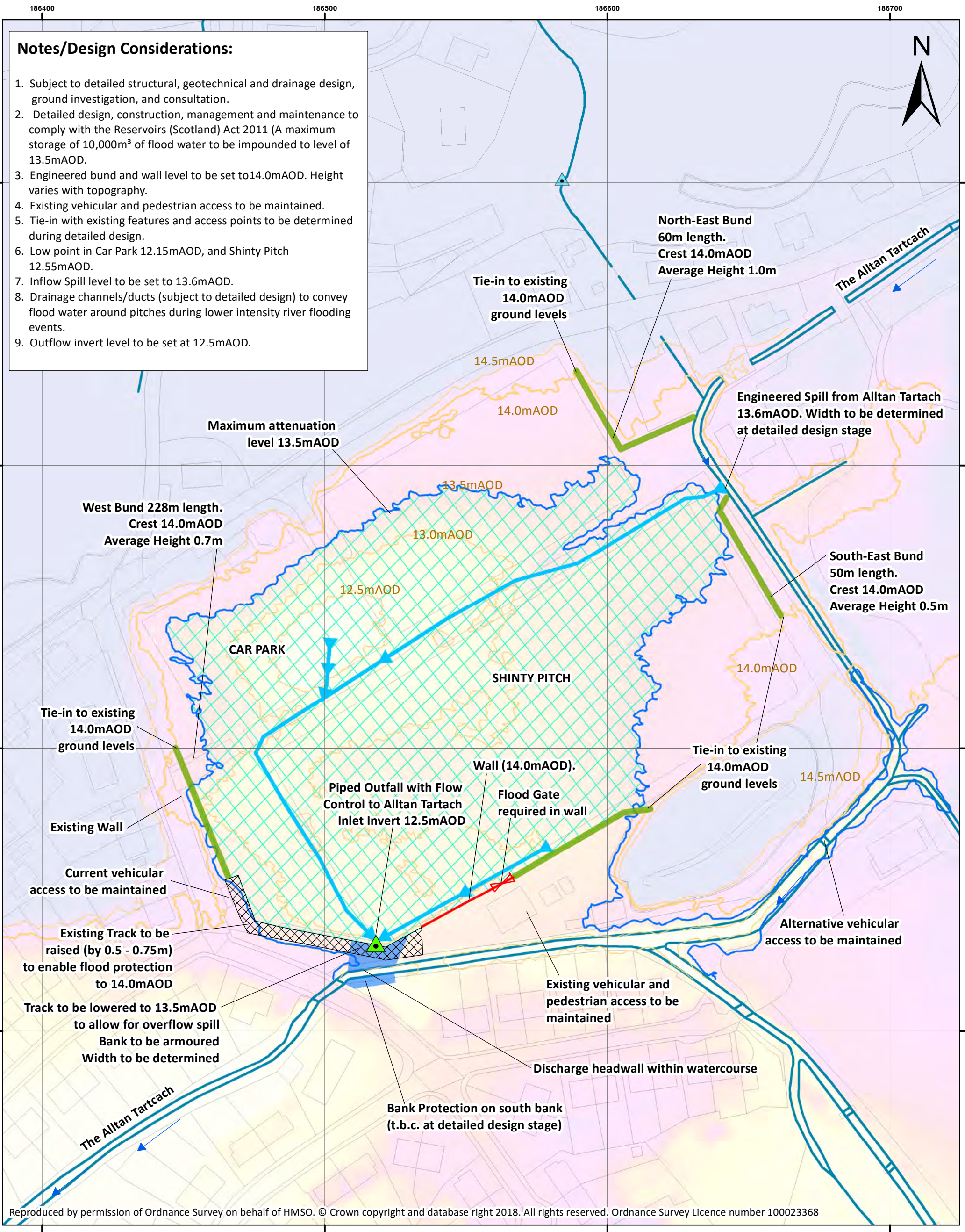
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**Notes/Design Considerations:**

1. Subject to detailed structural, geotechnical and drainage design, ground investigation, and consultation.
2. Detailed design, construction, management and maintenance to comply with the Reservoirs (Scotland) Act 2011 (A maximum storage of 10,000m<sup>3</sup> of flood water to be impounded to level of 13.5m AOD).
3. Engineered bund and wall level to be set to 14.0m AOD. Height varies with topography.
4. Existing vehicular and pedestrian access to be maintained.
5. Tie-in with existing features and access points to be determined during detailed design.
6. Low point in Car Park 12.15m AOD, and Shinty Pitch 12.55m AOD.
7. Inflow Spill level to be set to 13.6m AOD.
8. Drainage channels/ducts (subject to detailed design) to convey flood water around pitches during lower intensity river flooding events.
9. Outflow invert level to be set at 12.5m AOD.



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Legend	
	Mossfield Attenuation Bund
	Drainage Channel
	Flood Wall 14.0m AOD level
	Area of Ponding to 13.5m AOD
	Mossfield Track
	Reported Scottish Water Surface Water Outfalls
	Outfall Flow Control
	Mossfield Outflow Spill
	Levels greater than 15.0m AOD
	Levels less than 12.0m AOD

Client Argyll and Bute Council	Status <b>FINAL</b>
Project Oban Flood Study	Drawing No. 170506-058
Title Conceptual Flood Mitigation; Option 2C Mossfield Stadium Attenuation	Scale 1:1,250
	Date 08 Nov 2019
	Drawn CM
	Checked NG
	Approved KMD

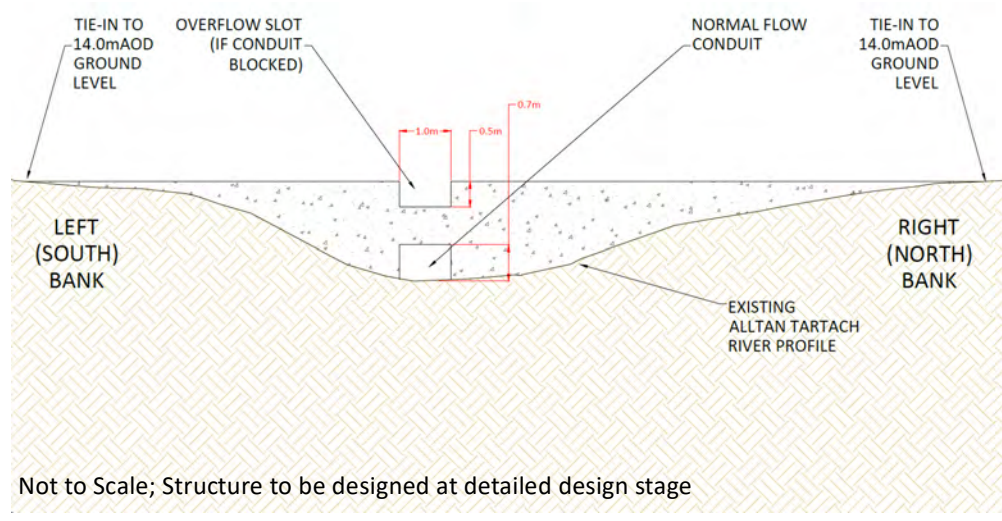
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### Alltan Tartach In-channel Flow Control Throttle



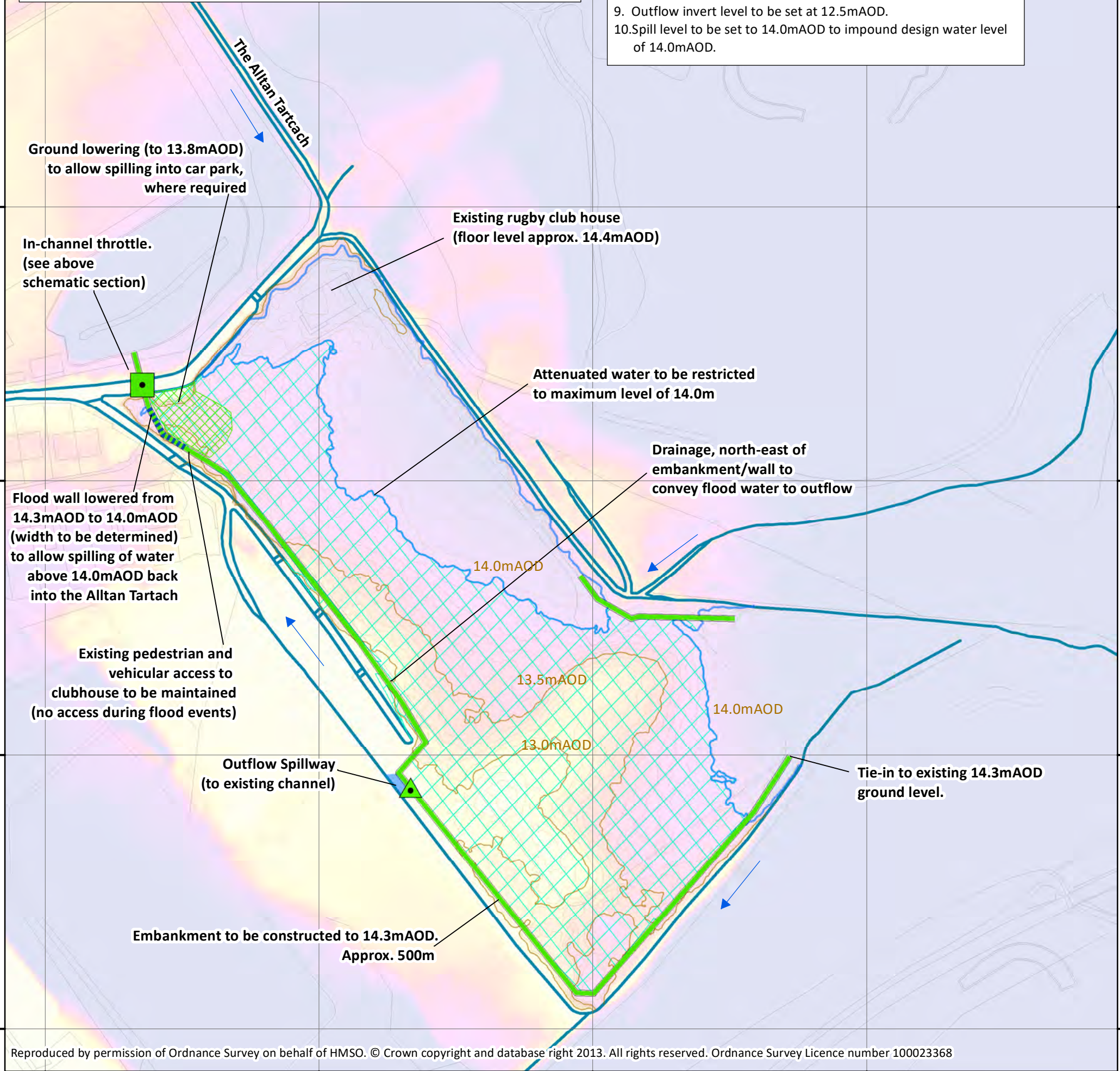
### Notes/Design Considerations:

1. Subject to detailed structural, geotechnical and drainage design, ground investigation, and consultation.
2. Detailed design, construction, management and maintenance to comply with the Reservoirs (Scotland) Act 2011 (A maximum storage of 10,000m<sup>3</sup> of flood water to be impounded to level of 14.0m AOD).
3. Bund level to be set to 14.3m AOD. Height varies with topography.
4. Existing vehicular and pedestrian access to be maintained.
5. Tie-in with existing features and access points to be determined during detailed design.
6. Low point at control discharge point 12.5m AOD,
7. Inflow Spill level to be set to 13.8m AOD.
8. Drainage channels/ducts (subject to detailed design) to convey flood water around pitches during lower intensity river flooding events.
9. Outflow invert level to be set at 12.5m AOD.
10. Spill level to be set to 14.0m AOD to impound design water level of 14.0m AOD.



729700  
729600  
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### Legend

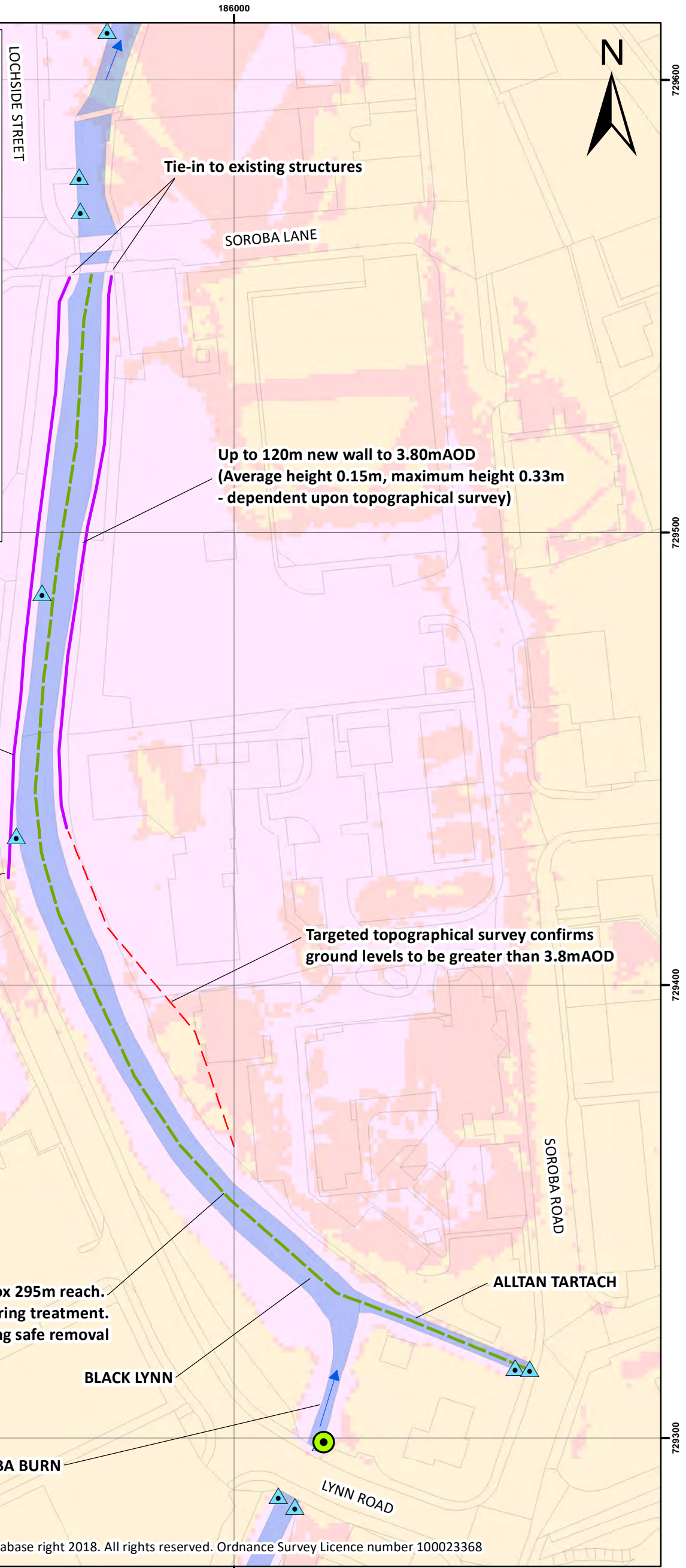
- Alltan Tartach Throttle
- Rugby Field Outfall
- Rugby Field Flood Embankment/Wall
- Spill (14.0m AOD)
- Rugby Field Inflow Spillway
- Rugby field Outfall Spillway
- Levels greater than 14.5m AOD
- Levels less than 13.0m AOD

Client <b>Argyll and Bute Council</b>		Status <b>FINAL</b>	
Project <b>Oban Flood Study</b>		Drawing No. 170506-065	Revision
Scale <b>1:1,500</b>	<b>A3</b>	Date <b>08 Nov 2019</b>	
Drawn <b>CM</b>	Checked <b>NG</b>	Approved <b>KMD</b>	
Title <b>Conceptual Flood Mitigation; Option 2D Rugby Pitches Attenuation</b>		 Craighall Business Park, Eagle Street, Glasgow, G4 9XA Tel: 0141 341 5040 Fax: 0141 341 5045	

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**Notes/Design Considerations:**

1. Subject to detailed structural, geotechnical and drainage design, ground investigation, contamination assessment, invasive non-native species (INNS) assessment and consultation.
2. LiDAR levels indicative of ground level, may not indicate existing 'informal' flood defences. Conceptual mitigation design based upon existing ground level/bund level derived from targeted topographical survey. Levels require confirmation by full topographical survey prior to detailed design.
3. Protection level set to 3.80m AOD based upon optimum level identified in the economic appraisal (however finished levels and extents may be revised following detailed modelling and design). Height above ground level varies with topography.
4. Embankment proposed for left/west bank. Wall proposed for right/east bank, where space limited.
5. Tie-in with existing features and access points to be determined during detailed design.
6. Non-return discharge points required to allow impounded surface water to discharge to Black Lynn, when watercourse level allows. Location and mechanism to be determined during detailed design stage.
7. Non-return valves to be fitted to existing outfalls on the Black Lynn, including outfall at Gibraltar Street.
8. Cut-off to limit superficial groundwater seepage in alluvium (identified on left bank) required. To be determined at detailed design stage.
9. Japanese Knotweed control and treatment methodology to be decided, in consultation with regulators, at detailed design phase.



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**Legend**

- Black Lynn Flood Protection up to 3.80m AOD
- Levels Confirmed by Targeted Topographic Survey
- Japanese Knotweed Indicative Treatment Area
- Water Level Gauging Station
- Reported Scottish Water Surface Water Outfalls
- LiDAR Levels less than 3.8m AOD
- LiDAR Levels between 3.8 and 4.0m AOD
- LiDAR Levels greater than 4.0m AOD

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Drawing No.  
170506-071

Revision

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Oban Flood Study

Scale  
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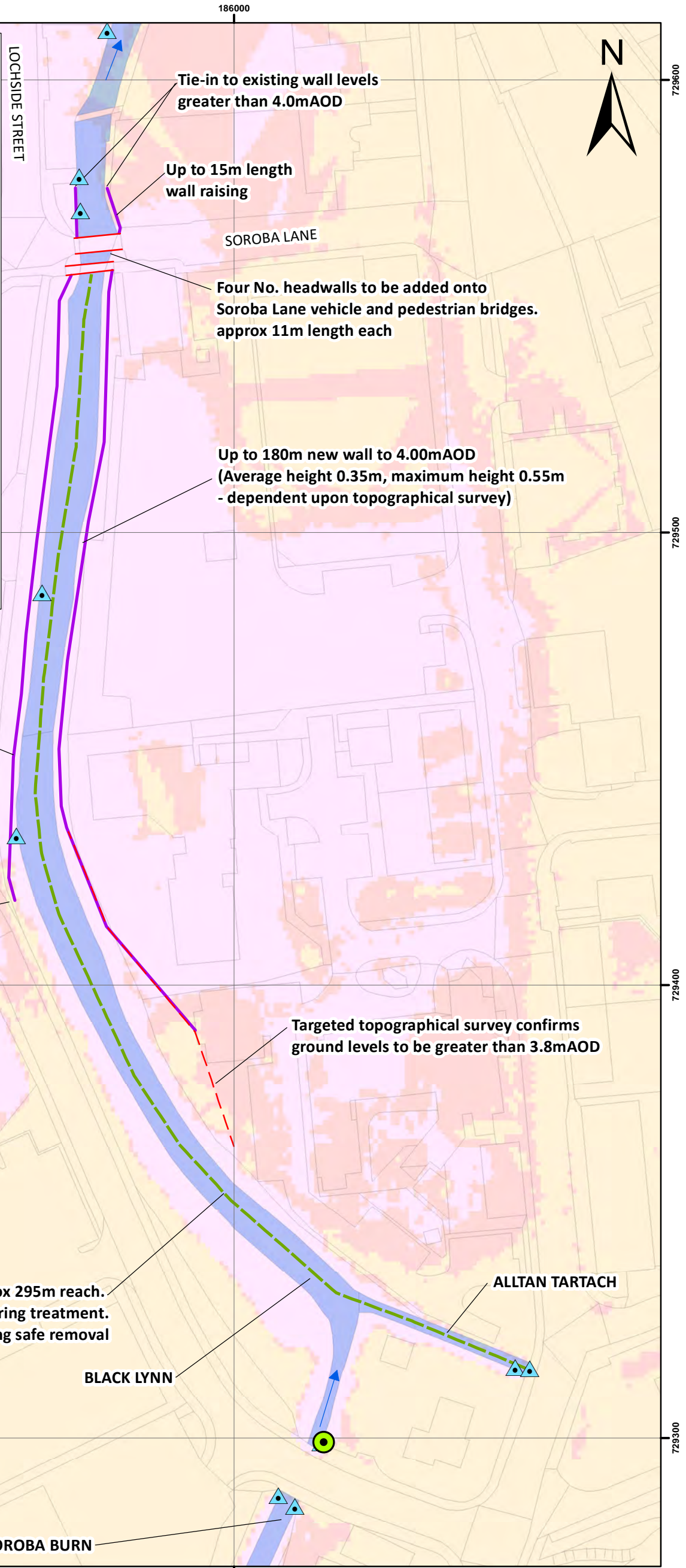
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KMD

Title  
Conceptual Flood Mitigation Option 3A  
Black Lynn Flood Defence Walls  
(up to 3.8m AOD)

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**Notes/Design Considerations:**

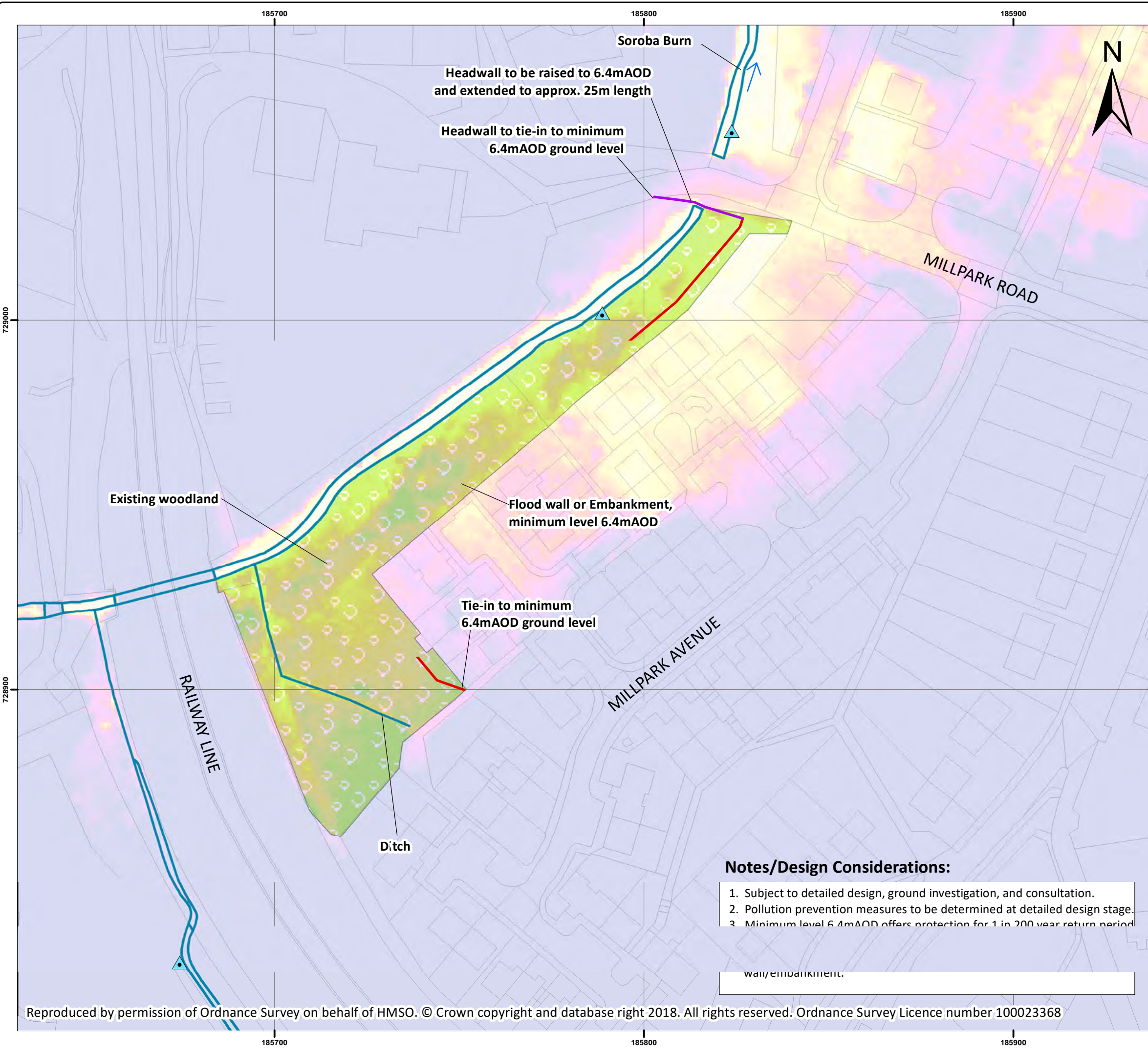
1. Subject to detailed structural, geotechnical and drainage design, ground investigation, contamination assessment, invasive non-native species (INNS) assessment and consultation.
2. LiDAR levels indicative of ground level, may not indicate existing 'informal' flood defences. Conceptual mitigation design based upon existing ground level/bund level derived from targeted topographical survey. Levels require confirmation by full topographical survey prior to detailed design.
3. Protection level set to 4.0mAOD based upon optimum level identified in the economic appraisal (however finished levels and extents may be revised following detailed modelling and design). Height above ground level varies with topography.
4. South of Soroba Lane bridge; embankment proposed for left/west bank and wall proposed for right/east bank, where space limited.
5. North of Soroba Lane bridge; existing walls to be raised to 4.0mAOD.
6. Headwalls to be added to Soroba Lane bridges, as bridge deck is lower than 4.0mAOD
7. Tie-in with existing features and access points to be determined during detailed design.
8. Non-return discharge points required to allow impounded surface water to discharge to Black Lynn, when watercourse level allows. Location and mechanism to be determined during detailed design stage.
9. Non-return valves to be fitted to existing outfalls on the Black Lynn, including outfall at Gibraltar Street.
8. Cut-off to limit superficial groundwater seepage in alluvium (identified on left bank) required. To be determined at detailed design stage.
10. Japanese Knotweed control and treatment methodology to be decided, in consultation with regulators, at detailed design phase.



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<b>Legend</b>		Client <b>Argyll and Bute Council</b>		Status <b>FINAL</b>	
Black Lynn Flood Protection up to 4.00mAOD	Water Level Gauging Station	Project <b>Oban Flood Study</b>		Drawing No. <b>170506-105</b>	Revision
Levels Confirmed by Targeted Topographic Survey	Reported Scottish Water Surface Water Outfalls	Scale <b>1:1,000</b>		<b>A3</b>	Date <b>08 Nov 2019</b>
Soroba Lane Bridge Headwall	LiDAR Levels less than 3.8mAOD	Drawn <b>CM</b>	Checked <b>NG</b>	Approved <b>KMD</b>	
Japanese Knotweed Indicative Treatment Area	LiDAR Levels between 3.8 and 4.0mAOD	Title <b>Conceptual Flood Mitigation; Option 3B Black Lynn Flood Defence Walls (up to 4.0mAOD)</b>		Craighall Business Park, Eagle Street, Glasgow, G4 9XA Tel: 0141 341 5040 Fax: 0141 341 5045	
LiDAR Levels greater than 4.0mAOD					



**Legend**

- Proposed Wall/Embankment
- Soroba Burn Millpark Road Headwall
- ▲ Reported Scottish Water Surface Water Outfalls
- Existing Woodland
- Levels greater than 6.5m AOD
- Levels less than 5.5m AOD

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Argyll and Bute Council

Project  
Oban Flood Study

Title  
Conceptual Flood Mitigation; Option 3C  
Millpark Corridor Flood Defences

Status  
**FINAL**

Drawing No. 170506-070	Revision
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Scale 1:1,000	<b>A3</b>	Date 08 Nov 2019
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Drawn CM	Checked NG	Approved KMD
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- Notes/Design Considerations:**
1. Subject to detailed design, ground investigation, and consultation.
  2. Pollution prevention measures to be determined at detailed design stage.
  3. Minimum level 6.4m AOD offers protection for 1 in 200 year return period.

way/embankment.



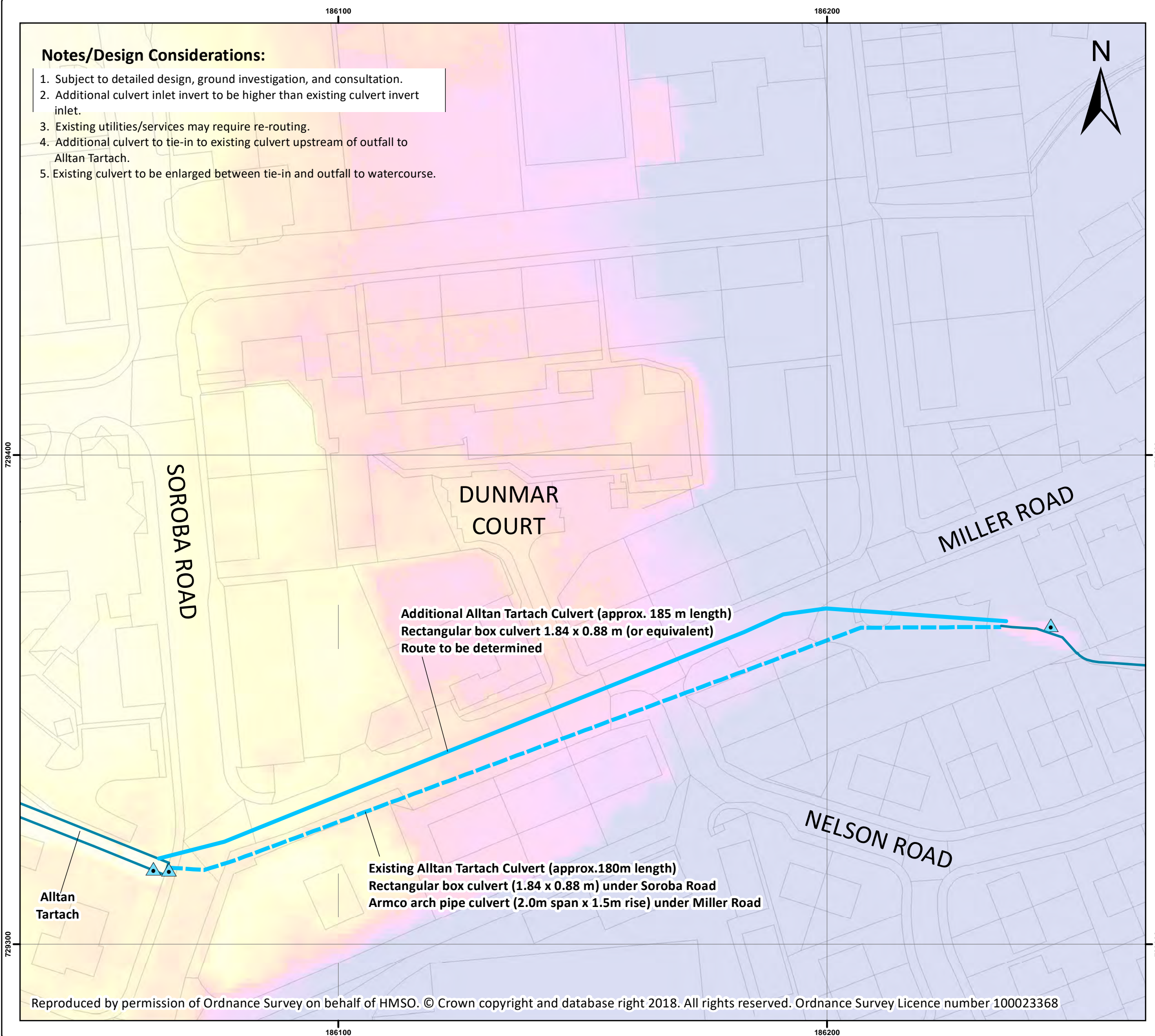
**Notes/Design Considerations:**

1. Subject to detailed design, ground investigation, and consultation.
2. Additional culvert inlet invert to be higher than existing culvert invert inlet.
3. Existing utilities/services may require re-routing.
4. Additional culvert to tie-in to existing culvert upstream of outfall to Alltan Tartach.
5. Existing culvert to be enlarged between tie-in and outfall to watercourse.



**Legend**

- Existing Alltan Tartach Culvert
- Proposed Additional Alltan Tartach Culvert
- Reported Scottish Water Surface Water Outfalls
- Levels greater than 8.0mAOD
- Levels less than 3.5mAOD



**Additional Alltan Tartach Culvert (approx. 185 m length)**  
 Rectangular box culvert 1.84 x 0.88 m (or equivalent)  
 Route to be determined

**Existing Alltan Tartach Culvert (approx. 180m length)**  
 Rectangular box culvert (1.84 x 0.88 m) under Soroba Road  
 Armco arch pipe culvert (2.0m span x 1.5m rise) under Miller Road

Alltan Tartach

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Project  
 Oban Flood Study

Title  
 Conceptual Flood Mitigation; Option 4A  
 Miller Road Culvert Dualing

Status  
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Drawing No. 170506-068      Revision

Scale 1:750      **A3**      Date 08 Nov 2019

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**Notes/Design Considerations:**

1. Subject to detailed design, ground investigation, and consultation.
2. Soroba Road to be raised 0.2m & 0.4m north & south of junction. To be incorporated with pedestrian crossing.
3. Soroba/Miller Road level to be lowered by 0.4m to facilitate flow to Burn.
4. Inflow to Burn, west of Soroba Road to be enhanced to increase conveyance capacity (subject to detailed design).
5. Conveyance and interception capacity of existing Ø300mm Miller Road storm sewer to be enhanced by increase in diameter/barrels and gullies.
6. Access to Job Centre and Ambulance Station car parks to be raised by 0.3m. Access to Dunmar Court to be raised by 0.45m.
7. Approx. 250m footway to be raised. Existing access to be maintained.
8. Approx. 65m flood wall to be constructed.
9. Three properties identified to require property level protection (tanking walls, demountable defences).
10. Enhanced flood information required for all residents/users impacted by Miller Road flood routing scheme.

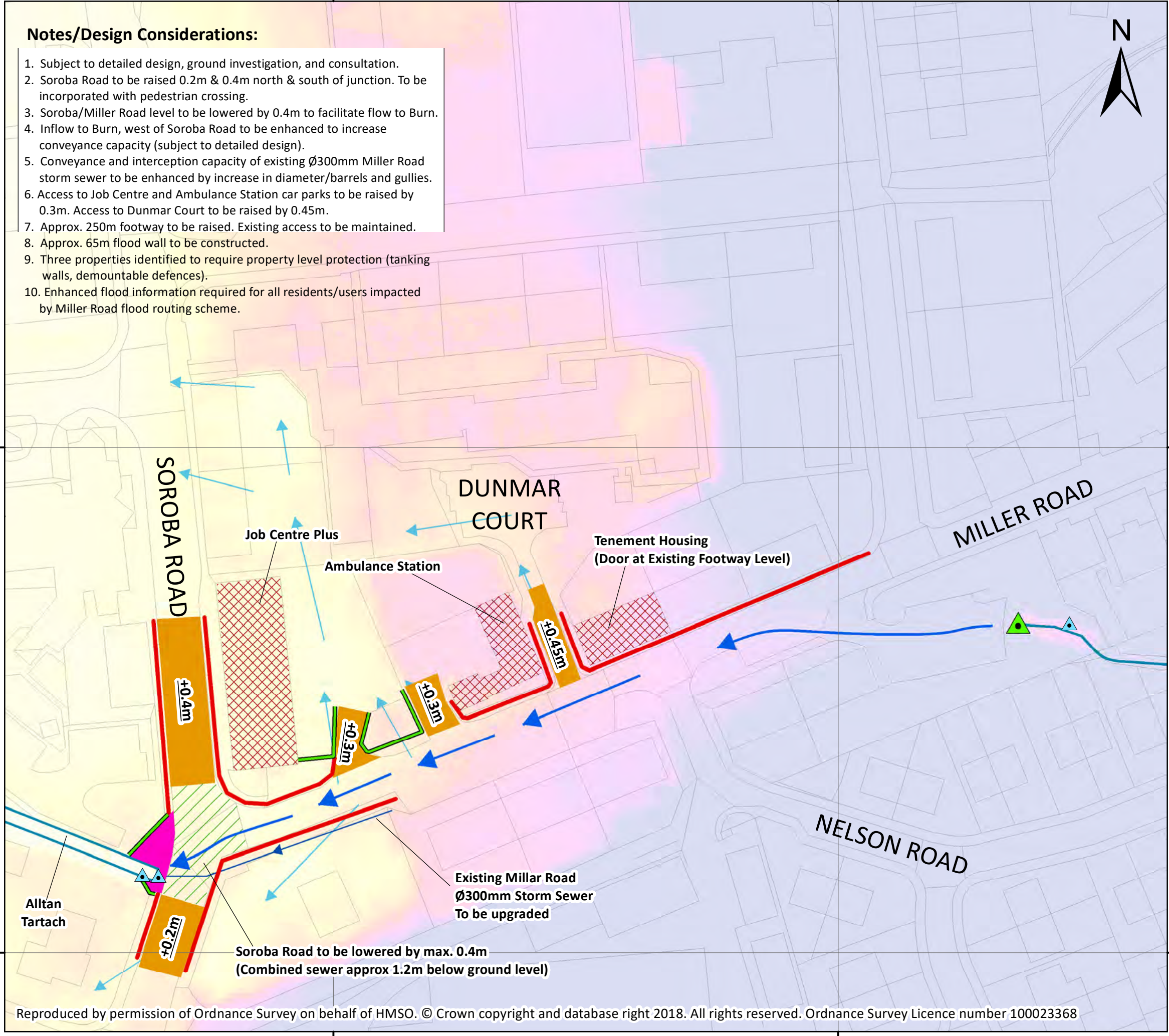


**Legend**

- Modelled Spill from Burn Culvert
- Flood-proof Wall
- Overland Flow Re-entry to Burn
- Raised Pavements
- Raised Crossings - to confine flow
- Property-level Protection & Resilience
- Pre-mitigation Overland Flow Routes
- Post-mitigation Overland Flow Routes
- Road Lowering at Junction
- Reported Scottish Water Surface Water Outfalls

Levels greater than 8.0mAOD

Levels less than 3.5mAOD



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Client  
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Project  
Oban Flood Study

Title  
Conceptual Flood Mitigation; Option 4B  
Miller Road Floodwater Routing

Status  
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Drawing No. 170506-064      Revision

Scale 1:750      **A3**      Date 08 Nov 2019

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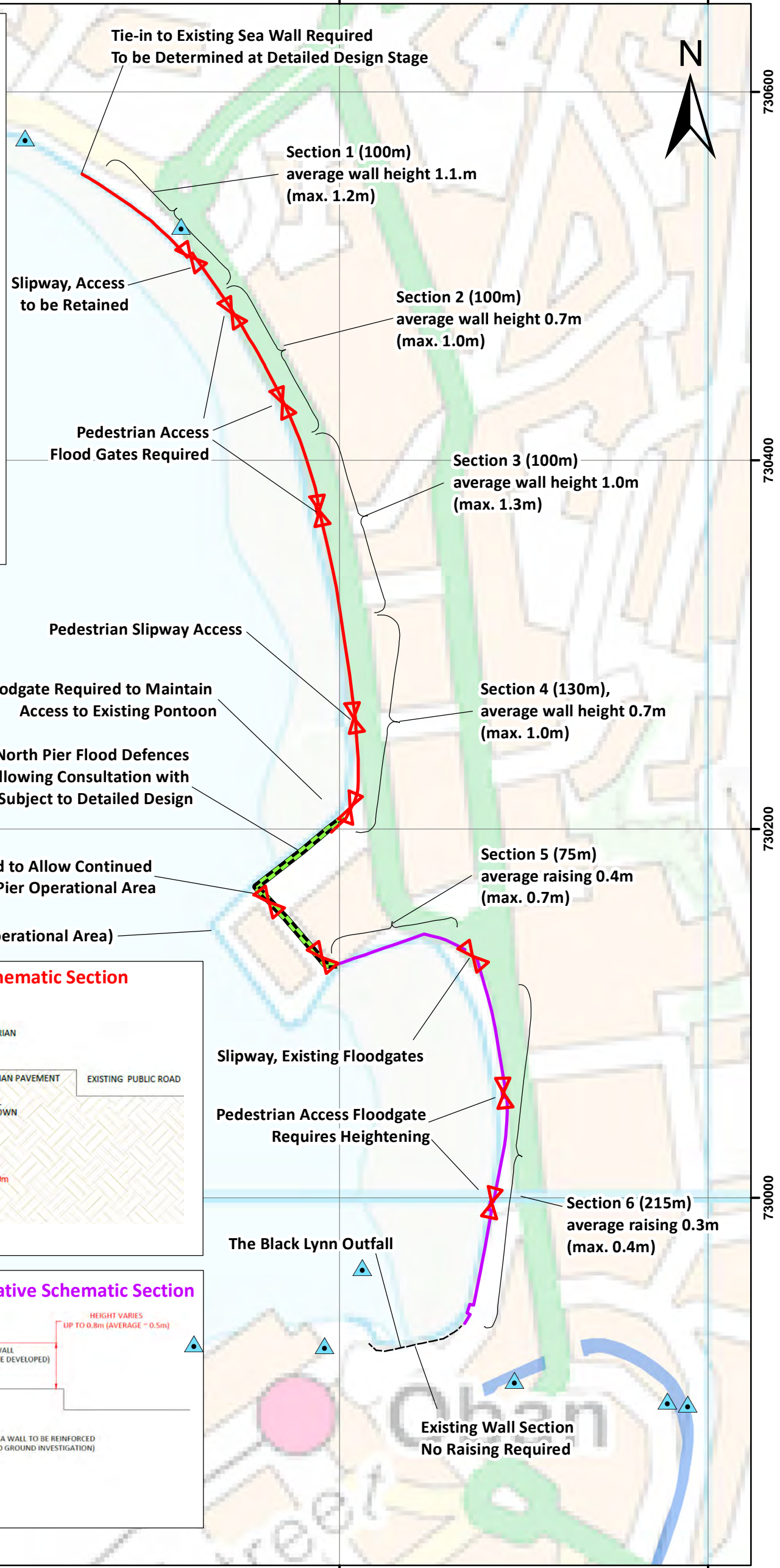
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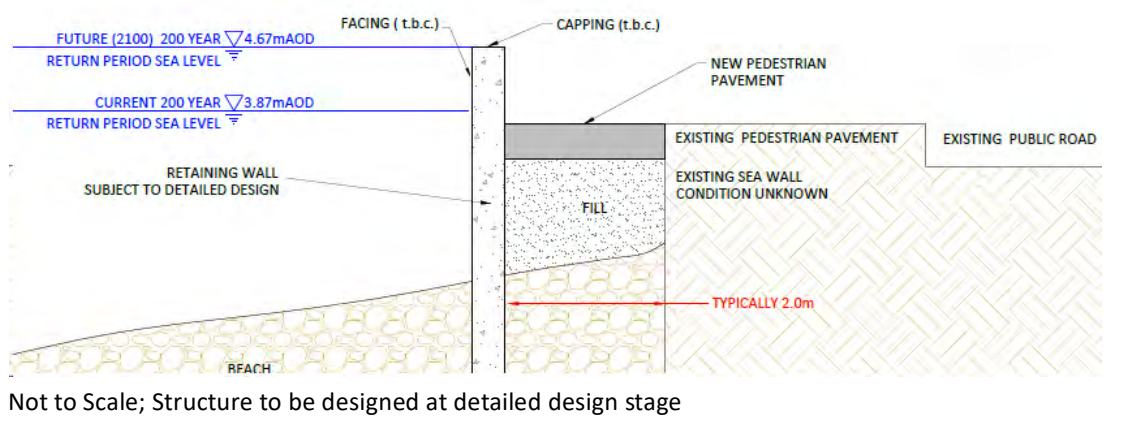
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### Notes/Design Considerations:

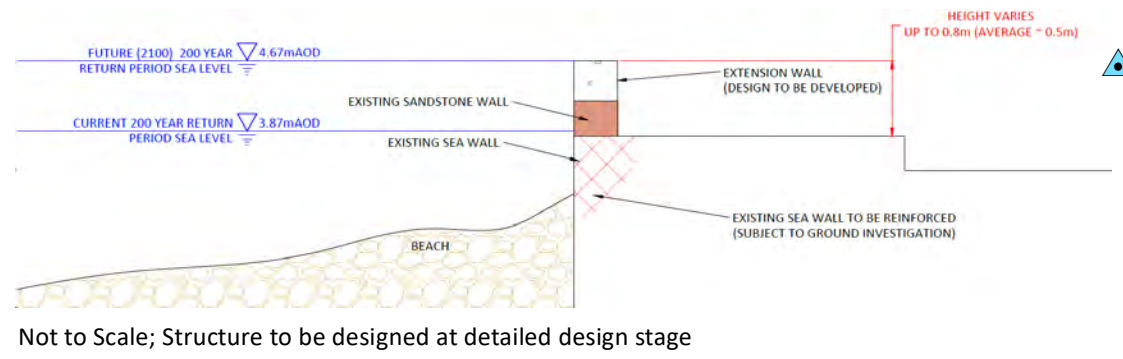
1. Wall crest set to 4.67mAOD. (Equal to the 2100 1 in 200 year return period still sea level (4.67mAOD)).
2. Subject to detailed structural, geotechnical, architectural and landscape design.
3. Detailed design will provide foundation and structural design to allow for adaptation to climate change.
4. Proposed levels to offer protection against current wave action. Walls and gates to have capacity for future height additions by up to 0.5m (by addition demountable defences) to provide protection from wave action (to 2100).
5. Detailed design to consider; utilities, drainage, access (to be closed, relocated, or enabled with demountable gates etc.).
6. Oban Bay; detailed design to consider structural attachment to existing sea walls.
7. Esplanade; reclamation required to maintain/enhance width of existing trunk road and avoid undue disruption to use of existing road.
8. Esplanade; relocated sea wall proposed to minimise footprint, cost and intertidal habitat disruption. Future investigation of option to create embankment to offer equivalent flood protection to flood wall to be undertaken.
9. Tie-in with existing features and access points to be determined at detailed design stage.
10. Combined licence from Marine Scotland and Planning Permission from Argyll and Bute Council required.
11. Build in intertidal zone will be subject to appropriate assessment & permissions



### Oban Esplanade (South), New Coastal Wall; Indicative Schematic Section



### Oban Bay, Raising of Existing Coastal Defence Wall; Indicative Schematic Section



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Do not scale this map

### Legend

- Proposed Sea Wall (Oban Esplanade; South)
- Existing Sea Wall - to be raised (Oban Bay Area)
- North Pier Streetscaping (to incorporate flood protection)
- Reported Scottish Water Surface Water Outfalls

Client  
Argyll and Bute Council

Project  
Oban Flood Study

Title  
Conceptual Flood Mitigation; Option 6A  
Extensive Coastal Defence

Status  
**FINAL**

Drawing No.  
170506-055

Scale  
1:2,500

Date  
08 Nov 2019

Drawn  
CM

Checked  
NG

Approved  
KMD

Craighall Business Park, Eagle Street, Glasgow, G4 9XA  
Tel: 0141 341 5040  
Fax: 0141 341 5045

185400

185600

185800

186000

### Notes/Design Considerations:

1. Wall crest set to 4.67mAOD. (Equal to the current 1 in 200 year return period still sea level plus 0.8m freeboard for wave action (4.67mAOD).
2. Subject to detailed structural, geotechnical, architectural and landscape design.
3. Detailed design will provide foundation and structural design to allow for adaptation to climate change.
4. Proposed levels to offer protection against current wave action. Walls and gates to have capacity for future height additions by up to 0.8m (by addition demountable defences) to provide protection from wave action (to 2100).
5. Detailed design to consider; utilities, drainage, access (to be closed, relocated, or enabled with demountable gates etc.).
6. Oban Bay; detailed design to consider structural attachment to existing sea walls.
7. Design of northern tie-in, to prevent bypassing of the defence, to be confirmed during detailed design; refer to Section 4.3.3 of the Economic Appraisal Report
8. Tie-in with other existing features and access points to be determined at detailed design stage.
9. Combined licence from Marine Scotland and Planning Permission from Argyll and Bute Council required.



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# Oban Bay

Tie-in to be determined at Detailed Design Stage

Pedestrian Access Flood Gates Required

Section 1 (100m) average wall height 1.0m (max. 1.3m)

Pedestrian Slipway Access

Section 2 (135m), average wall height 0.7m (max. 1.0m)

Floodgate Required to Maintain Access to Existing Pontoon

Nature and Positioning of North Pier Flood Defences to be Determined Following Consultation with Stakeholders and Subject to Detailed Design

Section 3 (75m) average raising 0.4m (max. 0.7m)

North Pier (Operational Area)

Flood Gates Required to Allow Continued Access to North Pier Operational Area

Slipway, Existing Floodgates

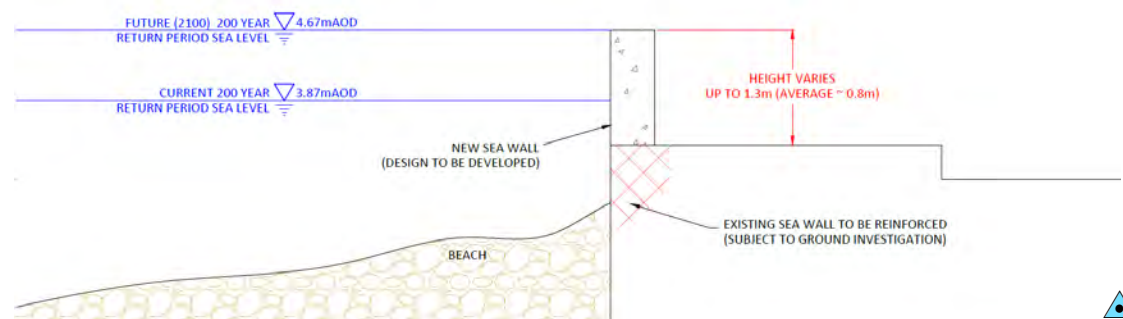
Pedestrian Access Floodgate Requires Heightening

Section 4 (215m) average raising 0.3m (max. 0.4m)

The Black Lynn Outfall

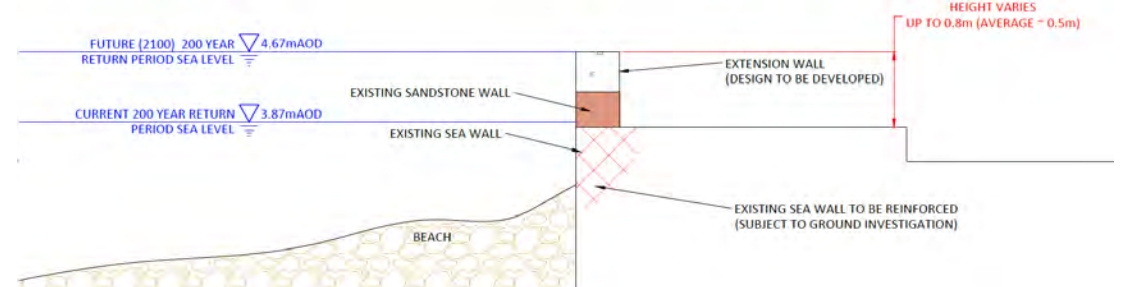
Existing Wall Section No Raising Required

### Oban Esplanade (South), New Coastal Wall; Indicative Schematic Section



Not to Scale; Structure to be designed at detailed design stage

### Oban Bay, Raising of Existing Coastal Defence Wall; Indicative Schematic Section



Not to Scale; Structure to be designed at detailed design stage

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Do not scale this map

### Legend

- Existing Sea Wall - to be raised (South Esplanade)
- ..... Northern Tie-in of Partial Coastal Defence
- Existing Sea Wall - to be raised (Oban Bay Area)
- North Pier Streetscaping (to incorporate flood protection)
- ▲ Reported Scottish Water Surface Water Outfalls

Client  
Argyll and Bute Council

Status  
**FINAL**

Drawing No.  
170506-101

Revision

Project  
Oban Flood Study

Scale  
1:2,500

A3  
Date  
08 Nov 2019

Drawn  
CM

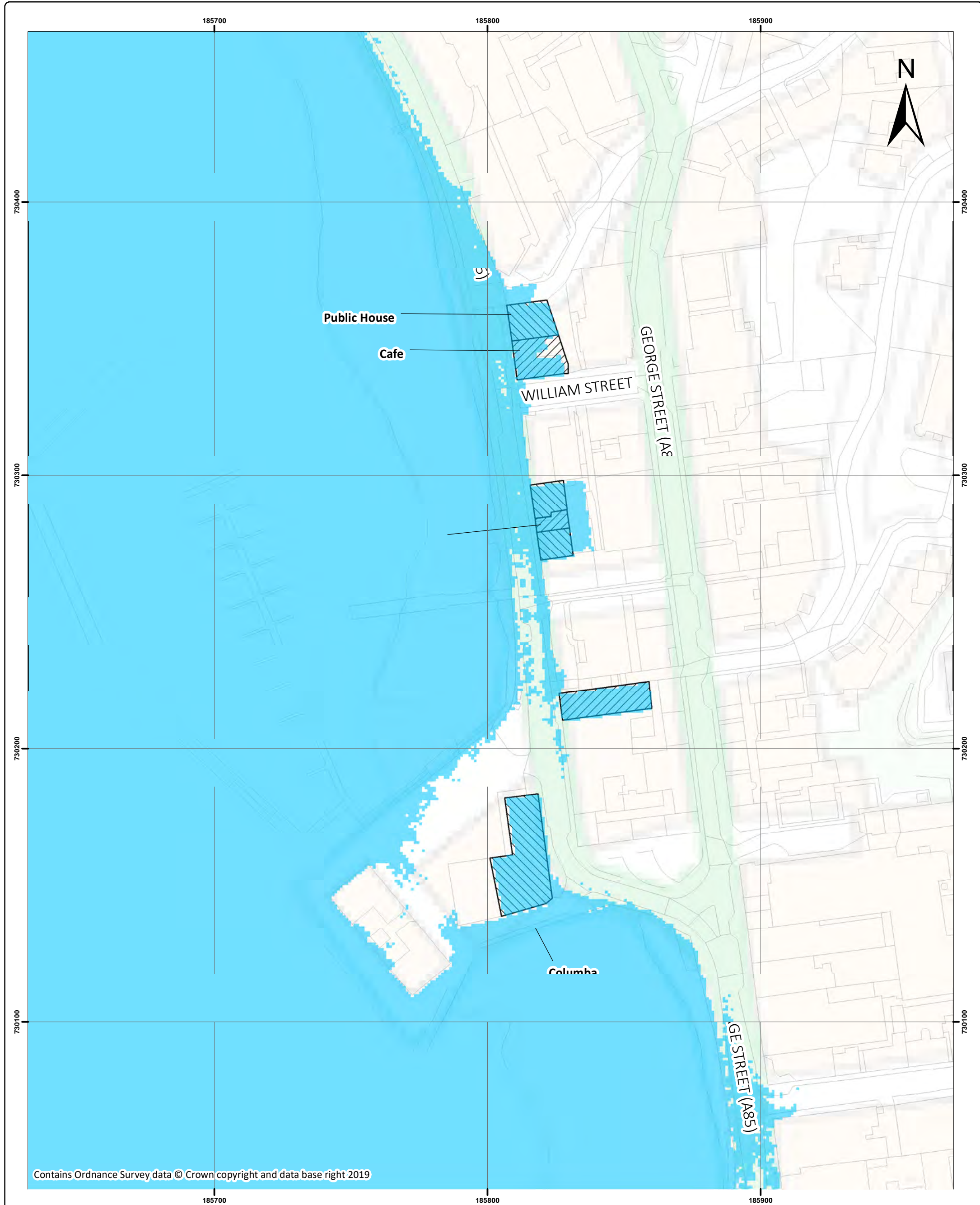
Checked  
NG

Approved  
KMD

Title  
Conceptual Flood Mitigation; Option 6B  
Reduced Extent Coastal Defence



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**Legend**

- Targeted Coastal Protection Zone. Coastal flooding, with inundation at or below ground level, up to 1 in 50 year return period, including wave action. All properties within this zone priority for property level protection.

**Client**  
Argyll and Bute Council

**Project**  
Oban Flood Study

**Title**  
Conceptual Flood Mitigation; Option 6C  
Coastal Property Level Protection

**Status**  
FINAL

**Drawing No.**  
170506-126

**Revision**

**Scale**  
1:1,250

**A3**

**Date**  
10 Dec 2019

**Drawn**  
CM

**Checked**  
IS

**Approved**  
KMD




Craighall Business Park, Eagle Street, Glasgow, G4 9XA  
Tel: 0141 341 5040  
Fax: 0141 341 5045


Do not scale this map

# **B      PREFERRED OPTIONS FACTSHEETS**

## Option 1B - Market Street Bridge Widening


<b>Nature of Problem</b>	<ul style="list-style-type: none"> <li>Present Market Street Road Bridge over the Black Lynn acts as a constraint, causing floodwater to back up to the south of bridge, exacerbating flood risk in the Lochavullin area.</li> <li>Modified channel has additionally been narrowed upstream of bridge by placement of a concrete platform on left bank (east of Kwik Fit).</li> </ul>																													
<b>Strategy</b>	<p><b>Remove and replace the existing bridge structure to allow the channel of the Black Lynn to be enlarged in width from 3.45m to 6.0m and cross-sectional area from 6.25m<sup>2</sup> to 14.0 m<sup>2</sup>:</b></p> <ul style="list-style-type: none"> <li>Demolition existing arch bridge and abutments and replace with a flat deck bridge;</li> <li>Removal of constricting platform on west bank to the south of the bridge, subject to structural assessment; and</li> <li>Local re-profiling watercourse bed where bridge removed.</li> </ul>																													
<b>Target Receptors</b>	<ul style="list-style-type: none"> <li>Commercial properties upstream of the bridge, primarily in the Lochavullin area.</li> <li>Commercial and residential properties beyond the eastern bank of the Black Lynn, which are currently at risk from direct flooding of the Black Lynn as well as overtopping of the Miller Road culvert headwall, with both mechanisms benefitting from bridge widening).</li> </ul>		<table border="1"> <thead> <tr> <th rowspan="2">Return Period</th> <th colspan="2">Current Climate</th> <th colspan="2">2100 Climate</th> </tr> <tr> <th>No. properties protected</th> <th>No. properties still at flood risk</th> <th>No. properties protected</th> <th>No. properties protected</th> </tr> </thead> <tbody> <tr> <td>1 in 10</td> <td>4</td> <td>14</td> <td>64</td> <td>79</td> </tr> <tr> <td>1 in 30</td> <td>4</td> <td>39</td> <td>17</td> <td>168</td> </tr> <tr> <td>1 in 200</td> <td>66</td> <td>77</td> <td>0</td> <td>305</td> </tr> </tbody> </table>				Return Period	Current Climate		2100 Climate		No. properties protected	No. properties still at flood risk	No. properties protected	No. properties protected	1 in 10	4	14	64	79	1 in 30	4	39	17	168	1 in 200	66	77	0	305
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1 in 30	4	39	17	168																										
1 in 200	66	77	0	305																										
<b>Measures</b>	<p><b>Core Measures:</b></p> <ol style="list-style-type: none"> <li>Design replacement flat deck road bridge.</li> <li>Demolish existing bridge and abutments, removal of material, includes in channel work.</li> <li>Removal of upstream platform and disposal of material (approx. 32m<sup>3</sup>)</li> <li>Channel excavation to re-profile banks and bed of watercourse around new bridge.</li> <li>Construction of abutments (13m wide).</li> <li>Construction Installation of 13m x 7m flat deck bridge.</li> </ol>		<p><b>Supplementary Measures:</b></p> <ul style="list-style-type: none"> <li>Temporary road closure of Market Street.</li> <li>Temporary and permanent re-routing of utilities.</li> <li>Over-pumping to facilitate in channel work.</li> </ul> <p><b>Maintenance Requirements:</b></p> <ul style="list-style-type: none"> <li>Channel inspection and maintenance.</li> <li>Structural inspection and maintenance.</li> </ul>																											
<b>Benefits &amp; Constraints</b>	<p><b>Flood Risk Benefits:</b></p> <ul style="list-style-type: none"> <li>23% (8,400 m<sup>3</sup>) reduction in 1 in 30 year peak flood volume</li> <li>18% (12,200 m<sup>3</sup>) reduction in 1 in 200 year peak flood volume</li> <li>£5.9 million present value flood damage reduction benefit over 100 years</li> </ul>		<p><b>Constraints &amp; Challenges:</b></p> <ul style="list-style-type: none"> <li>Maintaining structural integrity of nearby buildings.</li> <li>Management of utilities present during works.</li> <li>Temporary disruption to access Combie Street (trunk road) via Lochside Street and Market Street during construction.</li> <li>Uncertainty regarding ground conditions.</li> <li>Constrained access to river channel.</li> </ul>																											
<b>Potential Development Needs &amp; Cost (Indicative)</b>	<p><b>Key Consultations:</b></p> <ul style="list-style-type: none"> <li>Argyll &amp; Bute Council Roads Department</li> <li>Transport Scotland</li> <li>SEPA</li> <li>Scottish Water / Utilities</li> <li>Local residents &amp; business users</li> <li>Community Council</li> </ul>	<p><b>Assessments:</b></p> <ul style="list-style-type: none"> <li>Ecological.</li> <li>Geomorphological.</li> <li>Geotechnical.</li> <li>Detailed structural design.</li> </ul>	<p><b>Permits / Licences:</b></p> <ul style="list-style-type: none"> <li>SEPA CAR Licence.</li> <li>Road Order.</li> </ul> <p><i>To be confirmed following consultation.</i></p>		<p><b>Whole Life Cost (Planning, Implementation &amp; Maintenance):</b></p> <ul style="list-style-type: none"> <li>Capital Cost: £2.16 million.</li> <li>O&amp;M Cost: £0k per year on average.</li> </ul> <p><b>Whole Life Cost: £2.16 million</b></p>																									
	<p><b>Surveys:</b></p> <ul style="list-style-type: none"> <li>Ecological including INNS.</li> <li>Ground investigation.</li> <li>Topographic including utilities.</li> <li>Structural (buildings and existing bridge).</li> </ul>	<p><b>Design Considerations:</b></p> <ul style="list-style-type: none"> <li>Loading</li> <li>Minimisation of on-site construction time</li> </ul>	<p><b>Potential Surface Water Design Considerations:</b></p> <ul style="list-style-type: none"> <li>Management of surface water to be included in detailed design to ensure risk of pluvial flooding is not increased by implementation of this option.</li> </ul>		<p><b>Whole Life Benefit : Cost Ratio: 2.76</b></p>																									
<b>Longer-Term Considerations</b>	<ul style="list-style-type: none"> <li>None.</li> </ul>																													

## Option 2A – Lon Mor Attenuation


<b>Nature of Problem</b>	<ul style="list-style-type: none"> <li>Flows in the Glenshellach Burn contribute to flooding from the Soroba Burn and Black Lynn further downstream.</li> <li>The burn presently overtops its western bank upstream of the railway embankment in response to large storm events.</li> <li>At present, the Glenshellach Burn passes through a 900mm diameter culvert pipe (plus two smaller, raised culvert pipes), below an existing cyclepath embankment (level 7.2mAOD)</li> <li>The Lon Mor area has a history of flooding upstream of the cycle path embankment.</li> </ul>																											
<b>Strategy</b>	<p><b>Formalise and enhance the usage of the Lon Mor area, where flooding of greenspace currently occurs, for attenuation of high flows in Glenshellach Burn, by:</b></p> <ul style="list-style-type: none"> <li>Restricting the existing outflow arrangement from Lon Mor;</li> <li>Forming a raised embankment to provide up to an additional 10,000 m<sup>3</sup> of temporary flood storage; and</li> <li>Creation of an overflow spillway back into the burn downstream to protect the embankment from overtopping due to exceedance events.</li> </ul>																											
<b>Target Receptors</b>	<ul style="list-style-type: none"> <li>Residential properties on the eastern bank of the Soroba Burn downstream of the railway embankment.</li> <li>Commercial and residential properties further downstream within the Black Lynn floodplain.</li> <li>Note that table relates to all properties at flood risk from the modelled river system, and not just properties within the target areas.</li> </ul>	<table border="1"> <thead> <tr> <th rowspan="2">Return Period</th> <th colspan="2">Current Climate</th> <th colspan="2">2100 Climate</th> </tr> <tr> <th>No. properties protected</th> <th>No. properties still at flood risk</th> <th>No. properties protected</th> <th>No. properties still at flood risk</th> </tr> </thead> <tbody> <tr> <td>1 in 10</td> <td>2</td> <td>16</td> <td>55</td> <td>88</td> </tr> <tr> <td>1 in 30</td> <td>8</td> <td>35</td> <td>3</td> <td>182</td> </tr> <tr> <td>1 in 200</td> <td>15</td> <td>100</td> <td>0</td> <td>301</td> </tr> </tbody> </table>			Return Period	Current Climate		2100 Climate		No. properties protected	No. properties still at flood risk	No. properties protected	No. properties still at flood risk	1 in 10	2	16	55	88	1 in 30	8	35	3	182	1 in 200	15	100	0	301
Return Period	Current Climate		2100 Climate																									
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1 in 200	15	100	0	301																								
<b>Measures</b>	<p><b>Core Measures:</b></p> <ol style="list-style-type: none"> <li>Creation of 250m of new cycle path embankment with crest level of 8.0mAOD lowered to 7.55mAOD at overflow spill. Average height 1.8m above ground level, crest width 3.0m, side slopes 1 in 3. Volume of fill required 3780m<sup>3</sup>;</li> <li>Existing embankment fill to be re-utilised;</li> <li>Attenuate flow by replacement of existing culvert pipes with single 600mm diameter pipe;</li> <li>Addition of headwalls and screens, plus orifice flow control device;</li> <li>Overflow spill to be created by addition of lowered cycle path/embankment level (7.55mAOD) and addition of armour to downstream slope; and</li> <li>Embankment to be resurfaced to allow occasional use of service vehicles. Surface to tie-in to existing embankment at 8.0mAOD.</li> </ol>		<p><b>Maintenance Requirements:</b></p> <ul style="list-style-type: none"> <li>Regular inspection and clearing of screens and culvert pipe.</li> <li>Regular inspection of orifice plate and overflow spill.</li> <li>Regular inspection of embankments and the Glenshellach Burn bed upstream of the culvert.</li> <li>Vegetation management.</li> <li>Maintenance of cycle path.</li> </ul>																									
<b>Benefits &amp; Constraints</b>	<p><b>Flood Risk Benefits:</b></p> <ul style="list-style-type: none"> <li>29% (10,500 m<sup>3</sup>) reduction in 1 in 30 year peak flood volume</li> <li>12 % (8,050 m<sup>3</sup>) reduction in 1 in 200 year peak flood volume</li> <li>£3.77 million present value flood damage reduction benefit over 100 years</li> </ul>		<p><b>Constraints &amp; Challenges:</b></p> <ul style="list-style-type: none"> <li>Unknown materials within existing embankment fill.</li> <li>Working within watercourse.</li> <li>Low risk of utilities and buried assets impacting excavation/landscaping.</li> <li>Land ownership.</li> </ul>																									
<b>Potential Development Needs &amp; Cost (Indicative)</b>	<p><b>Key Consultations:</b></p> <ul style="list-style-type: none"> <li>Local residents &amp; business users.</li> <li>Argyll &amp; Bute Council Roads Department.</li> <li>Scottish Water.</li> <li>Community Council.</li> <li>SEPA.</li> </ul>	<p><b>Assessments:</b></p> <ul style="list-style-type: none"> <li>Ecological.</li> <li>Geotechnical/Site investigation.</li> <li>Detailed structural design.</li> <li>Detailed hydraulic modelling.</li> </ul>	<p><b>Permits / Licences:</b></p> <ul style="list-style-type: none"> <li>SEPA CAR licence (engineering works within watercourse).</li> <li>Note: As maximum attenuation volume (beyond natural attenuation) is below 10,000 m<sup>3</sup>, no requirement for registration under the Reservoirs (Scotland) Act 2011.</li> </ul> <p><i>To be confirmed following consultation</i></p>	<p><b>Whole Life Cost (Planning, Implementation &amp; Maintenance):</b></p> <ul style="list-style-type: none"> <li>Capital Cost: £1.44 million.</li> <li>O&amp;M Cost: £7k per year on average .</li> </ul> <p><b>Whole Life Cost: £1.65 million</b></p>																								
	<p><b>Surveys:</b></p> <ul style="list-style-type: none"> <li>Ground investigation.</li> <li>Topographic.</li> </ul>	<p><b>Design Considerations:</b></p> <ul style="list-style-type: none"> <li>Temporary works to protect the water environment.</li> <li>Opportunities for further ecological enhancement.</li> </ul>	<p><b>Potential Surface Water Design Considerations:</b></p> <ul style="list-style-type: none"> <li>Routing of overland surface water flows from immediate surrounding area to be incorporated into detailed design to reduce local pluvial flood risk.</li> </ul>	<p><b>Whole Life Benefit : Cost Ratio: 2.28</b></p>																								
<b>Longer-Term Considerations</b>	<ul style="list-style-type: none"> <li>Provision of appropriate flow attenuation for all future development upstream of the Lon Mor flood attenuation.</li> <li>Consider future increase in storage capacity (over 10,000m<sup>3</sup> – falling within the scope of the Reservoirs (Scotland) Act 2011) to further reduce flows and flood risk of the Glenshellach Burn / Soroba Burn / Black Lynn.</li> </ul>																											




## Option 2C – Mossfield Stadium Attenuation

<b>Nature of Problem</b>	<ul style="list-style-type: none"> <li>The Alltan Tartach flows past Mossfield Stadium and further downstream as it flows into the Miller Road culvert, high flows result in overtopping causing flooding along Miller Road and Soroba Road.</li> <li>High flows in the Alltan Tartach also contribute to flooding further downstream, in the Black Lynn.</li> <li>Mossfield Stadium contains walls alongside the Alltan Tartach, which disconnect the watercourse from its natural floodplain, providing flood defence to the stadium at the expense of increasing flood risk downstream.</li> </ul>																												
<b>Strategy</b>	<b>Formalise and enhance temporary floodwater storage on the Mossfield Stadium shinty pitch and adjacent area by:</b> <ul style="list-style-type: none"> <li>Creation of a structure to allow high flows to spill from the Alltan Tartach to an attenuation area at Mossfield;</li> <li>Forming the attenuation area by using the natural ground contours and raising lower lying ground to create up to 10,000 m<sup>3</sup> of flood storage;</li> </ul>		<ul style="list-style-type: none"> <li>Restricting the drainage from attenuated flows back into the Alltan Tartach, but ensuring drain-down within 24 hours to allow recovery of sports fields; and</li> <li>Maintain primary function of area as an actively used sports stadium.</li> </ul>																										
<b>Target Receptors</b>	<ul style="list-style-type: none"> <li>Residential and commercial properties in the Miller Road/Soroba Road area (east of the Black Lynn).</li> <li>Commercial properties in the Lochavullin area.</li> <li>Note that table relates to all properties at flood risk from the modelled river system, and not just properties within the target areas.</li> </ul>		<table border="1"> <thead> <tr> <th rowspan="2">Return Period</th> <th colspan="2">Current Climate</th> <th colspan="2">2100 Climate</th> </tr> <tr> <th>No. properties protected</th> <th>No. properties still at flood risk</th> <th>No. properties protected</th> <th>No. properties still at flood risk</th> </tr> </thead> <tbody> <tr> <td>1 in 10</td> <td>11</td> <td>7</td> <td>23</td> <td>120</td> </tr> <tr> <td>1 in 30</td> <td>16</td> <td>27</td> <td>11</td> <td>174</td> </tr> <tr> <td>1 in 200</td> <td>18</td> <td>125</td> <td>0</td> <td>298</td> </tr> </tbody> </table>			Return Period	Current Climate		2100 Climate		No. properties protected	No. properties still at flood risk	No. properties protected	No. properties still at flood risk	1 in 10	11	7	23	120	1 in 30	16	27	11	174	1 in 200	18	125	0	298
Return Period	Current Climate		2100 Climate																										
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1 in 30	16	27	11	174																									
1 in 200	18	125	0	298																									
<b>Measures</b>	<b>Core Measures:</b> <ol style="list-style-type: none"> <li>Inflow spill; lower approx. 5 m length of existing wall from 15 mAOD to 13.6 mAOD;</li> <li>Construct 220m new engineered embankment to 14.0mAOD (approx. 1,370m<sup>3</sup>);</li> <li>40m flood wall, approx. 1.0m high with flood gate;</li> <li>Raise existing internal access track to 14.0mAOD with reduced level for overflow spill (13.5mAOD);</li> <li>Orifice plate outflow control; and</li> <li>370m drainage ditches/french drains, to facilitate low flows and enhanced drawdown of attenuated water.</li> </ol>		<b>Maintenance Requirements:</b> <ul style="list-style-type: none"> <li>Regular inspection of orifice plate and overflow spill</li> <li>Periodic review of floodgate deployment effectiveness</li> <li>Mowing and inspection of embankments.</li> </ul>																										
<b>Benefits &amp; Constraints</b>	<b>Flood Risk Benefits:</b> <ul style="list-style-type: none"> <li>15% (5,400 m<sup>3</sup>) reduction in 1 in 30 year peak flood volume.</li> <li>2 % (1,350 m<sup>3</sup>) reduction in 1 in 200 year peak flood volume.</li> <li>£3.64 million present value flood damage reduction benefit over 100 years.</li> </ul>		<b>Constraints &amp; Challenges:</b> <ul style="list-style-type: none"> <li>Unknown condition of existing watercourse wall</li> <li>Low risk of utilities and buried assets impacting excavation/landscaping.</li> <li>Existing surface water drainage in car park to north of pitch, which is known to flood.</li> <li>Available space for embankment footprint.</li> </ul>																										
<b>Potential Development Needs &amp; Cost (Indicative)</b>	<b>Key Consultations:</b> <ul style="list-style-type: none"> <li>Shinty Club.</li> <li>Local residents &amp; business users.</li> <li>Argyll &amp; Bute Council Parks / Roads Department.</li> <li>Scottish Water.</li> <li>Community Council.</li> <li>SEPA.</li> </ul>	<b>Assessments:</b> <ul style="list-style-type: none"> <li>Ecological.</li> <li>Geomorphological assessment of Alltan Tartach.</li> <li>Geotechnical/Site investigation.</li> <li>Detailed structural design.</li> <li>Detailed Hydraulic modelling.</li> </ul>	<b>Permits / Licences:</b> <ul style="list-style-type: none"> <li>SEPA CAR licence (engineering works within watercourse).</li> <li>Note: As maximum attenuation volume is below 10,000 m<sup>3</sup>, no requirement for registration under the Reservoirs (Scotland) Act 2011.</li> </ul> <i>To be confirmed following consultation.</i>		<b>Whole Life Cost (Planning, Implementation &amp; Maintenance):</b> <ul style="list-style-type: none"> <li>Capital Cost: £1.12 million.</li> <li>O&amp;M Cost: £5.6k per year on average.</li> </ul> <b>Whole Life Cost: £1.29 million</b>																								
	<b>Surveys:</b> <ul style="list-style-type: none"> <li>Ground investigation.</li> <li>Traffic.</li> <li>Topographic.</li> </ul>	<b>Design Considerations:</b> <ul style="list-style-type: none"> <li>Maintain primary function of sports stadium.</li> <li>Access for emergency vehicles.</li> <li>Access diversions &amp; warning signage.</li> <li>Temporary works to control pollution to watercourse.</li> </ul>	<b>Potential Surface Water Design Considerations:</b> <ul style="list-style-type: none"> <li>Further investigation of surface water drainage network and discharge in Stadium car park.</li> </ul>		<b>Whole Life Benefit : Cost Ratio: 2.83</b>																								
<b>Longer-Term Considerations</b>	<ul style="list-style-type: none"> <li>Provision of appropriate rainfall runoff attenuation for all future development upstream of the Mossfield flood attenuation.</li> <li>Consider future increase in storage capacity (over 10,000m<sup>3</sup> – falling within the scope of the Reservoirs (Scotland) Act 2011) to further reduce flows and flood risk of the Alltan Tartach / Black Lynn.</li> </ul>																												


## Option 3B - Black Lynn Flood Defences (4.0 mAOD)

<b>Nature of Problem</b>	<ul style="list-style-type: none"> <li>High flows from the upstream watercourses cause high water levels in the Black Lynn, which may be exacerbated by high tidal water levels;</li> <li>Existing wall/embankment levels do not offer sufficient protection to the southern Oban Town Centre area, particularly in the Lochavullin area;</li> <li>River bank and ground conditions adjacent to Lochavullin Car Park can provide a seepage route into the car park during high water levels in the Black Lynn.</li> </ul>																				
<b>Strategy</b>	<p><b>Provide flood protection to 4.0 mAOD level, by:-</b></p> <ul style="list-style-type: none"> <li>Replacing existing informal flood protection on left (west) bank at Lochavullin Car Park;</li> <li>Adding flood protection on right (east) bank at Lidl Car Park and Lynn Court;</li> <li>Raising walls at identified locations downstream of Soroba Road bridge; and</li> <li>Raising the deck of the Soroba Lane Bridge, or else providing end-walls or headwalls to avoid defences being compromised here.</li> </ul>																				
<b>Target Receptors</b>	<ul style="list-style-type: none"> <li>Commercial properties in the Lochavullin area.</li> <li>Residential and commercial properties beyond the east bank of the Black Lynn.</li> </ul>		<table border="1"> <thead> <tr> <th rowspan="2">Return Period</th> <th colspan="2">Current Climate</th> <th colspan="2">2100 Climate</th> </tr> <tr> <th>No. properties protected</th> <th>No. properties still at flood risk</th> <th>No. properties protected</th> <th>No. properties still at flood risk</th> </tr> </thead> <tbody> <tr> <td>1 in 10</td> <td colspan="4" rowspan="3" style="text-align: center;"><i>Not determined; only assessed as part of option combinations.</i></td> </tr> <tr> <td>1 in 30</td> </tr> <tr> <td>1 in 200</td> </tr> </tbody> </table>	Return Period	Current Climate		2100 Climate		No. properties protected	No. properties still at flood risk	No. properties protected	No. properties still at flood risk	1 in 10	<i>Not determined; only assessed as part of option combinations.</i>				1 in 30	1 in 200		
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<b>Measures</b>	<p><b>Core Measures:</b></p> <p><u>West Bank</u></p> <ol style="list-style-type: none"> <li>Remove and dispose of existing 'informal' embankment within Lochavullin Car Park.</li> <li>Create new 140m engineered flood embankment with 0.5m crest and 1 in 3 side slopes to level 4.0mAOD, 1.4m average height above ground level, fill volume 925m<sup>3</sup>.</li> <li>Add cut-off to restrict flow within superficial soils under new embankment (to be advised by ground investigation).</li> <li>Raise wall section 15m downstream (north) of the Soroba Lane bridge.</li> </ol> <p><u>East Bank</u></p> <ol style="list-style-type: none"> <li>Construction of 120m new flood wall between Soroba Lane Bridge and area behind Lynn Court.</li> <li>Raise wall section 15m downstream (north) of the Soroba Lane bridge.</li> </ol>		<p><b>Supplementary Measures:</b></p> <ul style="list-style-type: none"> <li>Non-return piped outlets (2 per bank), to discharge surface water to burn when levels allow.</li> <li>Non-return valves to 6 existing surface water discharge pipes.</li> <li>Bankside soil erosion matting.</li> </ul> <p><b>Maintenance Requirements:</b></p> <ul style="list-style-type: none"> <li>Regular inspection of embankments.</li> <li>Vegetation maintenance and control of Japanese knotweed on embankments.</li> <li>Regular inspection and maintenance of flood walls.</li> <li>Regular inspection, maintenance and sediment removal pluvial drainage pipes.</li> </ul>																		
<b>Benefits &amp; Constraints</b>	<p><b>Flood Risk Benefits:</b></p> <ul style="list-style-type: none"> <li>Not determined; this option is predicted to cause flood risk detriment in some locations if progressed in isolation, so is only assessed as part of option combinations which mitigate this detriment.</li> </ul>		<p><b>Constraints &amp; Challenges:</b></p> <ul style="list-style-type: none"> <li>Knotweed prevalent within the reach of proposed works and upstream (concrete channel and brackish conditions restrict downstream spread).</li> <li>Ground conditions providing seepage routes alongside Lochavullin Car Park.</li> <li>Low risk of utilities and buried assets impacting excavation/piling.</li> <li>Space available for embankment footprint within Lochavullin Car Park.</li> <li>Existing surface water drainage in Car Park.</li> </ul>																		
<b>Potential Development Needs &amp; Cost (Indicative)</b>	<p><b>Key Consultations:</b></p> <ul style="list-style-type: none"> <li>Landowners, including Lidl and Lynn Court</li> <li>Argyll &amp; Bute Council Roads Department</li> <li>SEPA.</li> <li>Community Council, Local residents &amp; business users</li> <li>Scottish Water</li> </ul>	<p><b>Assessments:</b></p> <ul style="list-style-type: none"> <li>Ecological including invasive non-native species (INNS).</li> <li>Geomorphological assessment of the Black Lynn.</li> <li>Geotechnical investigation,</li> <li>Detailed structural design</li> <li>Detailed hydraulic modelling</li> </ul>	<p><b>Permits / Licences:</b></p> <ul style="list-style-type: none"> <li>SEPA CAR licence (engineering works within watercourse).</li> </ul> <p><i>To be confirmed following consultation</i></p>	<p><b>Whole Life Cost (Planning, Implementation &amp; Maintenance):</b></p> <ul style="list-style-type: none"> <li>Capital Cost: £1.59 million</li> <li>O&amp;M Cost: £4k per year on average</li> </ul> <p><b>Whole Life Cost: £1.71 million</b></p>																	
<b>Longer-Term Considerations</b>	<ul style="list-style-type: none"> <li>Do not re-develop land in proximity to river banks at end of life of existing buildings (i.e. make provision for future setting back of embankments and promoting managed retreat from floodplain).</li> <li>Provision of progressively higher flood defences to adapt to climate change.</li> <li>Management of the river corridor, including monitoring of sediment deposition and control of INNS (Japanese Knotweed).</li> </ul>																				
	<p><b>Surveys:</b></p> <ul style="list-style-type: none"> <li>Ground investigation.</li> <li>Topographic.</li> <li>Ecological including INNS.</li> </ul>	<p><b>Design Considerations:</b></p> <ul style="list-style-type: none"> <li>Freeboard provision.</li> <li>Ground conditions and seepage paths.</li> <li>Temporary works to control pollution to watercourse.</li> </ul>	<p><b>Potential Surface Water Design Considerations:</b></p> <ul style="list-style-type: none"> <li>Non-return valves on outfalls.</li> <li>Installation of surface water discharge pipes.</li> <li>Avoid seepage routing towards drainage network.</li> </ul>	<p><b>Whole Life Benefit: Cost Ratio:</b> Not determined; only assessed as part of option combinations.</p>																	


## Option 4A – Miller Road Culvert Dualling

<b>Nature of Problem</b>	<ul style="list-style-type: none"> <li>The Alltan Tartach flows through a culvert under Miller Road, which is unable to convey extreme flows.</li> <li>The culvert capacity is approximately 4m<sup>3</sup>/s (approximately 1 in 5 year (current) flow).</li> <li>When the inlet headwall overtops, floodwater flows westwards down Miller Road and then north onto Soroba Road, flooding roads and adjacent properties over a significant area to the east of the Black Lynn.</li> <li>There are other structures upstream of the Miller Road culvert which cause a constriction to flow, causing localised flooding to gardens and local access routes, but these are not predicted to pose a risk to buildings.</li> </ul>																				
<b>Strategy</b>	<b>Double capacity of undersized culverted section of the Alltan Tartach by:</b> <ul style="list-style-type: none"> <li>Installing additional culvert of similar cross sectional area along similar route.</li> </ul>																				
<b>Target Receptors</b>	<ul style="list-style-type: none"> <li>Residential properties adjacent to Miller Road, to the west of the culvert headwall.</li> <li>Residential and commercial properties between Soroba Road and the Black Lynn to the north of Miller Road.</li> <li>Arterial road (Soroba Road, which is the primary route into Oban from the south)</li> </ul>		<table border="1"> <thead> <tr> <th rowspan="2">Return Period</th> <th colspan="2">Current Climate</th> <th colspan="2">2100 Climate</th> </tr> <tr> <th>No. properties protected</th> <th>No. properties still at flood risk</th> <th>No. properties protected</th> <th>No. properties still at flood risk</th> </tr> </thead> <tbody> <tr> <td>1 in 10</td> <td colspan="4" rowspan="3" style="text-align: center;"><i>Not determined; only assessed as part of option combinations.</i></td> </tr> <tr> <td>1 in 30</td> </tr> <tr> <td>1 in 200</td> </tr> </tbody> </table>	Return Period	Current Climate		2100 Climate		No. properties protected	No. properties still at flood risk	No. properties protected	No. properties still at flood risk	1 in 10	<i>Not determined; only assessed as part of option combinations.</i>				1 in 30	1 in 200		
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<b>Measures</b>	<b>Core Measures:</b> <ol style="list-style-type: none"> <li>Installation of new 185m long rectangular box culvert (1840x880mm) with inlet invert set to higher level than existing culvert.</li> <li>Inlet and outfall headwalls and screens.</li> <li>Re-routing of existing services.</li> <li>Reinstatement of road surface.</li> </ol>		<b>Maintenance Requirements:</b> <ul style="list-style-type: none"> <li>Regular inspection of culvert inlet, outlet and screens.</li> <li>Occasional maintenance as necessary.</li> </ul>																		
<b>Benefits &amp; Constraints</b>	<b>Flood Risk Benefits:</b> <ul style="list-style-type: none"> <li>Not determined; this option will cause downstream detriment if progressed in isolation, so is only assessed as part of option combinations which mitigate this detriment.</li> <li>Minimised flood-related traffic disruption on Soroba Road.</li> </ul>		<b>Constraints &amp; Challenges:</b> <ul style="list-style-type: none"> <li>Potential interactions with local drainage network.</li> <li>High risk of existing utilities and buried assets impacting culvert route, requiring utility diversion.</li> <li>Traffic disruption to Miller Road and Soroba (Trunk) Road.</li> <li>Increase in extreme flow in the Alltan Tartach/Black Lynn downstream of the Soroba Road.</li> </ul>																		
<b>Potential Development Needs &amp; Cost (Indicative)</b>	<b>Key Consultations:</b> <ul style="list-style-type: none"> <li>Local residents &amp; business users</li> <li>Argyll &amp; Bute Council Roads Department</li> <li>Transport Scotland</li> <li>Scottish Water / Utility companies</li> <li>Community Council</li> </ul>	<b>Assessments:</b> <ul style="list-style-type: none"> <li>Ecological including invasive non-native species (INNS).</li> <li>Ground condition assessment.</li> <li>Drainage Impact Assessment</li> <li>Site-specific hydraulic modelling.</li> </ul>	<b>Permits / Licences:</b> <ul style="list-style-type: none"> <li>SEPA CAR Licence.</li> <li>Road Order.</li> </ul> <p><i>To be confirmed following consultation</i></p>	<b>Whole Life Cost (Planning, Implementation &amp; Maintenance):</b> <ul style="list-style-type: none"> <li>Capital Cost: £1.33 million</li> <li>O&amp;M Cost: £3.3k per year on average</li> </ul> <b>Whole Life Cost: £1.43 million</b>																	
	<b>Surveys:</b> <ul style="list-style-type: none"> <li>Ground investigation, including GPR for utilities.</li> <li>Topographic.</li> <li>Ecological including INNS.</li> </ul>	<b>Design Considerations:</b> <ul style="list-style-type: none"> <li>Alignment and size in relation to utilities.</li> <li>Local re-profiling of reinstated road surface to focus any surface overland flows away from properties and towards culvert outflow.</li> </ul>	<b>Potential Surface Water Design Considerations:</b> <ul style="list-style-type: none"> <li>Management of surface water to be included in detailed design to ensure risk of surface water flooding is not exacerbated by implementation of this option.</li> </ul>	<b>Whole Life Benefit : Cost Ratio:</b> Not determined; only assessed as part of option combinations.																	
<b>Longer-Term Considerations</b>	<ul style="list-style-type: none"> <li>Assessment of residual risk and application of property level resistance and resilience measures.</li> <li>Decreasing peak flows in the Alltan Tartach by additional upstream flow attenuation.</li> </ul>																				

## Option 6B – Coastal Flooding: Reduced Extent Coastal Defence Option

<b>Nature of Problem</b>	<ul style="list-style-type: none"> <li>Coastal flooding due to extreme sea levels and wave action;</li> <li>Present 1 in 200 year sea level (without wave action) modelled to be 3.87mAOD, rising to 4.67mAOD by 2100;</li> <li>Flood risk along entire coastal margin, with wider corridor of inundation between Stevenson Street and North Pier.</li> <li>Majority of receptors and damage, occurs between Corran Esplanade Roundabout (northern end) and Black Lynn outfall (southern end).</li> <li>Flooding also predicted around Ferry Terminal area, however, this is an operational area and more difficult to protect without impacting functionality and a water compatible use, so is not targeted for protection.</li> </ul>																													
<b>Strategy</b>	<b>Provide protection to 4.67m level (existing 1 in 200 year return period level plus 0.8m wave protection) by:</b> <ul style="list-style-type: none"> <li>Raising existing sea walls and constructing new defence walls;</li> <li>Optimal positioning of flood defences between the Great Western Hotel (A85 Oban Esplanade) and the Railway Pier;</li> <li>Installing floodgates to maintain current pier/beach access;</li> </ul>		<ul style="list-style-type: none"> <li>Implementing a tie-in at the northern end of the proposed defence, to avoid flooding around defences (either through road raising, installation of flood gates, or combination); and</li> <li>Detailed design to incorporate capacity to raise wall heights to facilitate protection to future sea levels.</li> </ul>																											
<b>Target Receptors</b>	<ul style="list-style-type: none"> <li>Residential and commercial properties located along the coast to the north of the Black Lynn outfall and south of the Great Western Hotel, where approximately 80% of Oban's overall coastal flood damages occur. Table only relates to receptor totals within area defended.</li> <li>(Note that area between ferry terminal and railway line accounts for majority of remaining 20% of total predicted flood damages; this area is not targeted for protection by this option.)</li> </ul>		<table border="1"> <thead> <tr> <th rowspan="2">Return Period</th> <th colspan="2">Current Climate</th> <th colspan="2">2100 Climate</th> </tr> <tr> <th>No. properties protected</th> <th>No. properties still at flood risk</th> <th>No. properties protected</th> <th>No. properties still at flood risk</th> </tr> </thead> <tbody> <tr> <td>1 in 5</td> <td>0</td> <td>0</td> <td>25</td> <td>0</td> </tr> <tr> <td>1 in 30</td> <td>9</td> <td>0</td> <td>0</td> <td>51</td> </tr> <tr> <td>1 in 200</td> <td>11</td> <td>0</td> <td>0</td> <td>112</td> </tr> </tbody> </table>				Return Period	Current Climate		2100 Climate		No. properties protected	No. properties still at flood risk	No. properties protected	No. properties still at flood risk	1 in 5	0	0	25	0	1 in 30	9	0	0	51	1 in 200	11	0	0	112
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<b>Measures</b>	<b>Core Measures:</b> <ol style="list-style-type: none"> <li>Raise existing wall by up to maximum 0.7m over 290m length of Oban Bay area and install 3 flood gates.</li> <li>Install new flood wall over 130m length on North Pier, with set-back wall and flood gates to enable continued usage of the pier.</li> <li>Construction of new sea wall over 235m length along the edge of the existing sea wall. Tie-in to North Pier. Terminate at Great Western Hotel southern boundary wall.</li> <li>Create northern "tie in" barrier, at Great Western Hotel. Final design of tie-in to be confirmed during detailed design. (Costed as raising A85 by up to 0.3m to 4.1mAOD with flood gates).</li> <li>Fit non-return valves to existing outfalls to limit backup flood risk to sewers during high sea level conditions.</li> </ol>			<b>Maintenance Requirements:</b> <ul style="list-style-type: none"> <li>Periodic servicing of floodgates</li> <li>Regular inspection of installed walls</li> <li>Periodic review of floodgate deployment effectiveness</li> </ul>																										
<b>Benefits &amp; Constraints</b>	<b>Flood Risk Benefits:</b> <ul style="list-style-type: none"> <li>Resolve existing coastal flood risk to 1 in 200 year level, reducing to 1 in 50 year by 2050 and 1 in 2 year by 2100; further raising of defences as required in the future can provide additional climate change resilience.</li> <li>£4.78 million present value flood damage reduction benefit over 100 years.</li> </ul>		<b>Constraints &amp; Challenges:</b> <ul style="list-style-type: none"> <li>Unknown condition of existing roadway/sea wall.</li> <li>Low risk of utilities and buried assets impacting excavation/piling.</li> <li>Temporary disruption to trunk road and pier usage during construction.</li> <li>Proximity of A85 trunk road and busy pedestrian route.</li> </ul>																											
<b>Potential Development Needs &amp; Cost (Indicative)</b>	<b>Key Consultations:</b> <ul style="list-style-type: none"> <li>Local residents and business users;</li> <li>Argyll &amp; Bute Council Roads Department;</li> <li>Transport Scotland;</li> <li>Scottish Fire and Rescue Service/Ambulance Service;</li> <li>Community Council;</li> <li>Utility companies, incl. Scottish Water; and</li> <li>Regulators; SEPA &amp; Marine Scotland.</li> </ul>	<b>Assessments:</b> <ul style="list-style-type: none"> <li>Ecological</li> <li>Geotechnical/Site investigation,</li> <li>Environmental Impact Assessment</li> <li>Detailed structural design</li> </ul>	<b>Permits / Licences:</b> <ul style="list-style-type: none"> <li>Road Order</li> </ul> <i>To be confirmed following consultation</i>	<b>Whole Life Cost (Planning, Implementation &amp; Maintenance):</b> <ul style="list-style-type: none"> <li>Capital Cost: £3.46 million</li> <li>O&amp;M Cost: £8.6k per year on average, plus anticipated capital maintenance after 50 years (£25% of capital cost)</li> </ul> <b>Whole Life PV Cost: £3.89 million</b>																										
	<b>Surveys:</b> <ul style="list-style-type: none"> <li>Traffic</li> <li>Ground investigation</li> <li>Utilities</li> <li>Topographic</li> </ul>	<b>Design Considerations:</b> <ul style="list-style-type: none"> <li>Access for emergency vehicles</li> <li>Access diversions &amp; warning signage</li> </ul>	<b>Potential Surface Water Design Considerations:</b> <ul style="list-style-type: none"> <li>Consideration of surface water/combined sewer outfalls during detailed design.</li> <li>Surface water discharge pipes with non-return valves</li> </ul>		<b>Whole Life Benefit : Cost Ratio: 1.23</b>																									
<b>Longer-Term Considerations</b>	<ul style="list-style-type: none"> <li>Defences should be designed to minimise the difficulty and cost associate with further raising to address sea level rise due to climate change, with up to 0.8 m of additional defence height predicted to be required by 2100.</li> </ul>																													

## Option 6C – Coastal Flooding: Property Level Protection Option

<b>Nature of Problem</b>	<ul style="list-style-type: none"> <li>Coastal flooding due to extreme sea levels and wave action;</li> <li>Present 1 in 200 year sea level (without wave action) modelled to be 3.87mAOD, rising to 4.67mAOD by 2100;</li> <li>12 receptors identified as being vulnerable to flooding during a 1 in 50 year coastal flood.</li> </ul>																												
<b>Strategy</b>	<p><b>Provide property level protection to a minimum 0.6m height (existing 1 in 50 year return period wave protection) by:</b></p> <ul style="list-style-type: none"> <li>Surveying recipient buildings to identify property-specific mitigation measures and methodology;</li> <li>Installing flood barriers, to doors and windows to mitigate against water ingress to buildings;</li> <li>Secondary measures to deter bypass of barriers, and so reduce coastal floodwater impact on properties; and</li> <li>Provision with dewatering capability;</li> </ul>																												
<b>Target Receptors</b>	<p><b>Selected residential and commercial properties located along the Corran Esplanade (A85) include:</b></p> <ul style="list-style-type: none"> <li>Coasters, public house (Corran Esplanade);</li> <li>The Oban Chocolate Company shop/cafe (34 Corran Esplanade)</li> <li>26 Alexandra Place (Corran Esplanade), office (containing up to 2 potential flood receptors);</li> <li>24 Alexandra Place (Corran Esplanade), residential property (containing 2 potential flood receptors);</li> <li>22 Alexandra Place (Corran Esplanade), residential property (containing 2 potential flood receptors);</li> <li>Whisky Cellar (formerly Cellar Bar), public house, under Regent Hotel (Corran Esplanade)</li> <li>Columba Hotel Building, inc. commercial units (3 receptors in database).</li> </ul>			<table border="1"> <thead> <tr> <th rowspan="2">Return Period</th> <th colspan="2">Current Climate</th> <th colspan="2">2100 Climate</th> </tr> <tr> <th>No. properties protected</th> <th>No. properties still at flood risk</th> <th>No. properties protected</th> <th>No. properties still at flood risk</th> </tr> </thead> <tbody> <tr> <td>1 in 5</td> <td>0</td> <td>0</td> <td>8</td> <td>36</td> </tr> <tr> <td>1 in 30</td> <td>9</td> <td>1</td> <td>0</td> <td>78</td> </tr> <tr> <td>1 in 200</td> <td>12</td> <td>25</td> <td>0</td> <td>134</td> </tr> </tbody> </table>		Return Period	Current Climate		2100 Climate		No. properties protected	No. properties still at flood risk	No. properties protected	No. properties still at flood risk	1 in 5	0	0	8	36	1 in 30	9	1	0	78	1 in 200	12	25	0	134
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<b>Measures</b>	<p><b>Core Measures (dependent upon property-specific survey):</b></p> <ol style="list-style-type: none"> <li>Install replacement doors with automatic seal;</li> <li>Install window protection for windows &lt;600mm above pavement level;</li> <li>Install sump and pump to allow immediate dewatering of water ingress;</li> <li>Provide portable (skimmer) pump to allow dewatering of property;</li> <li>Replace airbricks to provide automatic protection to stop flow into the building;</li> <li>Seal conduits (wiring ducts, window frames, etc.) into the property,</li> <li>Install back-flow control on foul drainage pipes, including sewage non-return valves and appliance non-return valves;</li> <li>External wall protection, mortar replacement, wall sealant</li> </ol>			<p><b>Maintenance Requirements:</b></p> <ul style="list-style-type: none"> <li>Yearly maintenance of property level protection required</li> </ul>																									
<b>Benefits &amp; Constraints</b>	<p><b>Flood Risk Benefits:</b></p> <ul style="list-style-type: none"> <li>Residual coastal flood risk (for 1 in 30 year event) only to the CalMac car park, south-west of the ferry terminal.</li> <li>PLP estimated to protect targeted properties up to a 1 in 200 year level (for current climate conditions), up to a 1 in 50 year level by 2050, and up to a 1 in 5 year level by 2100.</li> <li>£830k present value flood damage reduction benefit over 25 years (which is the estimated operational life for PLP measures)</li> </ul>			<p><b>Constraints &amp; Challenges:</b></p> <ul style="list-style-type: none"> <li>Unknown condition of existing buildings</li> <li>Some buildings potentially of historical significance</li> <li>Constrained urban location may limit space for sump</li> </ul>																									
<b>Potential Development Needs &amp; Cost (Indicative)</b>	<p><b>Key Consultations:</b></p> <ul style="list-style-type: none"> <li>Property owners and tenants,</li> <li>Scottish Flood Forum,</li> <li>Argyll &amp; Bute Council Roads Department;</li> <li>Transport Scotland;</li> <li>Community Council.</li> </ul>	<p><b>Assessments:</b></p> <ul style="list-style-type: none"> <li>Property Level Flood Protection assessment</li> <li>Structural Assessment</li> </ul>	<p><b>Permits / Licences:</b></p> <ul style="list-style-type: none"> <li>Planning Permission (if outward changes to listed buildings necessary)</li> </ul>	<p><b>Whole Life Cost (Planning, Implementation &amp; Maintenance):</b></p> <ul style="list-style-type: none"> <li>Capital Cost: £375k</li> <li>O&amp;M Cost: £1.9k per year on average</li> </ul> <p><b><u>Whole Life PV Cost: £407k (over 25 years)</u></b></p>																									
	<p><b>Surveys:</b></p> <ul style="list-style-type: none"> <li>Structural survey</li> </ul>	<p><b>Design Considerations:</b></p> <ul style="list-style-type: none"> <li>Disabled access</li> <li>Emergency access/egress</li> </ul>	<p><b>Potential Surface Water Design Considerations:</b></p> <ul style="list-style-type: none"> <li>Bypass of proposed flood doors, via foul drains, to be mitigated</li> </ul>		<p><b><u>Whole Life Benefit : Cost Ratio: 2.04</u></b></p>																								
<b>Longer-Term Considerations</b>	<ul style="list-style-type: none"> <li>Above mitigations considered effective up to end of mitigation's design life of 25 years.</li> <li>Future consideration of protection to protect wider area vulnerable to coastal flooding due to increased sea level as a result of climate change required.</li> </ul>																												