

IMPLICATIONS OF THE BRIGHTLEY BROOK REALIGNMENT TECHNICAL NOTE

DATE:	12 March 2025	CONFIDENTIALITY:	Public
SUBJECT:	§ 24, ii, Rochdale Borough Council Letter		
PROJECT:	Plot 3 of the South Heywood Masterplan	AUTHOR:	Chrystiann Lavarini
CHECKED:	Stephanie Davidson	APPROVED:	David Waters

INTRODUCTION

This technical note has been prepared to support the Reserved Matters application (planning reference 25/00045/REM), for a 350,021 sq ft Use Class B8 warehouse on land to the South of Pilsworth Road, Heywood. The Reserved Matters is pursuant to Outline Planning Permission Ref 22/01569/OUT. This technical note focuses on the hydraulic geomorphological and hydraulic implications associated with the realignment of the Brightley Brook main river.

An overview of the upstream improvements to the Brightley Brook tributary approved under Reserved Matters planning reference 22/00787/REM is also considered in this assessment due to the potential influence on peak flows, attenuation, and hydraulic connectivity within the Brightley Brook, potentially influencing its geomorphological evolution and flood response.

A map showing the locations of the Brightley Brook and Tributary of Brightley Brook relative to the proposed Plot 3 development is given in Figure 1 below.

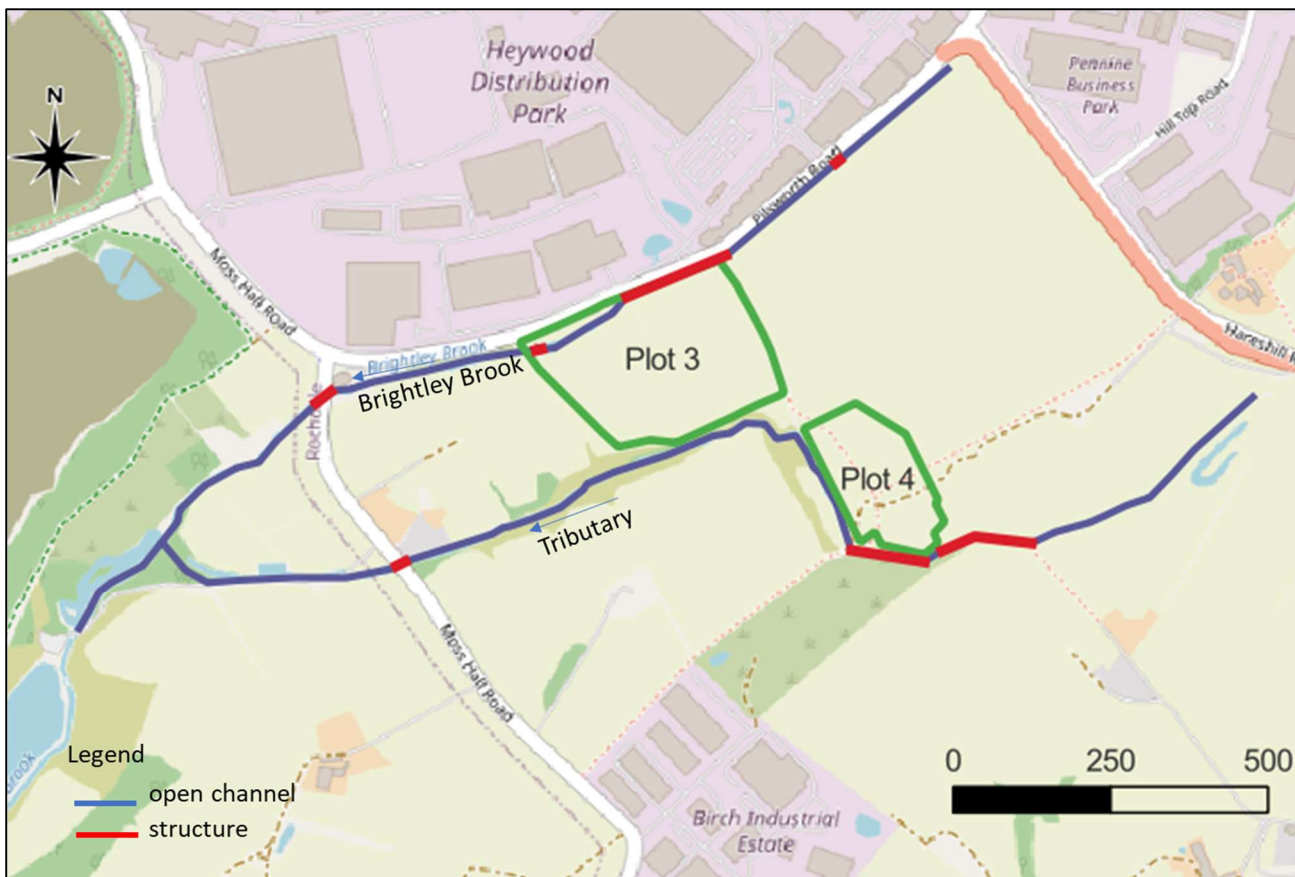


Figure 1 – Study area showing the locations of brightly Brook and Tributary in relation to the proposed Plot 3 Development

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Within the vicinity of the proposed scheme, the designation of Brightley Brook changes from Ordinary Watercourse to Main River. An extract from the Statutory Main River Map is given in Figure 2 below.



Figure 2 – Extract from Statutory Main River Map

METHODOLOGY

This assessment is based on qualitative reviews of reports and design drawings produced by WSP as part of the Outline Planning Application. A list of all consulted documents is provided below:

- WSP (2023a). Brightley Brook detailed design drawings:
 - 70089657-WSP-SHP3-WAT-DR-D-0100,

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- 70089657-WSP-SHP3-WAT-DR-D-0101,
 - 70089657-WSP-SHP3-WAT-DR-D-0102,
 - 70089657-WSP-SHP3-WAT-DR-D-0103,
 - 70089657-WSP-SHP3-WAT-DR-D-0104,
 - 70089657-WSP-SHP3-WAT-DR-D-0105.
- WSP (2023b). Brightley Brook Hydraulic Model Technical Note. 30 March 2023
 - WSP (2023c). South Heywood Box Culvert 3.0w x 2.5h spreadsheet. March 2023.
 - Brightley Brook Tributary ecological improvements drawings, associated with Reserved Matters planning reference 22/00787/REM.
 - TPM Landscape. 3595,206,
 - TPM Landscape. 3595-304,
 - WYG (TetraTech). SHOW-WYG-00-ZZ-90-C-0144

THE PROPOSED SCHEME

The river diversion associated with the Proposed Scheme comprises the following elements:

- **Channel Realignment:** An approximately 140m-long realigned open channel section to have gentler bank slopes with rock roll erosion protection attached to the toes, coir matting erosion protection along the bank faces, alternating berms, and landscaping works on the bank top;
- **Culvert Addition:** A 41.6 m-long and 3 m high x 3m wide box-shaped culvert is proposed. It comprises a culvert invert depressed to provide minimum riverbed substrate to facilitate general scour. Translocation of riverbed substrate extracted from the existing river channel and placed to form a meandering low-flow channel is also proposed; and
- **Erosion Protection:** Three open-channel sections with rock armour along the bed, toe, and bank faces at (i) upstream culvert outfall until 10m downstream (where an outfall is proposed), and two other sections (ii) upstream and (iii) downstream from the 41.6 m-long proposed culvert.

A copy of the proposed Brightley Brook river diversion general arrangement drawing is included in **Appendix A**.

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IMPROVEMENTS TO THE TRIBUTARY OF BRIGHTLEY BROOK

A proposed scheme of improvements designed to enhance ecology and landscaping on the upstream Brightley Brook Tributary was developed by WYG (TetraTech) and TPM Landscape in support of Reserved Matters planning reference 22/00787/REM. These works do not form part of the Proposed Scheme but have been included within this note to demonstrate the wider improvements being undertaken to the watercourses in the area as part of the Proposed Scheme and the wider development. The approved scheme of improvements comprises the following elements:

- **Berm 1**, which is 30m long with variable width and elevation of 113.5mAOD, covering 162.8m² with a cut volume of 253m³.
- **Berm 2**, spanning 44m, with elevations ranging from 113.8mAOD to 114.1mAOD, covering 266.3m² with a cut volume of 436m³.
- **Berm 3**, which is 16m long with elevations between 114.9mAOD and 115.0mAOD, covering 62.5m² with a cut volume of 50m³.

Copies of the approved drawings developed by WYG (TetraTech) and TPM Landscape are included in **Appendix B**:

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HYDRAULIC MODELLING ASSESSMENTS

WSP has conducted two studies to understand changes in hydraulics associated with the Proposed Scheme (WSP, 2023b, 2023c). These studies are summarised below.

2D Hydraulic Modelling

WSP (2023b) assesses if the Proposed Scheme would increase the flood risks downstream. Initial consultation with the Environment Agency (EA) in 2020 did not mandate hydraulic modelling. However, WSP considered that it would be beneficial to undertake further evaluation for site-specific flood risk, which included examining Brightley Brook and its tributary, located within Flood Zone 1. The model was designed to assess current and post-development flood risks, factoring in climate change projections to ensure a resilient flood risk strategy.

The scenarios simulated in this study for the Proposed Scheme on Plot 3 involve the diversion of Brightley Brook and the construction of a culvert under an access road. The Proposed Scheme on upstream river corridor improvements (approved under Reserved Matters planning reference 22/00787/REM) comprises bank improvements along a tributary of the Brightley Brook.

1.1 CONSULTATION

To guide the flood risk and water quality assessment, WSP conducted consultations with the EA. A meeting was held on Friday 27 January 2023 in which modelling was advised as not required, only a high-level fluvial calculation. WSP decided to still test the scenario by undertaking a 1D-2D hydraulic model, factoring in 35% CC (climate change).

1.2 MODELLING METHODOLOGY

INPUT DATA

The hydraulic model was based on an existing 1D model of Brightley Brook developed by WSP in 2016/17 for the M62 Junction 19 Link Road Flood Assessment. This model was updated and linked with a 2D TUFLOW model to enhance precision. Key inputs included the 2018 topographical survey, 2020 1-meter resolution LiDAR data, and client-supplied drawings for proposed site modifications. The 1D-2D linked model was limited to 60 meters downstream of the culvert outlet, as access constraints prevented extending the model to a nearby reservoir.

HYDRAULIC MODEL OF BRIGHTLEY BROOK

The model used Flood Modeller (1D) and TUFLOW (2D) to simulate hydraulic behaviour across the development site. Manning's roughness coefficients were chosen based on land use and site photographs.

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Manning’s roughness values of 0.03–0.04 were used for the channel, while floodplain values ranged from 0.045 to 0.07. The downstream boundary was defined as a Normal Depth boundary in Plot 3. A Manning’s value of 0.1 was adopted on the southern watercourses as a worst-case scenario to determine freeboard requirements for a footbridge adjacent to the upstream river corridor improvements (approved under Reserved Matters planning reference 22/00787/REM).

The model was run for a 1% Annual Exceedance Probability (AEP) event (equivalent to a 100-year event), factoring in a 35% climate change allowance for the 60-year epoch and central range allowance in the Irwell Management Catchment area. For the tributary, calculations using Manning’s equation estimated water levels, with a sensitivity analysis assessing the impact of varying roughness values.

HYDROLOGICAL ANALYSIS

WSP (2023b) conducted a hydrological analysis to determine model inflows for Brightley Brook and its tributary using Flood Estimation Handbook (FEH) statistical and Revitalised Flood Hydrograph rainfall-runoff method version 2 (ReFH2) methods. The derived peak flows were compared, and selected values were applied to the model. Hydrological catchments and flow distribution points were established for each sub-catchment, with peak flows applied at specified locations based on land use and topography.

1.3 MODELLING RESULTS

BRIGHTLEY BROOK

Model simulations (WSP (2023b) compared baseline and post-development conditions under a 1% AEP event plus a 35% climate change allowance. The baseline scenario showed minimal riverbank overtopping, primarily in low-lying areas intended for parking. A comparison of water depths at key locations showed a reduction in flooding along this area in the post-development scenario. No changes occurred compared to the baseline in other sections of the river corridor. This indicates that the Proposed Scheme has a small, limited effect on out-of-bank flows.

The proposed water levels are generally lower than the baseline water levels in the reach downstream of the proposed culvert except at the location of the downstream boundary, where the proposed water level is higher than the baseline water levels by 0.047m. However, the proposed water levels are well contained within the channel and do not induce additional flooding downstream, supporting the EA flood risk criteria.

TRIBUTARY OF BRIGHTLEY BROOK

The assessment of the tributary of Brightley Brook revealed that maximum water levels under the 1% AEP plus 35% climate change event remain consistently below riverbank levels for baseline and post-development conditions. This supports that there is no risk of flooding in the tributary area. The normal depth calculations demonstrate that projected maximum water levels at various locations remain well within

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safe limits, thereby confirming that the tributary can accommodate extreme flood events (% AEP plus 35% climate change) without adverse impacts. Overall, the results affirm the stability and safety of the tributary under anticipated hydrological conditions.

1.4 CONCLUSION

The hydraulic model demonstrates that the Proposed Scheme does not significantly increase flood risk within or downstream. The modelled scenarios confirm that the proposed Brightley Brook diversion, combined with the culvert and improvements along the tributary, effectively mitigates flood risk even under climate change projections. This approach, aligned with EA guidance, ensures that the Proposed Scheme will not induce adverse hydrological impacts on adjacent or downstream areas. The findings support the proposed flood risk strategy, reinforcing compliance with planning and environmental standards.

Tailwater Analysis

WSP (2023c) assesses specifically if the culvert proposed as part of the Brightley Brook diversion would impact water levels upstream. In hydraulic engineering, particularly in the design of culverts and outfalls as outlined in CIRIA C786, the downstream water level at the discharge point of a structure is defined as tailwater. This level is crucial as it impacts the flow behaviour – determining whether it will be free-flowing or submerged – and influences factors like discharge capacity and potential for backwater effects, where high tailwater levels cause water to back up, raising flood risk upstream.

Using “Section 11, CIRIA C786 - Culvert, Screen and Outfall Manual” for a variety of flow returns (2, 10, 20, 30, 50, 75, 100, and 100+CC return periods), WSP (2023d) shows that there is a change in velocity (1.8 m/s in a 2-year return flow to 2.2 m/s in a 100+CC return flow) and depth (0.6 m in a 2-year return flow to 1.0 m in a 100+CC return flow) upstream of the culvert, but flow regime remains subcritical, with Froude number between 0.8 (in a 2-year return flow) and 0.7 (in a 100+CC return flow).

In conclusion, WSP (2023c) demonstrates that the proposed culvert for the Brightley Brook diversion is expected to maintain subcritical flow conditions across varying return periods, with Froude numbers consistently below 1. Despite fluctuations in flow velocity (from 1.8 m/s to 2.3 m/s) and depth (from 0.6 m to 1.0 m) depending on the return period, the tailwater remains manageable, minimising potential backwater effects and ensuring efficient discharge capacity. This outcome aligns with CIRIA C786 guidelines, reinforcing that the culvert design will effectively accommodate the hydraulic conditions without increasing flood risk upstream. As a result, the soffit level of the culvert is calculated using the headwater level plus freeboard and the invert level has been calculated based on the downstream bed level (with an allowance for 0.5m sediment build-up). The freeboard has been calculated based on a risk-based approach, considering factors such as flow variability, debris passage, sediment transport, and climate resilience. The width of the culvert was determined through the assessment of both velocity (inlet, barrel and outlet) and

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top water elevations (headwater and tailwater) to match properties to reduce the risk of erosion or development of supercritical flow.

Extracts of the calculations are included in **Appendix C**.

GEOMORPHOLOGICAL ASSESSMENT

The hydraulic modelling for Brightley Brook and its tributary offers a detailed understanding of flow dynamics, sediment transport, and geomorphic stability under the proposed scheme. WSP's findings (2023b, 2023c) reveal that the scheme successfully maintains subcritical flow conditions throughout, ensuring that velocities remain low and reducing the likelihood of bed and bank erosion. Subcritical flows are key in this context, as they support a stable flow regime with minimal erosive energy, essential for preserving channel morphology and avoiding excessive scouring that could destabilise the banks or bed. The careful design thus mitigates potential erosion risks associated with high-velocity flows, which could otherwise alter sediment distribution and affect channel stability.

To address flood risk, the culvert management strategy shows that the channel can accommodate increased flows by providing sufficient conveyance capacity during peak events. The proposed culvert dimensions for Brightley Brook adhere to standard good practices by balancing hydraulic conveyance needs with ecological and geomorphological requirements (For example, EA, 2010a&b; Scottish Government, 2012; Sear, D.A., et al. 2009; SEPA, 2010, 2012, & 2015). The culvert is designed to be sufficiently wide to manage peak flood flows, while also accommodating a low-flow channel and natural bed material.

In high-flow scenarios, protective measures (rock armour, coir matting, and rock rolls) along the realigned sections are expected to absorb and dissipate erosive forces efficiently. This design minimises bed and bank erosion, sustaining the channel's morphology and sediment transport processes under both average and extreme conditions.

The modelled flow velocities, which range from 1.8 m/s (2-year flow) to 2.3 m/s (100-year +CC flow), indicate that while scouring forces are present, they remain within tolerable limits. The embedded protections are robust enough to withstand these velocities, reducing the risk of channel incision or structural failure in the channel bed. Furthermore, the modelling predicts that water depths in post-development conditions will not exceed bankfull levels during peak events, thus preventing out-of-bank flows and the associated risks of lateral erosion on the floodplain. This containment of flows within the channel confines sediment deposition processes to the main channel, with peak recession favouring in-channel sediment deposition over floodplain deposition.

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Overall, these hydraulic modelling results suggest that the Proposed Scheme can sustain baseline flow regimes and sediment transport dynamics, supporting both geomorphic stability and effective flood management. By preserving these natural processes, the scheme fosters a balanced riverine system, enhancing long-term stability without adversely impacting downstream sediment supply. This approach achieves dual objectives: minimising flood risks and maintaining the ecological and geomorphological integrity of the Brightley Brook system.

CONCLUSION

The hydraulic and geomorphological assessments affirm that significant alteration to the existing hydraulic and geomorphic processes are not anticipated upstream, along, and downstream of the Proposed Scheme.

Modelling results indicate that the proposed channel modifications, such as the 3m x 3m culvert and bank protection, effectively mitigate potential flood risks, even under a 1% AEP (100-year) flood event with a 35% climate change allowance. The post-development conditions demonstrate that flood extents and water levels remain controlled within the channel, reducing inundation risks at key on-site locations and supporting Environment Agency flood risk guidelines. Additionally, the tributary assessment shows maximum water levels consistently below riverbank elevations, reinforcing no flood risk in this area.

The tailwater analysis, adhering to CIRIA C786 guidelines, further confirms that the proposed culvert design will maintain subcritical flow regimes across various return periods, managing flow velocity and discharge capacity without inducing backwater effects or upstream flooding. The culvert is sufficiently wide to manage peak flood flows, while also accommodating a low-flow channel and natural bed material. This layout promotes continuity of habitat within the channel, enabling aquatic organisms to traverse the culvert while supporting the continuing transport of sediment and nutrients downstream.

From a geomorphological perspective, the diversion is designed to maintain stable flow conditions, which limits erosive forces and supports gradual sediment deposition within the channel rather than on the floodplain. The inclusion of erosion control measures along the realigned section, such as rock armour and coir matting, will enhance bank stability and protect channel morphology over the long term. The addition of berms in the Tributary of Brightley Brook (Reserved Matters planning reference 22/00787/REM) also improves flood capacity and encourages morphological stability and sustainability without changing the footprint of the watercourse.

In summary, the proposed flood risk strategy and channel modifications align with regulatory expectations and follow standard good practice guidelines, effectively balancing flood management objectives with the preservation of existing geomorphological processes. This comprehensive approach ensures that the geomorphological integrity and flood resilience of the Brightley Brook system are safeguarded in response to future hydrological conditions.



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REFERENCES

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Environment Agency (EA) (2010b). Structural modification of culverts. Flood and Coastal Erosion Risk Management Research & Development Programme.

Sear, D. A., et al. (2009). Guidebook of Applied Fluvial Geomorphology.

Scottish Environmental Protection Agency (SEPA) (2010). Engineering in the Water Environment: Good Practice Guide. Sediment Management (WAT-SG-26).

SEPA (2012). Environmental Standards for River Morphology. Supporting Guidance (WAT-SG-21).

SEPA (2015). Culverting of Watercourses: Position Statement and Supporting Guidance (WAT-PS-06-02).

Scottish Government (2012). River Crossings and Migratory Fish: Design Guidance.

WSP (2023a). Brightley Brook Detailed Design (Drawings No 70089657-WSP-SHP3-WAT-DR-D-0100, 70089657-WSP-SHP3-WAT-DR-D-0101, 70089657-WSP-SHP3-WAT-DR-D-0102, 70089657-WSP-SHP3-WAT-DR-D-0103, 70089657-WSP-SHP3-WAT-DR-D-0104). March 23

WSP (2023b). Brightley Brook Hydraulic Model Technical Note. 30 March 2023

WSP (2023c). South Heywood Box Culvert 3.0w x 2.5h spreadsheet. March 2023

Brightley Brook Tributary ecological improvements drawings, associated with Reserved Matters planning reference 22/00787/REM. 3595,206 & 3595-304 (TPM Landscape), SHOW-WYG-00-ZZ-90-C-0144 (WYG (TetraTech)).



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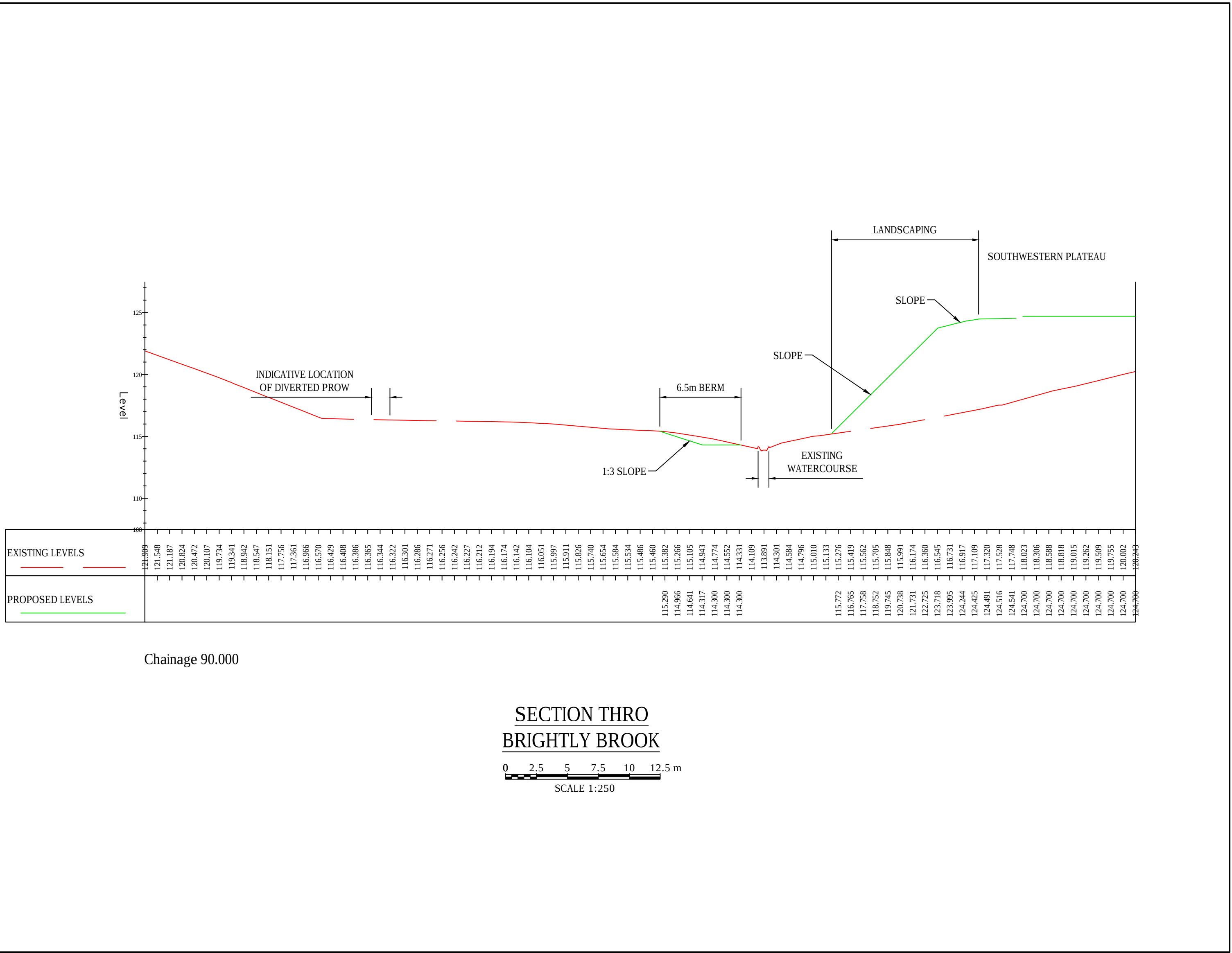
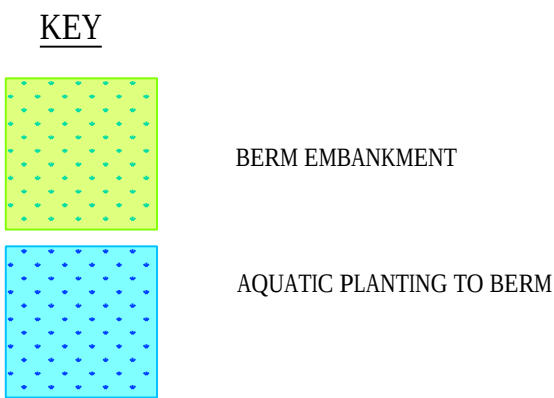
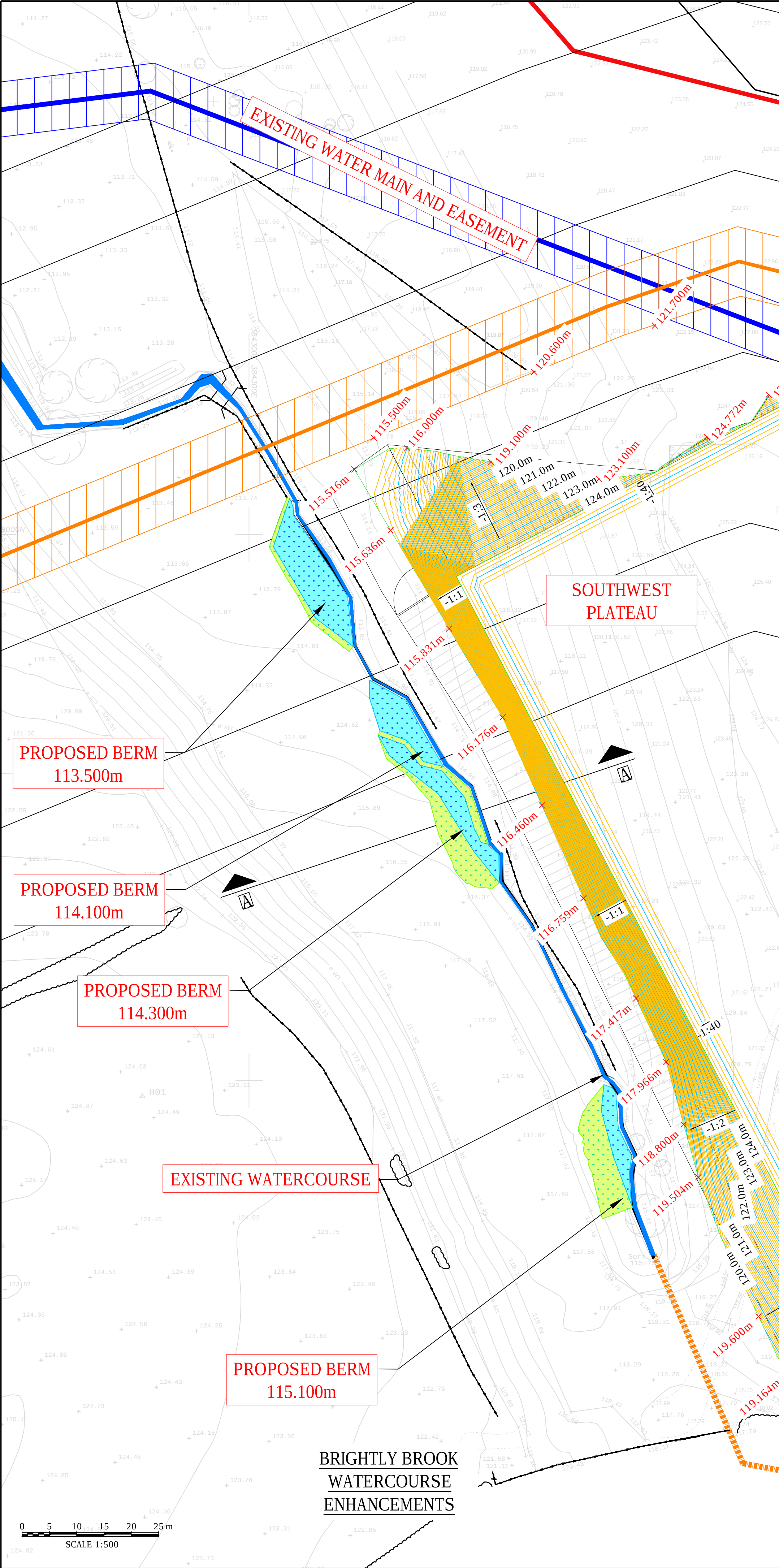
APPENDIX A – BRIGHTLEY BROOK MAIN RIVER DIVERSION GENERAL ARRANGEMENT



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APPENDIX B – TRIBUTARY OF BRIGHTLEY BROOK IMPROVEMENTS, APPROVED DRAWINGS



PLANNING ISSUE

P01	PRELIMINARY FIRST ISSUE	30.10.20	RM	DB	JP
Rev	Description	Date	Drawn	Checked	Approved
Document Control					
Issuing Office					

Client

RUSSELLS SOUTH HEYWOOD LTD

Project Name

SOUTH HEYWOOD COMMERCIAL

Sheet Title

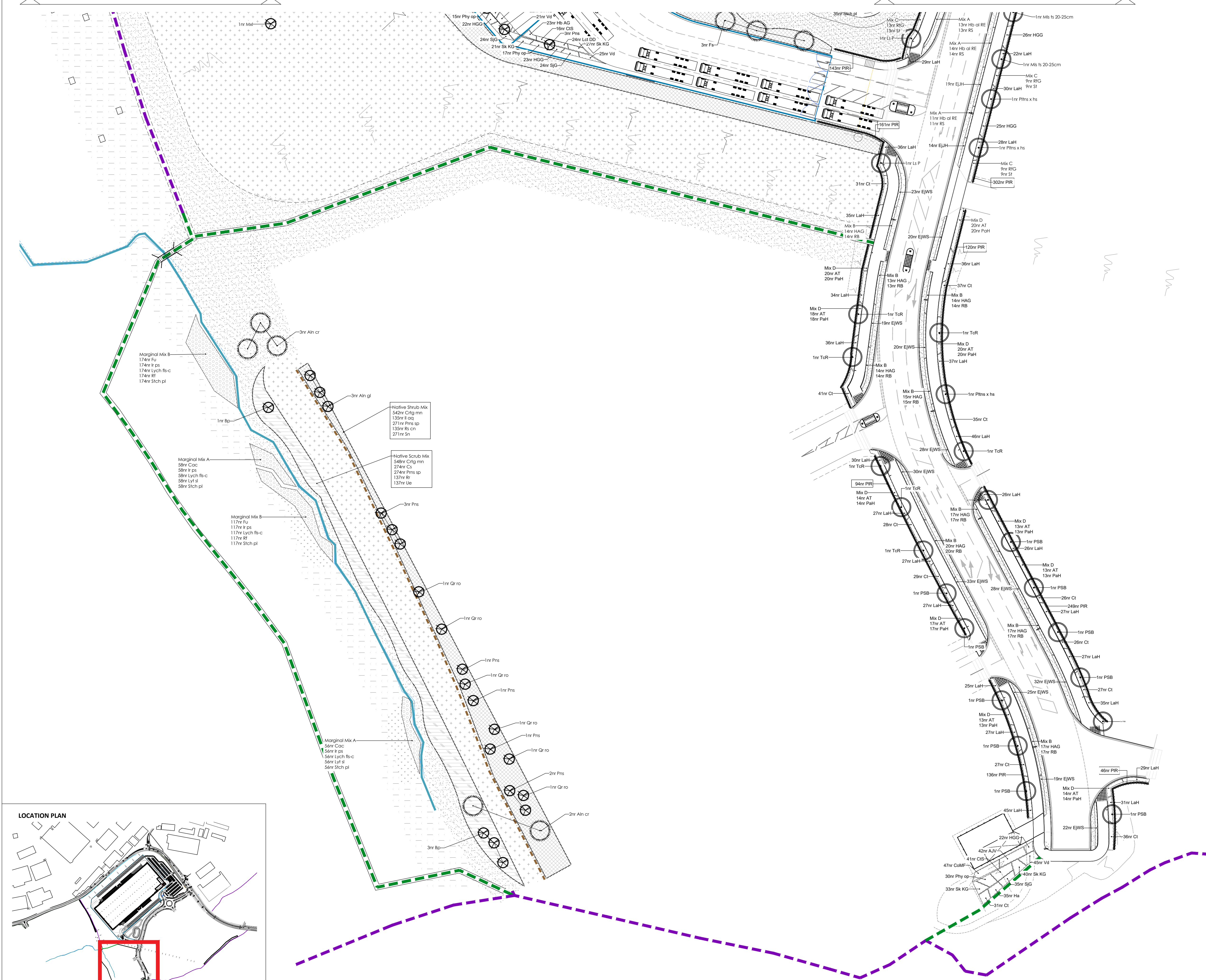
BRIGHTLY BROOK ENHANCEMENT DETAILS

WYG Project Number	Drawn By	Date	Checked By	Date	Approved By	Date	Scale @ A1	Suitability
A104444-8	RM	JULY 20	DB	JULY 20	JP	JULY 20	1:500	S0
Client Project Number	Originator	Volume/System	Level/Location	Type	Role	Number	Revision	
SOHW	- WYG	- 00	- ZZ	- 90	- C	- 0144	P01	

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For the rest of the plan refer to drawing 3595 - 204

For the rest of the plan refer to drawing 3595 - 205



LEGEND

- Existing Trees/ Hedgerows retained**
Trees and hedges to be retained and protected in line with BS5837:2012.
- Proposed Spine Road Trees**
Semi-mature, 20-25cm girth, 5-6m high, secured with underground guys. Trees require an irrigation pipe wrapped around the root ball.
- Proposed Medium Size Trees**
Extra heavy standards, 14-16cm, 4-5m high, to be secured with a double timber stakes secured with a rubber tree tie.
- Proposed Small Trees**
Selected Standard/ Heavy Standards, 10-12cm/12-14cm, 3-4m high, secured with single stakes. Or multi-stemmed tree.
- Proposed Small Box Head Tree**
Clear Stem Height: 200cm (Overall tree height with head - 3.5m)
Head Size: 1.5 x 1.5m x 1.5m
Stem Girth: 20-20cm. To be secured with a double timber stakes secured with a rubber tree tie.
- Proposed Native Hedgerow and Hedgerow Infill**
Native hedgerows planted as bare root stock, 80-100cm high, planted in a double staggered row at 300mm centres. To be planted in groups of 3-5. Proposed native hedge to be planted as a part of South Heywood Link Road landscaping.
- Proposed Evergreen Hedgerow**
To be planted at 100-120cm high, 7.5-10L containers at 3 per linear metres. Or pre-clipped instant hedge, to be planted at 50cm high, supplied in 1m long trough. Planted 1 trough per lin.m
- Proposed Ornamental Planting**
Proposed shrubs and flowering herbaceous plants to be planted as 3-SL, at 3-5 per sq.m. Planted with feature specimen, 10-15L pots.
- Proposed Woodland Mix**
Bare root/ whip planting stock, of native tree species set at 1 p/m2 secured with spiral guards where necessary. To be planted in groups of 3-5.
- Proposed Native Shrub Mix**
Bare root planting stock of native shrub species set at 2 p/m2 secured with spiral guards where necessary. To be planted in groups of 3-5.
- Proposed Native Scrub Mix**
Bare root planting stock of native scrub species set at 2 p/m2 secured with spiral guards where necessary. To be planted in groups of 3-5.
- Proposed Species Rich Grassland**
Species Rich Grass Mix KSRL as supply by Kings Crops or similar approved. Seed rate 20kg/ha.
- Proposed Flowering Meadow Mix**
To be EM2 Standard Meadow Mixture, supply by Emorsgate or similar approved. Including 80% of ornamental grasses and 20% of flowering perennials. Sowing rate 4/gm2.
- Proposed Wetland Seed Mix**
EMSF - Meadow Mixture for Wetlands as supplied by Emorsgate or similar approved. Including 80% of ornamental grasses and 20% of flowering perennials. Sowing rate 4/gm2.
- Proposed Marginal Planting**
Mix of native marginal plants, planted at 6 per m2. To be planted in groups of 3-5.
- Existing Grassland Retained**
- Proposed Bulbs**
- REFER TO DRAWING 201 FOR PLANT SCHEDULE**
REFER TO DRAWING 205 PLANTING NOTES

GENERAL NOTES

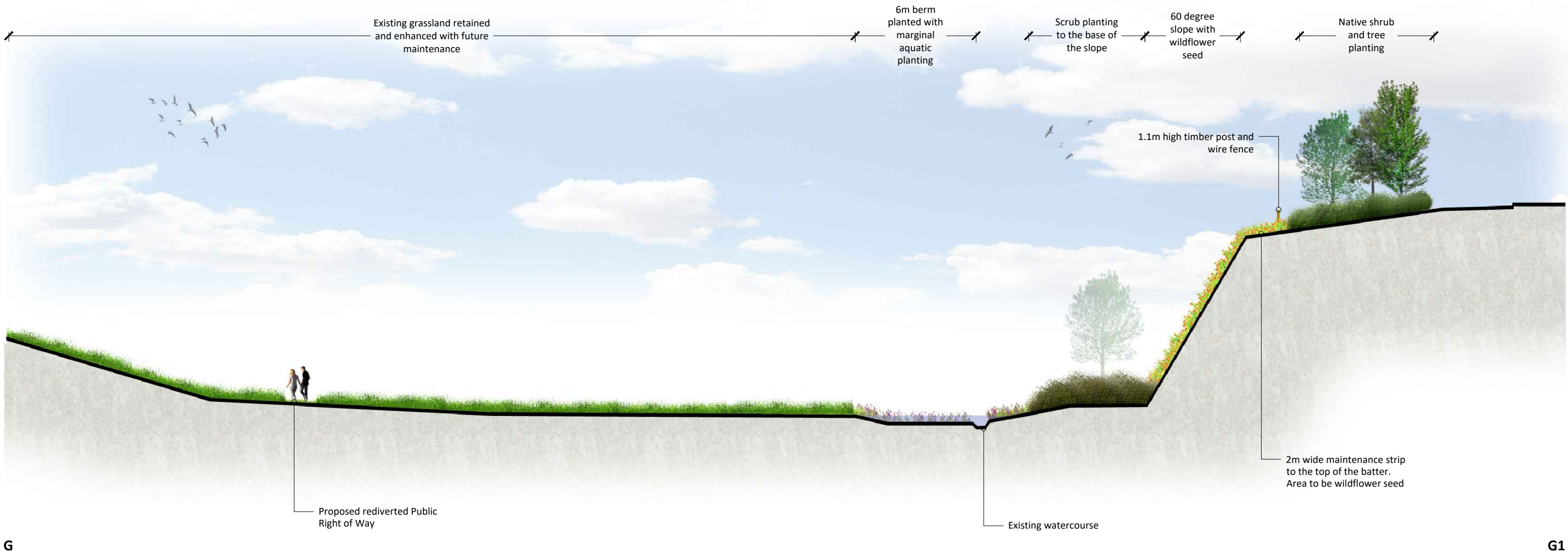
- This drawing is the copyright of tpm landscape Ltd and cannot be reproduced in any form without the consent of the company.
- This drawing is to be read in conjunction with detail landscape drawings, details and specification.
- This drawing is to be read in conjunction with all relevant Architects', Engineer's, Specialists, Bills of Quantities and Specifications.
- The insertion of any firm or proprietary brand on this drawing is an indication of the class or quality required and does not exclude the use of alternative materials that are equal in performance, quality and appearance, provided that they have been approved in writing by the Landscape Architect.
- The Contractor is responsible for accurately ascertaining the position of underground services and responding to all relevant service easement requirements.
- All dimensions are in millimetres unless stated otherwise, for the purposes of construction this drawing must not be scaled and only written dimensions used. Written and scaled dimensions to be checked on site, any discrepancies reported prior to work commencing. IF IN DOUBT PLEASE ASK.
- All work and materials are to be in accordance with the relevant British Standards and Code of Practice.
- All Proprietary products are to be used strictly in accordance with the manufacturer's instructions and details.

REVISION NOTES

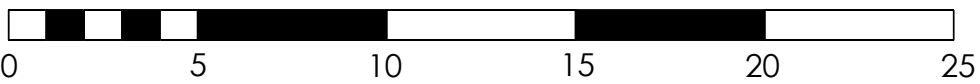
Rev	By	Description	Date
H	DC	Updated in line with amended site plan	06.06.22
G	JS	Revised application	20.05.22
F	GBS	Amended in line with landscape layout	12.05.21
E	MW	Amended to revised spine road extents	01.04.21
D	MW	Revised in line with architects layout	29.01.21
C	DC	Gravel path replaces section of boardwalk	30.11.20
B	MC	Revised in line with architects comments	13.11.20

Client	Russells South Heywood Ltd	N
Project	South Heywood Commercial	
Description	Planting Plan: 6 of 6	
Status	Planning Issue	
Scale @ A1	1:500	Drawn MW
Job number	3595	Checked DC
		Date 27.10.20
		Revision H

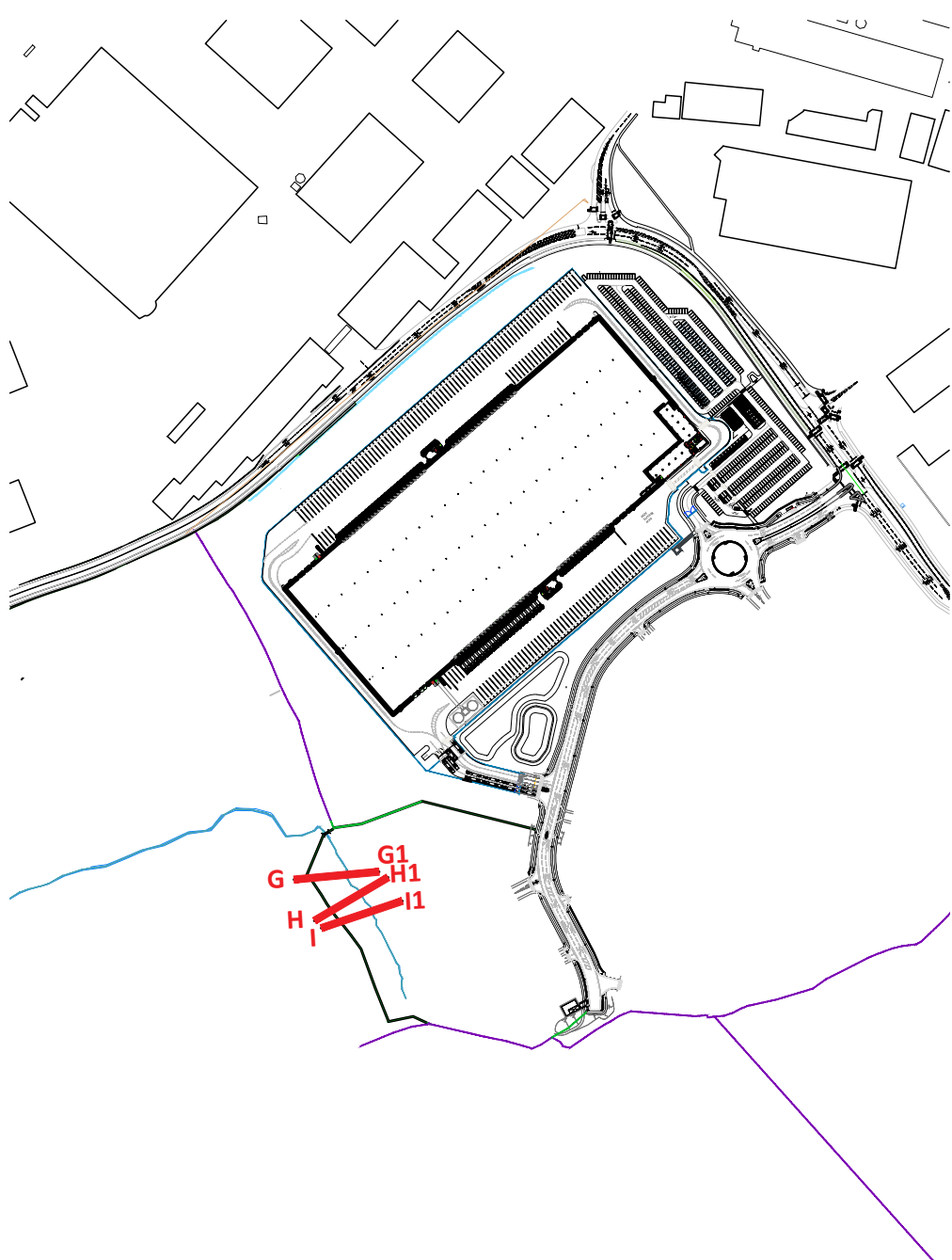
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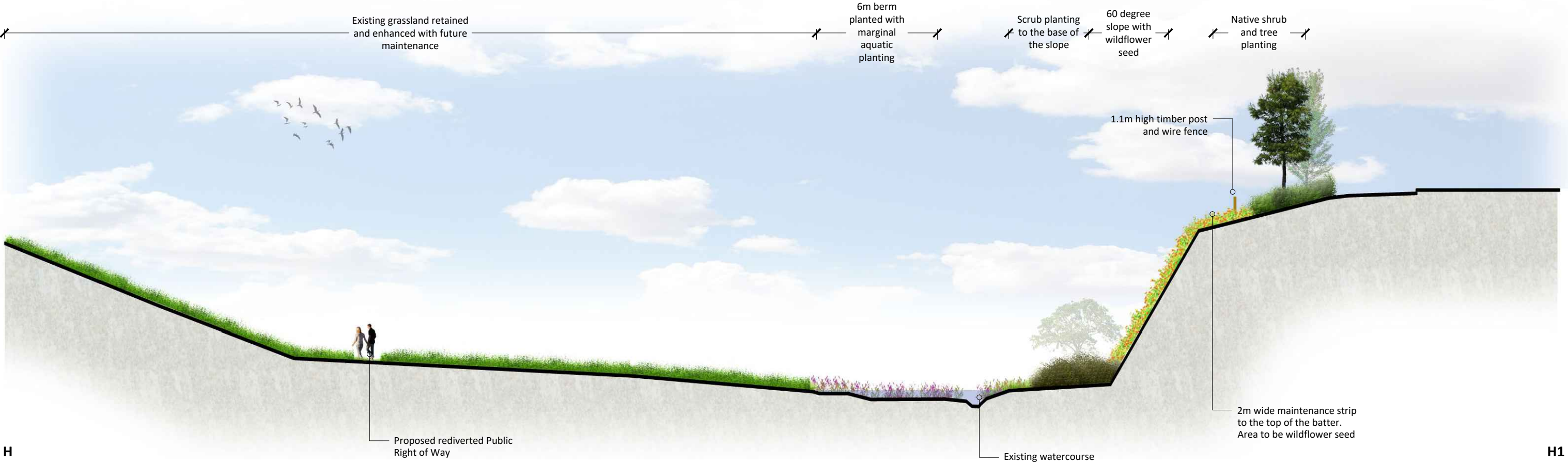
SCALE BAR



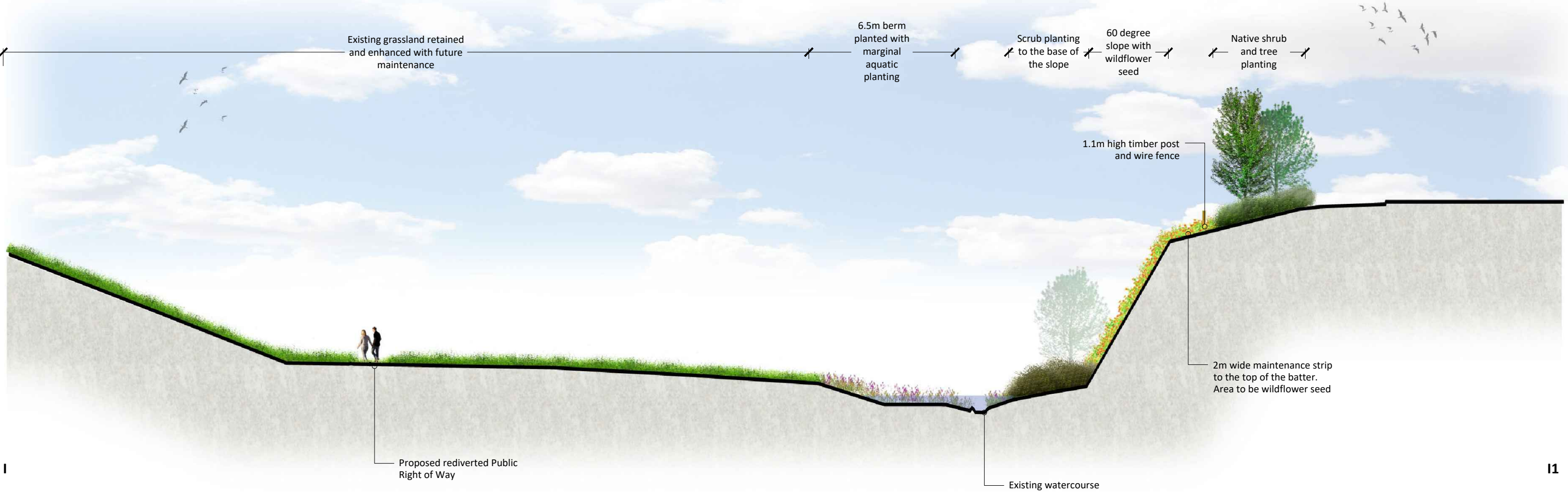
LOCATION PLAN



SECTION H-H1
Scale - 1:200



SECTION I-I1
Scale - 1:200



TO BE READ IN LINE WITH DRAWING 3595 104

GENERAL NOTES

- This drawing is the copyright of tpm landscape Ltd and cannot be reproduced in any form without the consent of the company.
- This drawing is to be read in conjunction with detail landscape drawings, details and specification.
- This drawing is to be read in conjunction with all relevant Architects', Engineer's, Specialists, Bills of Quantities and Specifications.
- The insertion of any firm or proprietary brand on this drawing is an indication of the class or quality required and does not exclude the use of alternative materials that are equal in performance, quality and appearance, provided that they have been approved in writing by the Landscape Architect.
- The Contractor is responsible for accurately ascertaining the position of underground services and responding to all relevant service easement requirements.
- All dimensions are in millimetres unless stated otherwise, for the purposes of construction this drawing must not be scaled and only written dimensions used. Written and scaled dimensions to be checked on site, any discrepancies reported prior to work commencing, IF IN DOUBT PLEASE ASK.
- All work and materials are to be in accordance with the relevant British Standards and Code of Practice.
- All Proprietary products are to be used strictly in accordance with the manufacturer's instructions and details.

REVISION NOTES

Rev	By	Description	Date
F	DC	Updated in line with amended site plan	06.06.22
E	DC	Revised application	17.05.22
D	DC	Timber fence spec amended	29.01.21
C	DC	Timber post and rail fence note added	28.01.21
B	DC	Minor amends to client comments	29.10.20
A	DC	Minor amends to client comments	28.10.20

Client	Russells South Heywood Ltd	N
Project	South Heywood Commercial	
Description	Landscape Sections: 4 of 7	
Status	Planning Issue	
Scale @ A1	1:200	Drawn DC
Job number	3595	Checked DC
		Date 26.10.20
		Revision F

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IMPLICATIONS OF THE BRIGHTLEY BROOK REALIGNMENT TECHNICAL NOTE

DATE:	12 March 2025	CONFIDENTIALITY:	Public
SUBJECT:	§ 24, ii, Rochdale Borough Council Letter		
PROJECT:	Plot 3 of the South Heywood Masterplan	AUTHOR:	Chrystiann Lavarini
CHECKED:	Stephanie Davidson	APPROVED:	David Waters

APPENDIX C – SOUTH HEYWOOD BOX CULVERT CALCULATIONS (EXTRACT)

Project Name		Chainage		Key
Project No.		Road/Watercourse		Input
Client		Structure No.		Reference
Calculation No.		Revision		Calculation
Date		Status		Output

Section 2: Inputs

Ref				Output																																																														
1.0	Load Cases Add Another Load Case Remove Empty Load Cases Please select the load case to view in the printed calculations: Load Case 10 <table border="1"> <thead> <tr> <th>Load Case</th> <th>Description</th> <th>Active?</th> </tr> </thead> <tbody> <tr><td>Load Case 1</td><td>Q2</td><td>Yes</td></tr> <tr><td>Load Case 2</td><td>Q5</td><td>Yes</td></tr> <tr><td>Load Case 3</td><td>Q10</td><td>Yes</td></tr> <tr><td>Load Case 4</td><td>Q20</td><td>Yes</td></tr> <tr><td>Load Case 5</td><td>Q25</td><td>No</td></tr> <tr><td>Load Case 6</td><td>Q30</td><td>Yes</td></tr> <tr><td>Load Case 7</td><td>Q50</td><td>Yes</td></tr> <tr><td>Load Case 8</td><td>Q75</td><td>Yes</td></tr> <tr><td>Load Case 9</td><td>Q100</td><td>Yes</td></tr> <tr><td>Load Case 10</td><td>Q100 + CC</td><td>Yes</td></tr> <tr><td>Load Case 11</td><td>Q200</td><td>Yes</td></tr> <tr><td>Load Case 12</td><td>Q200 + CC</td><td>No</td></tr> <tr><td>Load Case 13</td><td>Q1000</td><td>No</td></tr> <tr><td>Load Case 14</td><td>Q200 + CC</td><td>No</td></tr> <tr><td>Load Case 15</td><td>Q1000</td><td>No</td></tr> <tr><td>Load Case 16</td><td>Not Used</td><td>No</td></tr> <tr><td>Load Case 17</td><td>Not Used</td><td>No</td></tr> <tr><td>Load Case 18</td><td>Not Used</td><td>No</td></tr> <tr><td>Load Case 19</td><td>Not Used</td><td>No</td></tr> <tr><td>Load Case 20</td><td>Not Used</td><td>No</td></tr> </tbody> </table>	Load Case	Description	Active?	Load Case 1	Q2	Yes	Load Case 2	Q5	Yes	Load Case 3	Q10	Yes	Load Case 4	Q20	Yes	Load Case 5	Q25	No	Load Case 6	Q30	Yes	Load Case 7	Q50	Yes	Load Case 8	Q75	Yes	Load Case 9	Q100	Yes	Load Case 10	Q100 + CC	Yes	Load Case 11	Q200	Yes	Load Case 12	Q200 + CC	No	Load Case 13	Q1000	No	Load Case 14	Q200 + CC	No	Load Case 15	Q1000	No	Load Case 16	Not Used	No	Load Case 17	Not Used	No	Load Case 18	Not Used	No	Load Case 19	Not Used	No	Load Case 20	Not Used	No		
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Load Case 19	Not Used	No																																																																
Load Case 20	Not Used	No																																																																
2.0	Downstream Channel Geometry Inputs Using topographic survey, a cross section of the channel downstream of the culvert may be rationalised as a compound channel as per the below diagram.																																																																	

Project Name		Chainage		Key
Project No.		Road/Watercourse		Input
Client		Structure No.		Reference
Calculation No.		Revision		Calculation
Date		Status		Output

Section 2: Inputs

Ref											Output
2.10	<u>Channel Type</u> select from dropdown list										
	Zone B			Zone A			Zone C				
	Excavated Earth Channel			Excavated Earth Channel			Excavated Earth Channel				
2.20	<u>Channel Material/Form</u> select from dropdown list										
	Zone B			Zone A			Zone C				
	Stony,cobbles			Stony,cobbles			Stony,cobbles				
2.30	<u>Channel Dimensions</u>										
	Zone B			Zone A			Zone C				
	Component	Quantity	Units	Component	Quantity	Units	Component	Quantity	Units		
				h_1	0.614	m					
				h_2	0.467	m					
	w_2	0.000	m	w_1	1.621	m	w_3	0.000	m		
	s_3	1 in 8.0	-	s_1	1 in 0.1	-	s_4	1 in 2.8	-		
				s_2	1 in 0.5	-					
	n_2	0.035	-	n_1	0.035	-	n_3	0.035	-		
	S_{o2}	0.016	m/m	S_{o1}	0.016	m/m	S_{o3}	0.016	m/m		
	What is the downstream channel invert level?					$Z_{IL,dc}$	109.025	mAOD			
	what is the downstream channel top of bank level?					$Z_{TOB,dc}$	110.374	mAOD			
	What is the channel height						1.349	m			
	what is the channel area?						5.402	m ²			
	Are there any significant structures/obstructions downstream?						No				
	if yes, what is the distance from the culvert outlet?						0.00	m			
3.0	<u>Culvert Geometry Inputs</u>										
3.10	<u>General</u>										
3.1.1	<u>Inputted Geometry</u>										
	Inputted geometry to be sourced from topographic survey for existing culverts or from culvert design tool.										
	What is the inlet hydraulic invert level?					$Z_{IL,inlet}$	109.610	mAOD			
	What is the outlet hydraulic invert level?					$Z_{IL,outlet}$	109.040	mAOD			
	What is the culvert barrel length?					L	38.000	m			
3.1.2	<u>Calculated Geometry</u>										
	What is the culvert gradient?					$S_{o,culvert}$	0.015	m/m			

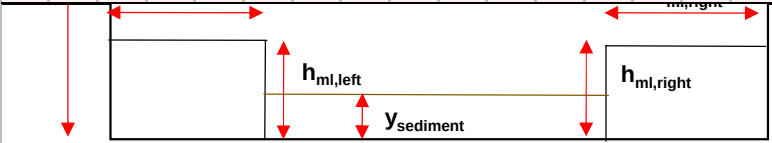
Project Name		Chainage		Key
Project No.		Road/Watercourse		Input
Client		Structure No.		Reference
Calculation No.		Revision		Calculation
Date		Status		Output

Section 2: Inputs

Ref				Output
	what is the depth of natural bed?	y_{sediment}	0.500 m	
	What is the inlet construction invert level?	$Z_{\text{IL,inlet,cons}}$	109.110 mAOD	
	What is the inlet soffit level?	$Z_{\text{SL,inlet}}$	112.110 mAOD	
	What is the outlet construction invert level?	$Z_{\text{IL,outlet,cons}}$	108.540 mAOD	
	What is the outlet soffit level?	$Z_{\text{SL,outlet}}$	111.540 mAOD	
3.20	<u>Culvert Section</u>			
	What is the culvert shape?		Box	
3.2.1	<u>Pipe Culvert</u>			
	What is the internal culvert diameter?	ϕ		m
	What is the Mannings roughness coefficient?	n		-
	what is the roughness coefficient?	k		mm
	What is the depth of natural bed/ sediment?	y_{sediment}		m
	What is the internal culvert area?	A		m ²
	What is the radius of the culvert?	r		m
	What is the centre angle of the culvert?	θ		rads
	What is the effective internal culvert area?	A_{eff}		m ²
	What is the effective diameter of the culvert?	ϕ_{eff}		m
3.2.2	<u>Box Culvert</u>			

Project Name		Chainage		Key
Project No.		Road/Watercourse		Input
Client		Structure No.		Reference
Calculation No.		Revision		Calculation
Date		Status		Output

Section 2: Inputs

Ref				Output
				
	What is the internal culvert span?	a	3.000	m
	What is the internal culvert rise?	b	3.000	m
	What is the depth of natural bed/ sediment?	y _{sediment}	0.500	m
	Is mammal ledge required on the left hand side?		no	
	What is the width of the left hand mammal ledge?	w _{ml,left}		m
	what is the height of the left hand mamal ledge?	h _{ml,left}		m
	Is mammal ledge required on the right hand side?		no	
	What is the width of the right hand mammal ledge?	w _{ml,right}		m
	What is the height of the right hand mamal ledge?	h _{ml,right}		m
	What is the gradient on the left low flow channel	s1	1 in 0.0	
	What is the gradient on the right low flow channel	s2	1 in 0.0	
	what is the gradient on the left mammal shelf	s3	1 in 0.0	
	what is the gradient on the right mammal shelf	s4	1 in 0.0	
	What is the Manning's roughness coefficient?	n	0.0306	
	What is the roughness coefficient?	k	0.150	
	What is the effective area of the culvert?	A _{eff}	9.000	
3.2.3	<u>Appendix A7 Coefficients</u>			
	Type 1 Free flow (table A7.5, A7.6, A7.7)	k	0.56	
	Assuming concrete bbox with 150mm corner fillets			
	Type 1 Free flow (table A7.5, A7.6, A7.7)	m	0.62	
	Type 2 Submerged flow (table A7.5, A7.6, A7.7)	c	0.045	
	Type 2 Submerged flow (table A7.5, A7.6, A7.7)	y	0.55	
	Inlet loss coefficient (table A7.8)	k _i	0.4	
	Outlet loss coefficient (table A7.8)	k _o	0.5	
	Bend Loss coefficient (Figure A7.8)	k _{bn}		

Section 2: Inputs

[illegible]

4.0	Return Period Peak flows		
	Load Case	Description	Discharge Q, m ³ /s
	Load Case 1	Q2	1.810
	Load Case 2	Q5	2.260
	Load Case 3	Q10	2.740
	Load Case 4	Q20	3.050
	Load Case 5	Q25	
	Load Case 6	Q30	3.480
	Load Case 7	Q50	3.870
	Load Case 8	Q75	4.160
	Load Case 9	Q100	4.990
	Load Case 10	Q100 + CC	6.238
	Load Case 11	Q200	7.550
	Load Case 12	Q200 + CC	
	Load Case 13	Q1000	
	Load Case 14	Q200 + CC	
	Load Case 15	Q1000	
	Load Case 16	Not Used	
	Load Case 17	Not Used	
	Load Case 18	Not Used	
	Load Case 19	Not Used	
	Load Case 20	Not Used	
5.0	<u>Tailwater Depths</u> The below depths are to be inputted in instances where detailed analysis is required to calculate tailwater elevation. This may also be used to input depths of receiving watercourses from hydraulic model outputs.		
	Load Case	Source	Tailwater Velocity V _{dc} , m/S
	Load Case 1		
	Load Case 2		
	Load Case 3		
	Load Case 4		
	Load Case 5		
	Load Case 6		
	Load Case 7		
	Load Case 8		
	Load Case 9		
	Load Case 10		
	Load Case 11		
	Load Case 12		
	Load Case 13		
	Load Case 14		
	Load Case 15		
	Load Case 16		
	Load Case 17		
	Load Case 18		
	Load Case 19		
	Load Case 20		

Project Name		Chainage		Key
Project No.		Road/Watercourse		Input
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Section 2: Inputs																								
Ref																								Output

Project Name		Chainage		Key
Project No.		Road/Watercourse		Input
Client		Structure No.		Reference
Calculation No.		Revision		Calculation
Date		Status		Output

Section 2: Inputs

Ref	Output																																																																																																																																																			
1.00	<u>Load Cases</u> The load case that has been selected to print in full is: Load Case 10 L10 AD 38 The following calculations are based on guidance given in Section 11, CIRIA C786 - Culvert, Screen and Outfall Manual for the detailed inlet control method (box 11.12)																																																																																																																																																			
1.10	<u>Prior Checks</u> What is the culvert shape? Box Is overflowing analysis required? No																																																																																																																																																			
2.00	<u>Tailwater Results</u> For this assessment the following analysis has been undertaken Intermediate <table border="1"> <thead> <tr> <th>Load Case</th> <th>V_{dc} (m/s)</th> <th>Y_{dc} (m)</th> <th>WL_t (mAOD)</th> <th>H_t (mAOD)</th> <th>Fr_t</th> <th>Flow Regime</th> </tr> </thead> <tbody> <tr><td>Q2</td><td>1.830</td><td>0.551</td><td>109.576</td><td>109.746</td><td>0.787</td><td>Subcritical</td></tr> <tr><td>Q5</td><td>1.947</td><td>0.627</td><td>109.652</td><td>109.845</td><td>0.785</td><td>Subcritical</td></tr> <tr><td>Q10</td><td>2.034</td><td>0.693</td><td>109.718</td><td>109.929</td><td>0.780</td><td>Subcritical</td></tr> <tr><td>Q20</td><td>2.068</td><td>0.731</td><td>109.756</td><td>109.974</td><td>0.772</td><td>Subcritical</td></tr> <tr><td>Q25</td><td>1.965</td><td>0.638</td><td>109.663</td><td>109.860</td><td>0.785</td><td>Subcritical</td></tr> <tr><td>Q30</td><td>2.103</td><td>0.778</td><td>109.803</td><td>110.028</td><td>0.761</td><td>Subcritical</td></tr> <tr><td>Q50</td><td>2.127</td><td>0.816</td><td>109.841</td><td>110.072</td><td>0.752</td><td>Subcritical</td></tr> <tr><td>Q75</td><td>2.143</td><td>0.842</td><td>109.867</td><td>110.102</td><td>0.746</td><td>Subcritical</td></tr> <tr><td>Q100</td><td>2.184</td><td>0.909</td><td>109.934</td><td>110.177</td><td>0.731</td><td>Subcritical</td></tr> <tr><td>Q100 + CC</td><td>2.240</td><td>0.993</td><td>110.018</td><td>110.274</td><td>0.718</td><td>Subcritical</td></tr> <tr><td>Q200</td><td>2.295</td><td>1.067</td><td>110.092</td><td>110.361</td><td>0.709</td><td>Subcritical</td></tr> <tr><td>Q200 + CC</td><td>0.163</td><td>0.010</td><td>109.035</td><td>109.036</td><td>0.529</td><td>Subcritical</td></tr> <tr><td>Q1000</td><td>2.283</td><td>1.052</td><td>110.077</td><td>110.342</td><td>0.711</td><td>Subcritical</td></tr> <tr><td>Q200 + CC</td><td>2.109</td><td>0.787</td><td>109.812</td><td>110.039</td><td>0.759</td><td>Subcritical</td></tr> <tr><td>Q1000</td><td>0.184</td><td>0.012</td><td>109.037</td><td>109.038</td><td>0.545</td><td>Subcritical</td></tr> <tr><td>Not Used</td><td>0.190</td><td>0.012</td><td>109.037</td><td>109.039</td><td>0.549</td><td>Subcritical</td></tr> <tr><td>Not Used</td><td>0.129</td><td>0.007</td><td>109.032</td><td>109.033</td><td>0.500</td><td>Subcritical</td></tr> <tr><td>Not Used</td><td>0.133</td><td>0.007</td><td>109.032</td><td>109.033</td><td>0.503</td><td>Subcritical</td></tr> <tr><td>Not Used</td><td>0.136</td><td>0.007</td><td>109.032</td><td>109.033</td><td>0.506</td><td>Subcritical</td></tr> <tr><td>Not Used</td><td>0.139</td><td>0.008</td><td>109.033</td><td>109.034</td><td>0.509</td><td>Subcritical</td></tr> </tbody> </table>	Load Case	V _{dc} (m/s)	Y _{dc} (m)	WL _t (mAOD)	H _t (mAOD)	Fr _t	Flow Regime	Q2	1.830	0.551	109.576	109.746	0.787	Subcritical	Q5	1.947	0.627	109.652	109.845	0.785	Subcritical	Q10	2.034	0.693	109.718	109.929	0.780	Subcritical	Q20	2.068	0.731	109.756	109.974	0.772	Subcritical	Q25	1.965	0.638	109.663	109.860	0.785	Subcritical	Q30	2.103	0.778	109.803	110.028	0.761	Subcritical	Q50	2.127	0.816	109.841	110.072	0.752	Subcritical	Q75	2.143	0.842	109.867	110.102	0.746	Subcritical	Q100	2.184	0.909	109.934	110.177	0.731	Subcritical	Q100 + CC	2.240	0.993	110.018	110.274	0.718	Subcritical	Q200	2.295	1.067	110.092	110.361	0.709	Subcritical	Q200 + CC	0.163	0.010	109.035	109.036	0.529	Subcritical	Q1000	2.283	1.052	110.077	110.342	0.711	Subcritical	Q200 + CC	2.109	0.787	109.812	110.039	0.759	Subcritical	Q1000	0.184	0.012	109.037	109.038	0.545	Subcritical	Not Used	0.190	0.012	109.037	109.039	0.549	Subcritical	Not Used	0.129	0.007	109.032	109.033	0.500	Subcritical	Not Used	0.133	0.007	109.032	109.033	0.503	Subcritical	Not Used	0.136	0.007	109.032	109.033	0.506	Subcritical	Not Used	0.139	0.008	109.033	109.034	0.509	Subcritical
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3.00	<u>Initial Hydraulic Assessment Results</u>																																																																																																																																																			
3.10	<u>Step 1 - Check for Submergence by the tailwater.</u> Step 1 outcome unconfirmed, proceed to step 2																																																																																																																																																			

Section 2: Inputs

492b Calculation Continuation Sheet 2 of 2

Section 2: Inputs

[illegible][illegible][illegible]

Load Case	Flow Type	H _h (mAOD)	Overflowing?	H _{h,overflowing} (mAOD)
Q2	3 or 4	110.172	No	#DIV/0!
Q5	3 or 4	110.262	No	#DIV/0!
Q10	3 or 4	110.352	No	#DIV/0!
Q20	3 or 4	110.407	No	#DIV/0!
Q25	3 or 4	110.667	No	#DIV/0!
Q30	3 or 4	110.480	No	#DIV/0!
Q50	3 or 4	110.579	No	#DIV/0!
Q75	3 or 4	110.679	No	#DIV/0!
Q100	3 or 4	110.980	No	#DIV/0!
Q100 + CC	3 or 4	111.478	No	#DIV/0!
Q200	3 or 4	112.071	No	#DIV/0!
Q200 + CC	3 or 4	109.618	No	#DIV/0!
Q1000	3 or 4	111.699	No	#DIV/0!
Q200 + CC	3 or 4	111.074	No	#DIV/0!
Q1000	3 or 4	109.619	No	#DIV/0!
Not Used	3 or 4	109.619	No	#DIV/0!
Not Used	3 or 4	109.619	No	#DIV/0!
Not Used	3 or 4	109.619	No	#DIV/0!
Not Used	3 or 4	109.615	No	#DIV/0!
Not Used	3 or 4	109.615	No	#DIV/0!

Project Name		Chainage		Key
Project No.		Road/Watercourse		Input
Client		Structure No.		Reference
Calculation No.		Revision		Calculation
Date		Status		Output

Section 2: Inputs																								
Ref																								Output