PROJECT: A483/A489 Newtown Bypass

JOB NUMBER: 5105742			DOCUMENT REF: Volume 3: Appendix K.4			
Revision	*Purpose and Description*	*Originated*	*Checked*	*Reviewed*	*Authorised*	*Date*
1	Volume 3: Appendix K.4	Kathryn Connolly	Ian Dalgleish	Mark Blackmore	Mark Blackmore	30/06/2014

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Proposed

		Chainages of Catchment			
Catchment Ref	**Catchment Name**	**West**	**East**	**Road catchment Length (m)**	**Total Impermeable Area (ha)**
1A West	Mochdre West	0	600	600	1.49
1A East	Mochdre East	600	1670	1070	1.47
2A	Dolfor	1670	2600	930	2.71
2B	Dolfor	2600	2770	170	0.29
3	Vastre	2770	4100	1330	1.68
4	Kerry Road	4100	4500	400	0.93
5	Railway	4500	5500	1000	1.39
6	Glan Hafren	5500	5800	300	1.027
Aggregated outfalls					
2A + 2B	Dolfor	1670	2770	1100	3

Proposed with mitigation

		Chainages of Catchment			
Catchment Ref	**Catchment Name**	**West**	**East**	**Road catchment Length (m)**	**Total Impermeable Area (ha)**
1A West	Mochdre West	0	600	600	1.49
1A East	Mochdre East	600	1670	1070	1.47
2A	Dolfor	1670	2600	930	2.71
2B	Dolfor	2600	2770	170	0.29
3	Vastre	2770	4100	1330	1.68
4	Kerry Road	4100	4500	400	0.93
5	Railway	4500	5500	1000	1.39
6	Glan Hafren	5500	5800	300	1.027
Aggregated outfalls					
2A + 2B	Dolfor	1670	2770	1100	3

Mitigation

Treatment efficiency of			
Wet pond	**Bypass oil seperator**	**Detention basin**	**Parameter**
39	0	0	**Soluble**
62	0	60	**Sediment**
0	0.25	0	**Spillage**

Total permeable Area (ha)	Outfall Chainage	Outflow (l/s) to Q100	Receiving water feature	Low flow	BFI
1.19	50	unlimited	Trib River Severn	0.001	0.5
0.80	600	unlimited	Mochdre Brook	0.031	0.448
2.80	2500 - West of Dolfor Rd roundabout	unlimited	Trib River Severn	0.002	0.467
0.51	2600	unlimited	Trib River Severn	0.002	0.467
1.11	3650	unlimited	Trib River Severn	0.001	0.488
0.91	4400	unlimited	Trib River Severn	0.001	0.45
1.12	5500	unlimited	Trib River Severn	0	0.437
0.08	6050	unlimited	Trib River Severn	0.003	0.421

3.31	2600	0	Trib River Severn	0.002	0.467

Total permeable Area (ha)	Outfall Chainage	Outflow (l/s) to Q100	Receiving water feature	Low flow	BFI
1.19	50	5.1	Trib River Severn	0.001	0.5
0.80	600	4.8	Mochdre Brook	0.031	0.448
2.80	est of Dolfor Rd rou	9.7	Trib River Severn	0.002	0.467
0.51	2600	1.4	Trib River Severn	0.002	0.467
1.11	3650	7.6	Trib River Severn	0.001	0.488
0.91	4400	4	Trib River Severn	0.001	0.45
1.12	5500	2.9	Trib River Severn	0	0.437
0.08	6050	3	Trib River Severn	0.003	0.421

3.31	2600	11.1	Trib River Severn	0.002	0.467

					RST		EQS	
Downstream protected area?	**AADT**	**% HGV**	**AADT ID_Saturn Node ID**	**Hardness**	**Copper**	**Zinc**	**Copper**	**Zinc**
No	9385	5	1202	50-200	Fail	Pass	0.98	3.55
No	9385	5	1202	50-200	Pass	Pass	0.05	0.19
No	12037	8	1035	50-200	Fail	Pass	0.91	3.29
No	12037	8	1035	50-200	Pass	Pass	0.14	0.53
No	12037	8	1203	>200	Fail	Pass	1.08	3.88
No	12037	8	1203	50-200	Pass	Pass	0.69	2.52
No	13440	7	1203	50-200	Fail	Pass	0.91	3.28
No	13729	7	1087	50-200	Pass	Pass	0.31	1.13

No	12037	8	1035	50-200	Fail	Pass	0.98	3.51

					RST		EQS	
Downstream protected area?	**AADT**	**% HGV**	**AADT ID_Saturn Node ID**	**Hardness**	**Copper**	**Zinc**	**Copper**	**Zinc**
No	9385	5	1202	50-200	Pass	Pass	0.6	2.21
No	9385	5	1202	50-200	Pass	Pass	0.03	0.12
No	12037	8	1035	50-200	Pass	Pass	0.56	2.04
No	12037	8	1035	50-200	Pass	Pass	0.14	0.54
No	12037	8	1203	>200	Pass	Pass	0.66	2.39
No	12037	8	1203	50-200	Pass	Pass	0.43	1.56
No	13440	7	1203	50-200	Pass	Pass	0.56	2.08
No	13729	7	1087	50-200	Pass	Pass	0.19	0.71

No	12037	8	1035	50-200	Pass	Pass	0.6	2.18

Sediment						
Accum	Extent	Result	Spillage risk	Mitigation required?	Magnitude of impact	Significance of effect
0	97	Pass	9597	Yes	Minor Adverse	Slight/Moderate
0.02	55	Pass	31360	No	Negligible	Neutral
0	177	Fail	5715	Yes	Moderate Adverse	Moderate/Large
0	19	Pass	96184	No	Negligible	Neutral
0	110	Fail	12294	Yes	Moderate Adverse	Moderate/Large
0	61	Pass	7015	No	Negligible	Neutral
0	91	Pass	8515	Yes	Minor Adverse	Slight/Moderate
0	67	Pass	7344	No	Negligible	Neutral
0	196	Fail	n.a	Yes	Moderate Adverse	Moderate/Large

Sediment						
Accum	Extent	Result	Spillage risk	Mitigation type	Magnitude of impact	Significance of effect
0	37	Pass	38386	Wet pond	Negligible	Neutral
0.02	21	Pass	125438	Wet pond	Negligible	Neutral
0	67	Pass	22861	Wet pond	Negligible	Neutral
0	8	Pass	192367	Detention basin (flow)	Negligible	Neutral
0	42	Pass	49177	Wet pond	Negligible	Neutral
0	23	Pass	28058	Wet pond	Negligible	Neutral
0	35	Pass	34060	Wet pond	Negligible	Neutral
0	26	Pass	29375	Wet pond	Negligible	Neutral
0	29	Pass	na	Detention basin (2b) wetland 2a	Negligible	Neutral

					Roundabout			
Catchment Ref	**Catchment Name**	**West**	**East**	**Road catchment Length (m)**	**Length**	**AADT**	**HGV (%)**	**Spillage factor**
1A West	Mochdre West	0	600	600	300	9385	5	3.09
1A East	Mochdre East	600	1670	1070				
2A	Dolfor	1670	2600	930	200	12037	8	3.09
2B	Dolfor	2600	2770	170				
3	Vastre	2770	4100	1330				
4	Kerry Road	4100	4500	400	200	12037	8	3.09
5	Railway	4500	5500	1000	100	13440	7	3.09
6	Glan Hafren	5500	5800	300	200	13729	7	3.09

No Junction				
Length	**AADT**	**HGV (%)**	**Spillage factor**	**Probability factor**
300	9385	5	0.29	0.6
1070	9385	5	0.29	0.6
730	12037	8	0.29	0.6
170	12037	8	0.29	0.6
1330	12037	8	0.29	0.6
200	12037	8	0.29	0.6
900	13440	7	0.29	0.6
100	13729	7	0.29	0.6

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Some cells have overlapping conditional formatting ranges. Earlier versions of Excel will not evaluate all of the conditional formatting rules on the overlapping cells. The overlapping cells will show different conditional formatting.	5 'Summary of WQ'!C34:D34 'Summary of WQ'!D35:D36 'Summary of WQ'!B33:B36 'Summary of WQ'!A33
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Llywodraeth Cymru
Welsh Government



A483/A489 NEWTOWN BYPASS

WFD Detailed Compliance Assessment Report

July 2014

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CLIENT: The Welsh Government
Transport

PROJECT: A483/A489 Newtown Bypass

Report Title: Detailed Compliance Assessment Report
Issue: Draft 3
Status: Finalised version for submission to AGC Team

V0.5	14/01/14	Draft for review	JD/LK /LM	KS	
Draft 1	17/01/14	Finalised version for submission to AGC Team	JD/LK /LM	KS	
Draft 1.2	06/03/14	Draft updated in line with proposed design changes	JD		
Draft 1.3	02/07/14	Draft for internal review	JD/LK	KS	
Draft 2	04/07/14	Finalised version for submission to AGC Team	-	-	
Draft 3	13/08/14	Final for ES	KS		
Issue	Date	Status	Written	Reviewed by	Authorised by Project Manager

Table of Contents

List of abbreviations

Abbreviation	Definition
AGC Team	Alun Griffiths Contractors Team
AIES	Assessment of Implications of European Sites
ASPT	Average Score Per Taxon
BMWP	Biological Monitoring Working Party
ECI	Early Contractor Involvement
EIA	Environmental Impact Assessment
ES	Environmental Statement
FFD	Freshwater Fish Directive
GCS	Good Chemical Status
GEP	Good Ecological Potential
GES	Good Ecological Status
GW	Groundwater
HGV	Heavy Goods Vehicle
HMWB	Heavily Modified Water Body
KS2	Key Stage 2
NRW	Natural Resources Wales
PRINCE 2	Projects In Controlled Environments 2
RBMPs	River Basin Management Plans
RIGS	Regionally Important Geological Sites
SAC	Special Area of Conservation
SINC	Sites of Importance for Nature Conservation
SPA	Special Protection Area
SSSI	Sites of Special Scientific Interest
TPOs	Transport Planning Objectives
TraCC	Trafnidiaeth Canolbarth Cymru
UKBAP	United Kingdom Biodiversity Action Plan

Abbreviation	Definition
WelTAG	Welsh Transport Planning and Appraisal Guidance
WFD	Water Framework Directive
ZoI	Zone of Influence

1. The Project

1.1. Context

The Welsh Government proposes to provide a bypass to the south of the town of Newtown in Powys, which will link the A489 and A483 Trunk Roads.

Newtown is a pinch point on the network and the junction of the A483 and A489 regularly suffers from traffic congestion. The A483/A489 at Newtown forms part of the north–south and east–west transport corridors linking areas such as Mid Wales and the West Midlands in England. Further industrial development of Newtown is believed to be hampered by transport/congestion issues.

Historically, extensive work has been undertaken to identify traffic problems in Newtown, Powys, dating back to 1969 when a study to investigate possible bypass routes was commissioned because of the proposed expansion of the town. The result of this study led to a Preferred Route being announced and protected in 1973.

The protection of the route was relaxed in 1989 and certain developments have encroached onto the protected route at the south-western end and on Upper Dolfor Road. Over the years the area has seen industrial development along the trunk road corridor together with housing within the town and more recently the development of a number of retail stores having direct access onto the trunk road.

1.2. Background

The Welsh Government commissioned an independent study to examine the transport problems associated with the A483(T) and A489(T) through Newtown. The Newtown Planning Objectives and Pre-Appraisal Report (February 2006) concluded it was unlikely that further traffic management measures, improvements in public transport or a combination of such measures, would have a significant impact on alleviating the problems. A road improvement or bypass option, which removes the low headroom restrictions and reduces congestion within the town, was likely to be the only acceptable solution.

In December 2007 the Welsh Government commissioned a Key Stage 2 (KS2) Study to investigate options to resolve the transport problems in Newtown. The study was conducted and options appraised in accordance with the Welsh Transport Planning and Appraisal Guidance (WelTAG), taking into account the numerous policies, plans and strategies including undertaking a Health Impact Assessment. The study placed specific emphasis on the social, economic and environmental impacts.

A Public Consultation Exhibition was held between 8-10th September 2009 in Newtown and in October 2010 the Deputy First Minister announced a preferred route which has been protected for planning purposes. Further Public Consultation Exhibitions have been held by the AGC Team in July 2013 and April 2014. A revise TR111 was announced by the Minister in March 2014.

1.3. The Scheme

The A483/A489 Newtown Bypass is a 5.8km bypass to the south of Newtown. It would commence at the new A489 'Llanidloes Roundabout' to the west of Newtown adjacent to the River Severn and would pass through the Glandulas Holiday Home Park. Flood compensation would be provided as the Scheme passes across floodplain and a section of known Roman Road would be left in situ within the flood compensation area. An overbridge would be provided to access the southern section of the Holiday Home Park and a new section of bridleway.

The Scheme would pass into cutting before passing over the Mochdre Brook on a clear span bridge. The structure would also cross Mochdre Lane and the upper Mochdre Lane. An underpass would be provided to the east of the Mochdre Bridge to facilitate access south of the Scheme for Coleg Powys. It would pass across the agricultural fields on embankment and in cutting to accommodate the undulating landform until Ch 1200 where there would be a cutting through Castell y Dail Wood which lies to the north of the Iron Age fort and to the south of Castell y Dail House (Listed Structure).

The Scheme would continue to the south of Mochdre Industrial Estate eastwards over Dolfor brook. It would cross an area of high ground in cutting prior to crossing over the Middle Dolfor Road and under the Upper Dolfor Road on a three span bridge. The Scheme would tie into the existing A483 to the south of the Dolfor Road Roundabout adjacent to the entrance to Black Hall Farm.

There would be a new link road between the Dolfor Road Roundabout and the Lower Dolfor Roundabout from which connecting roads would tie in to the Mochdre Industrial Estate along Hoel Ashley and into Newtown along Dolfor Road.

From Upper Dolfor Overbridge the Scheme would pass in cutting through agriculture pasture then on embankment over Brimmon Farm Underbridge and Brimmon Lane Underbridge followed by a slight cutting to Kerry Road Junction. Kerry Road Roundabout would be at grade and adjacent to Lower Brimmon Farm.

The Scheme would be in cutting under Wern Ddu Overbridge and then on embankment as it goes over the railway and the over Pool Road Underbridge to A483 Pool Road Roundabout where it would tie in with the existing A483. From the Roundabout there would be a link back into Newtown under Pool Road Underbridge.

1.4. The Project Objectives and reason for the Project

1.4.1. Welsh Government Objective and Mission Statement

The Welsh Government's objective is to provide a bypass to the town of Newtown in accordance with the findings of the KS2 scheme, and to include the commitments made at the Public Consultation undertaken as part of this study. This is to be carried out through appointment of a design and build Contractor under an Early Contractor Involvement (ECI) contract to be managed following the principles of PRINCE2 project management system and to deliver the works to programme, budget, and with due regard to the Welsh Ministers policies.

The Welsh Government's mission is to:

> *"Promote the vision and transport strategy described in the Welsh Government's 'One Wales: Connecting the Nation', the Wales Transport Strategy, and the National and Regional Transport Plans".*

1.4.2. Scheme/Planning Objectives

Seven specific Transport Planning Objectives (TPOs) have been identified for the Scheme. These will be achieved by the successful ECI Contractor and several other stakeholders, namely Powys County Council/Trafnidiaeth Canolbarth Cymru (TraCC) (Objectives 1, 4 and 5) and Welsh Government (Objectives 2, 3, 6 and 7). The objectives are detailed below:

Objective 1 – Maintain economic base

- Maintain economic base of Newtown measured by levels of local employment by the date in the local development plan (2025).

Objective 2 – Meeting relevant environmental targets

- Within Newtown settlement boundary limit and within 200 m of the Scheme;
- Meet targets and comply with appropriate environmental legislation and policies by 2018;
- Reduce greenhouse gas emissions along Pool Road and New Road by 3 % from 2008 levels, by 2018 (in accordance with Wales Transport Strategy).

Objective 3 – Removing through traffic from local roads

- Reduce through traffic on Heol Treowen, Plantation Lane and Milford Road by 50 % over 2008 levels by 2018;
- Reduce HGVs on Heol Treowen, Plantation Lane by 90 % from 2008 levels, by 2018.

Objective 4 – Increasing level of usage for non-car forms of transport

- For travel with origin and destination within Newtown, achieve modal shift of 10 % from car to non-car forms of transport (cycling, walking and public transport), over 2008 levels, by 2018;
- For travel with origin or destination within Newtown, achieve modal shift of 2 % from car to public transport, over 2008 levels, by 2018.

Objective 5 – Integration of public transport

- Within Newtown limit interchange penalty linking bus services and train services to 20 minutes, by 2018;
- Within Newtown, during morning and evening peak hours (0700–0900 and 1600–1800) limit interchange penalty between bus services to 10 minutes, by 2018.

Objective 6 – Improve journey time consistency (North–South, East–West)

- Reduce journey times during morning and evening peak hours (0800–0900 and 1615–1715) on A489/A483 between A470/A489 junction (Caersws) and A483/B4389 junction (Aberbechan junction) by 10 % by 2018;
- Reduce journey times during morning and evening peak hours (0800–0900 and 1615–1715) on A489/A483 between A483/unnamed C class Road at 'The Dingle', and A483/B4389 junction (Aberbechan junction) by 10 % by 2018;
- Reduce journey times during morning and evening peak hours (0800–0900 and 1615–1715) on A489/A483 between A483/unnamed C class Road at 'The Dingle', and A470/A489 junction (Caersws) by 10 % by 2018.

Objective 7 – Reduction in accidents

- Within Newtown settlement boundary limit, reduce road traffic accidents on A483(T), A489(T), Heol Treowen, Plantation Lane and Milford Road by 25 % by 2018.

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2. Introduction

2.1. Legislative Background

The Water Framework Directive (WFD) (2000) requires all natural water bodies to achieve both Good Chemical Status (GCS) and Good Ecological Status (GES). The River Basin Management Plans (RBMPs) outline the actions required to enable natural water bodies to achieve GES. Artificial and Heavily Modified Water Bodies (A/HMWB) may be prevented from reaching GES due to the modifications necessary to maintain their function. They are, however, required to achieve Good Ecological Potential (GEP), through the implementation of a series of mitigation measures outlined in the applicable RBMP.

New activities and schemes that affect the water environment may adversely impact biological, hydromorphological, physico-chemical and/or chemical quality elements (WFD quality elements), leading to a deterioration in water body status. They may also render proposed improvement measures ineffective, leading to the water body failing to meet its WFD objectives for GES/GEP. Under the WFD, activities must not cause deterioration in water body status or prevent a water body from meeting GES/GEP by invalidating improvement measures.

The overall ecological status of a water body is primarily based on consideration of its biological quality elements and determined by the lowest scoring of these elements. These biological elements are, however, supported by the physico-chemical and hydromorphological quality elements. Assessment of hydromorphological quality is not explicitly required for a water body to achieve moderate ecological status or lower. However, to achieve the overall WFD aim of GES or higher, hydromorphological quality must be considered within the classification assessment.

In addition to achieving the overall WFD aim of GES, a water body must pass a separate chemical status assessment, relating to pass/fail checks on the concentrations of various identified priority/dangerous substances.

A summary of key WFD concepts is presented in

Figure 2-1. This includes a definition of what a water body is in relation to this assessment.

2.2. Purpose of the report and process overview to date

The Scheme, would provide a bypass to the south of the town of Newtown in Powys, which will link the A489 and A483 Trunk Roads. The lead authority for the Scheme is the Welsh Government. The competent authority for WFD compliance is Natural Resources Wales (NRW). Figure 2-2 provides a site overview map showing water body information with respect to the Scheme elements; for an indication of the route length and location please refer to the black route.

To ensure that the Scheme complies with WFD legislation, a compliance assessment has been requested for review and approval by NRW. This will form part of the Environmental Statement (ES). An initial WFD compliance assessment was undertaken in November 2013 (The AGC Team November 2013 Ref: 5105742/ENV/WFD/RT207). Four water bodies were considered within this initial WFD 'screening' compliance assessment to determine if the Scheme could potentially physically impact them due to (but not limited to):

- The development of new roads, associated infrastructure and the widening of existing roads;
- Drainage infrastructure; or
- Receiving drainage from the Scheme.

This final report presents the detailed assessment during which there has been specific consideration of three of the four water bodies:

- 'The River Severn – conf Afon Dulas to conf R. Camlad (GB109054049310);'
- 'Mochdre Bk – source to conf R. Severn (GB109054044730);'
- 'Secondary Uplands – Secondary Combined (GB40902G203400).'

During the initial assessment stage potential impacts to the fourth water body, the Montgomery Canal, Southern section, (GB70910253) were scoped out. Originally the Mochdre Brook – source to conf R. Severn water body was also scoped out, however the detailed assessment has led to an improved understanding that some of the impacts to the tributaries need to be assessed against this water body. There is also an additional element associated with the Mochdre Brook Bridge crossing, which will also now require further consideration. For this reason, the water body has been scoped back into the assessment.

NRW has been consulted during the scoping, initial assessment and detailed assessment stages of this WFD compliance assessment. As part of this consultation, meetings were held with them on 26 September 2013 and 8 January 2014. NRW do not currently have guidance for the WFD compliance assessment, however as agreed with NRW, the compliance assessment has been based on Environment Agency draft guidance.

The initial assessment was based on early design outputs produced during 2013 and received by The AGC Team up until 21 November 2013. This latest detailed assessment takes account the final detailed design outputs as set out in

Table 2-1, received up until 15 July 2014.

This WFD compliance assessment has been carried out in parallel to the production of the Newtown Bypass draft Environmental Impact Assessment (EIA). If the Scheme is approved, the WFD assessment should be reviewed at the detailed design stage to ensure assumptions made at this early stage of the design process are still valid.

Table 2-1 Newtown scheme datasets used within the WFD Assessment

Source	Title	Date on dataset	Description
General Alignment and scheme			
The AGC Team	PDF name: P-5105742-FULL-SCHEME-Opt 5-1-I Title of figure: Overall scheme options 1C 2C 3B 4E	Undated but issued with NRW meeting agenda on the 06/01/14.	Overall scheme route with structures and culverts labelled.
The AGC Team	PDF name: P-5105742-FULL-SCHEME+SECTIONS-Opt 5-1-H	Undated but received 5/11/13.	Long profile sections through the full scheme.
The AGC Team	Environmental Statement Landscape – Landscape Mitigation Measures – Sheets 1-4 of 4 (Figure no 7.12a-d)	June 2014	Landscape mitigation – useful background including woodland planting, proposed attenuation ponds, proposed flood compensation storage areas etc.
The AGC Team (TACP)	Culvert Information Table 20.06.14 with mammal mitigation received 23/06/14	June 2014	Table summarising latest mammal mitigation measures.
The AGC Team (TACP)	RE: WFD culvert Info_RE: A483/A489 Newtown Bypass Frozen Design 1:2500 plans	Tue 24/06/2014 06:53	Email describing scheme mitigation and enhancement details.
The AGC Team (TACP)	PDF name A483NB-ATK-HGN-0100-DR-D-0001-0004-P2 Title of figure: General arrangement	9th June 2014, received 7th August 2014	Overall scheme route with updated structures and culverts
Structures			
The AGC Team	S02 Preliminary bridge options Mochdre Brook Bridge Sheet (1)	Dated 07/10/13 but received with NRW meeting agenda on the 06/01/14.	Cross section through Mochdre Bridge which indicates a 3 m wide access path on the left bank and a possible area

Source	Title	Date on dataset	Description
	[Drawing no A483NB-ATK-ST17-BR02-SK-S-0020-P1.2] Revision P1.2		of ground excavation within the bank.
The AGC Team	S02 Preliminary bridge options Mochdre Brook Bridge Sheet (2) [Drawing no A483NB-ATK-ST17-BR02-SK-S-0021-P1.1] Revision P1.2	Dated 07/10/13 but received with NRW meeting agenda on the 06/01/14.	Cross section through bridge and abutment.
The AGC Team	Options report S02 – Mochdre Bridge Option 1 – Steel / Concrete composite singe span [Drawing no. A483NB-ATK-ST17-OPT-SK-S-3.1] Revision P1	Dated 21/02/14	Updated plan and cross section through Mochdre Bridge.
The AGC Team	S05 Preliminary bridge options Lower Dolfor Road Sheet (1) [Drawing no A483NB-ATK-ST17-BR05-SK-S-0050-P1.2] Revision P1.2	Dated 07/10/13 but received with NRW meeting agenda on the 06/01/14.	Plan and cross section through Lower Dolfor Bridge.
The AGC Team	Options report SO5-Middle Dolfor Road Bridge Option 1 – Three Span Single Piers [Drawing no. A483NB-ATK-ST17-OPT-SK-S-4.3] Revision P1	Dated 21/02/14	Updated plan and cross section through Lower Dolfor Bridge.
The AGC Team	Culvert information table received internally 23/06/14	June 2014	Table summarising latest culvert designs.
Flood risk information			
The AGC Team	Flood risk locations and NRW flood map [Drawing no A483NB-ATK-WA00-XX-DR-Y-0010-P1] Revision P1.1	Dated 11/12/13 but received with NRW meeting agenda on the 06/01/14.	Baseline flood map.

Source	Title	Date on dataset	Description
The AGC Team	Flood risk locations - New modelling [Drawing no A483NB-ATK-WA00-XX-DR-Y-0011-P1] Revision P1.1	Dated 11/12/13 but received with NRW meeting agenda on the 06/01/14.	Modelled flood map/proposed attenuation pond locations.
Groundwater data			
The AGC Team	G336 Fieldwork Monitoring Records BHs	27/11/2013	Preliminary groundwater level data.
The AGC Team	Proposed Ground Investigation Provision Layout and Long Section	06/06/2013	Long section figure showing depth of cuttings and location of ground investigation boreholes.
Environment Agency	Water Framework Directive: Groundwater Quantitative Status Assessment (Classification)	Undated	Method statement for determination of quantitative status of groundwater body.
Environmental data (excluding data collected by the AGC Team in the preparation of the ES)			
APEM	Newtown bypass electric fishing surveys	July 2014	Electric fishing surveys

2.3. Environmental Objectives

The following environmental objectives (based on Articles 4.1, 4.8 and 4.9 of the WFD, and internal Environment Agency (Environment Agency July 2010, November 2010 and July 2012) guidance) were used to assess WFD compliance:

- Objective 1: The Scheme will not cause deterioration in any element of water body classification.
- Objective 2: The Scheme will not prevent the WFD status objectives from being reached within the water body or other downstream water bodies.
- Objective 3: The Scheme will not negatively impact critical or sensitive habitats within the water body[1].
- Objective 4: The Scheme will contribute to the delivery of the Severn RBMP (2009) which the assessed water bodies are situated within.

[1] Objective 3 is driven by the Environment Agency's wider responsibility for the protection of the UK's environmental assets rather than a specific requirement of the WFD legislation.

Figure 2-1 Background to the Water Framework Directive

WFD Objectives

The Water Framework Directive (WFD) is a European Directive, which sets out a strategic planning process for the purposes of managing, protecting and improving the water environment. The main objectives of the WFD are to:

Prevent deterioration in the status of aquatic ecosystems, protect them and improve the ecological condition of waters;
Aim to achieve at least 'Good Status' for all waters by 2015 (2021 or 2027 where fully justified within an extended deadline under Article 4.4);
Promote sustainable use of water;
Conserve habitats and species that depend directly on water;
Progressively reduce or phase out the release of individual pollutants or groups of pollutants that present a significant threat to the aquatic environment;
Progressively reduce the pollution of groundwater and prevent or limit the entry of pollutants; and
Help reduce the effects of floods and droughts.

Natural Resources Wales (NRW) are the lead authority for Wales for improving inland and coastal waters through better land management, regulating discharges, encouraging more sustainable use of water as a natural resource and processing environmental permits and licenses. NRW is also committed to creating better habitats for the wildlife that lives in and around water and a better quality of life for everyone.

WFD Classification

The WFD classification for a defined water body is produced by assessment of a wide variety of different 'elements' which includes:

'*biological elements'* such as fish, invertebrates, phytobenthos (which includes plants, macro-algae and phytoplankton);
'*supporting elements*' that include chemical measurements such as ammonia, dissolved oxygen, pH, phosphate, copper, zinc and temperature; and
'*supporting conditions*' (sometimes referred to as hydromorphology) that assess the physical attributes of the water body such as 'quantity and dynamics of flow' and 'morphology'.

The assessment given for each element is also accompanied by a measure of certainty in the result. The status classification is published in the River Basin Management Plan (RBMP) and provides a baseline condition against which compliance and future improvements can be measured.

Continued overleaf……

WFD Compliance

There are three key objectives against which the impacts of proposed works on a water body need to be assessed to determine compliance with the overarching objectives of the WFD:

Objective 1: The scheme will not cause a deterioration in any element of water body classification.
Objective 2: The scheme will not prevent the WFD status objectives from being reached within the water body or other downstream water bodies.
Objective 3: The scheme will contribute to the delivery of the relevant WFD objectives. In this case it will be what contribution the scheme can make towards the water body reaching its objective Good Ecological Potential (GEP) through planned RBMP mitigation measures.

The first two obligations must be met to avoid infraction of the WFD. The delivery of the third objective is central to the implementation of the WFD, where it can be supported through its operational activities. If it is considered that the scheme is likely to cause deterioration in water body status or prevent a water body from meeting its ecological objectives then an assessment would be made against the conditions listed in Article 4.7 of the WFD. Article 4.7 can be invoked if; 'new modifications' are of overriding public interest and/or the environmental and social benefits of achieving the WFD objectives are outweighed by the benefits of the new modifications to human health, safety and sustainable development; there are no significantly better environmental options that are technically feasible or not disproportionately costly; and all practicable steps for mitigation have been taken.

Artificial or Heavily Modified Water Bodies

These water bodies cannot achieve Good Ecological Status (GES) due to substantial modification, e.g. for flood risk management. Instead, they are required to reach GEP. The presence or absence of a set list of mitigation measures is used as a proxy for biological indicators. If all mitigation measures have been taken, the water body is assigned a preliminary tag of 'GEP or better'. Good Chemical Status is a prerequisite for GEP. 'Moderate or worse' is used if some mitigation measures are yet to be implemented. HMWBs may therefore have an element rated 'Poor' but not be considered 'Poor' in overall status.

Hydromorphology

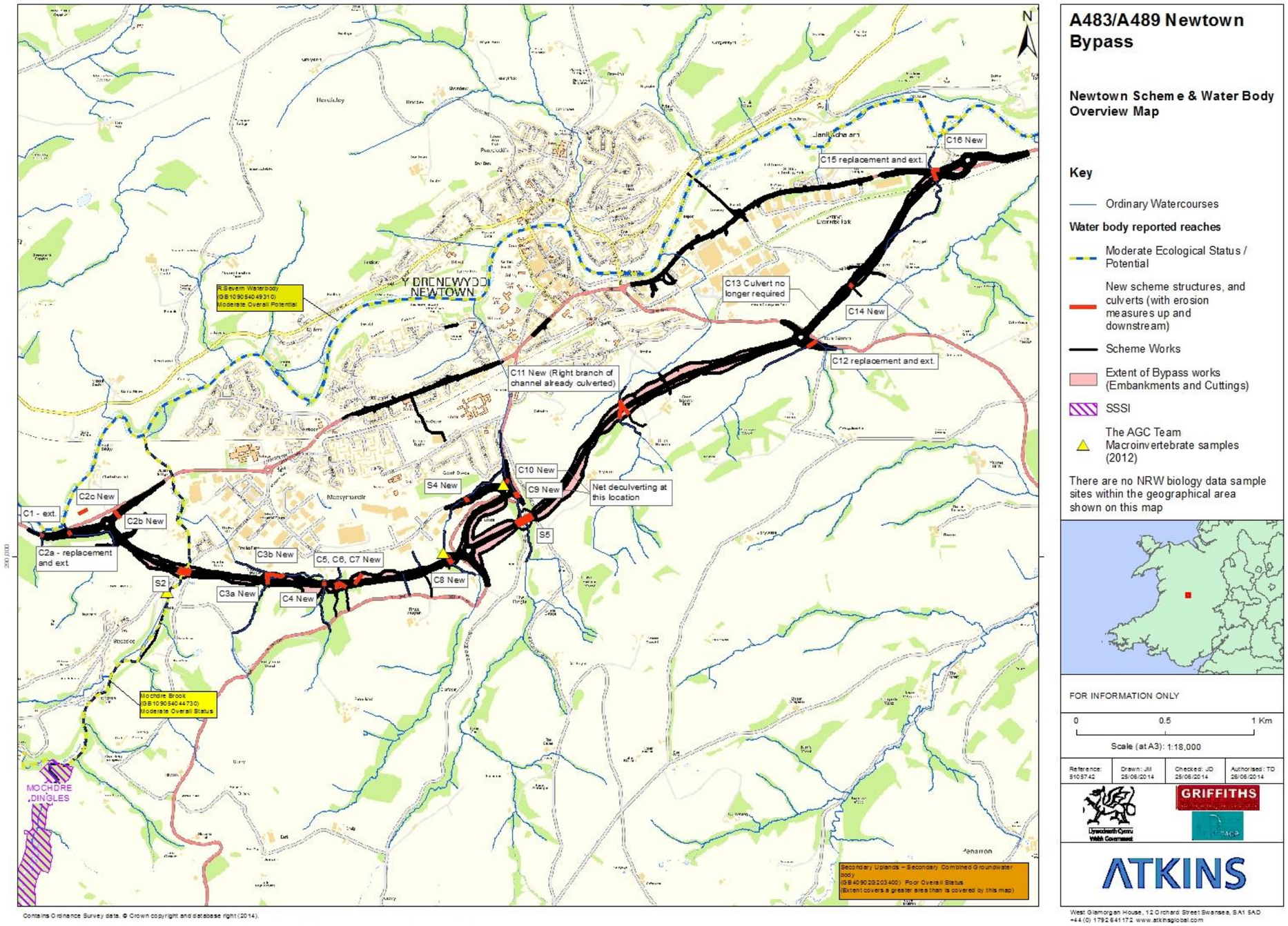
Hydromorphology is a term used in the WFD to describe the processes operating within, and the physical form of, a water body. The term encompasses both hydrological and geomorphological characteristics that, in combination, help support a healthy ecology. Hydromorphology is a supporting condition unless a water body is classified as being of 'High' ecological status. In these cases, hydromorphological elements contribute towards status classification. NRW provided Summary Guidance for the Water Framework Directive (WFD) Geomorphological Assessment as part of their response to the Environmental Scoping report (NRW, August 2013). This has been taken into account when defining the scope of the assessment.

What is a water body? (in relation to this assessment)

NRW do not currently have guidance for the WFD compliance assessment, however as agreed with NRW this assessment will be based on Environment Agency draft guidance. The Environment Agency's guidance note 'Water bodies for the Water Framework Directive'(Environment Agency July 2012) explains that the Directive defines a surface water body as a "discrete and significant element" of surface water such as a lake or reservoir or entire (or part) stream, river or canal, estuary or stretch of coastal water (out to 1 mile). They were identified in England and Wales as part of the characterisation process. The guidance further explains that 'the objectives for a river water body apply to every bit of the watercourse within the river body catchment' not just the reported network as shown on the Environment Agencies 'What's in Your Backyard' system.

The Environment Agency is in the process of developing guidance on the no deterioration requirements of the WFD and how to deal with local deterioration of reaches that have a perceived different status to that of the overall water body. For the purposes of this assessment, we will use best judgement to make an appropriate assessment

Figure 2-2 Site overview map showing water body information with respect to the scheme elements (NRW ecological and fisheries monitoring locations are beyond the extent of this map).



3. Newtown Bypass Scheme description and screening assessment

3.1. Description of the Scheme

The Scheme preferred route is a 5.6 km route to the south of Newtown. It links into the A489 Llanidloes Road to the west of Newtown at the A489 Llanidloes Road Roundabout. It crosses over Mochdre Brook then runs south of Mochdre Industrial Estate and interfaces with the A483 at the A483 Dolfor Road Roundabout. There will be a new direct link into the Mochdre Industrial Estate from the A483.

From the A483 roundabout the bypass runs in a north easterly direction and crosses over Middle Dolfor Road and under Upper Dolfor Road. The alignment then crosses agricultural land south of the Vastre and Dyffryn Industrial Estates.

It then crosses the main Cambrian railway line east of Dyffryn Industrial Estate before tying into the existing A483 Pool Road Roundabout to the east of Newtown.

In addition to the bypass the Scheme includes some online improvements along Pool Road and New Road through Newtown.

The Scheme will involve a combination of bridge crossings, culvert extensions, culvert replacements with longer extents of culverts, new culverts where the Scheme crosses a watercourse and some flood relief culverts. At some locations, a small amount of river realignment and deculverting is required. The scheme also involves excavation of the floodplain for flood alleviation and attenuation ponds at some locations. The Scheme involves cuttings of up to 24 m depth at various locations along the route. These elements are listed out more fully below. The element letter references relate to codes used within the initial assessment (The AGC Team November 2013 Ref: 5105742/ENV/WFD/RT207). Only those which were deemed to require consideration at the detailed assessment stage have been listed below *(which explains why A, B and H are missing i.e. they were screened out from requiring further assessment)*.

C. S5: New bridge over the Dolfor watercourse (within the Dingle Valley) which potentially may involve a short temporary realignment of the watercourse;

D. S4: Crossing (*now known to be a culvert*) over Green Brook (to the north of the roundabout at Dolfor);

E. Culvert extensions relating to minor watercourses that the Scheme crosses (C1, C2, C12, C15) (*further design details now indicate that C1 involves replacing the existing culvert headwalls only, and that C2, C12 and C15 now involve abandoning existing culverts but replacing them with new culverts of extended length along a slightly different alignments*);

F. New culverts relating to minor watercourses that the Scheme crosses (C3, C4, C5, C6, C7, C8, C9, C10, C11, C13, C14), (*C9 and C10 are now thought to likely require realignments or have deculverting associated as part of the works*);

G. The Scheme involves cuttings of up to 24 m depth at various locations along the route. The two largest cuttings[2] are close to Dolfor and are approximately 24 m (chainage 2300) and 15 m deep (chainage 2660). Other cuttings are approximately 8–10 m deep.

3.2. WFD initial assessment

An initial 'screening' assessment was undertaken in November 2013 using best available data to consider what scheme elements could impact on the hydromorphological, biological, physico-chemical or groundwater elements of the four water bodies (as explained further within the 'Purpose of the report and process overview to date' Section 2.2). It should be noted that the Environment Agency WFD guidance implies that temporary impacts, such as those resulting from construction works should be screened out of the WFD compliance assessment (with the assumption that they would be short in nature and the site would recover quickly). Construction impacts are considered within the Scheme ES 'Road Drainage and the Water Environment' Chapter 14.

At a meeting on 8 January 2014, NRW confirmed that the assessment was suitable and that the appropriate elements were screened in and out of the detailed assessment. However, due to further design information becoming available it was also agreed that the excavation of the floodplain at the Mochdre Brook Bridge crossing should also be screened into the assessment. To summarise, the elements that require further consideration in relation to specific water body objectives in this detailed assessment are as follows (see

Figure 2-1 for further detail and locations):

- New bridge impacts (Elements B, C and D) to the hydromorphological and biological (including fisheries elements and critical/sensitive habitats) of the R. Severn – conf Afon Dulas to conf R. Camlad water body.
- Culvert extension/replacement impacts (Element E) to the hydromorphological and biological (including fisheries elements and critical/ sensitive habitats) of the R. Severn – conf Afon Dulas to conf R. Camlad water body.
- New culvert or Multi-plate Arch structure impacts (Element F) to the hydromorphological and biological (including fisheries elements and critical/ sensitive habitats) of the R. Severn – conf Afon Dulas to conf R. Camlad water body.
- The impacts of cuttings (Element G) to the water balance and on surface water of the Secondary Uplands – Secondary Combined water body.

[2] Note that these depths of the largest cutting have been updated since the initial assessment (The AGC Team, 2013)

- Impacts that may lead to indirect, additional or cumulative impacts on the downstream R Severn – conf R Camlad to conf Bele Bk (GB109054049700) water body.

For completeness the element screened out at the initial assessment stage was Element A (direct impacts to the R Severn where the Scheme joins the A489). In addition, no potential impacts to the Montgomery Canal southern section (GB70910253) water body were identified. An Assessment of Implications of European Sites (AIES) was carried out in parallel to the WFD compliance process. This confirmed that it was considered that there is no potential for any direct or indirect negative impact resulting from pollution incidents during construction or operation (See Volume 3, Appendix E. 4 of the ES for further detail.) For this reason, the Montgomery Canal southern section (GB70910253) water body is not considered further in the detailed WFD Assessment.

Surface and groundwater quality impacts were assumed to be compliant with WFD objectives because they are being fully considered within the Scheme ES 'Road Drainage and the Water Environment' Chapter 14, and drainage will be designed to meet all relevant statutory thresholds.

4. Detailed background information and baseline descriptions

4.1. WFD detailed assessment – further Scheme details

This section provides a summary of scheme details based on design information up to July 2014. The 'S' (Structure), and 'C' (Culvert) code names correspond to the names on Figure 2-2. For consistency with the Newtown ES, a summary table and figure to show each of the watercourse crossing points and code names for the various unnamed watercourses and ditches, are presented in Appendix A of this report.

Element B. S2: New bridge over the Mochdre Brook

- A clear span bridge will be positioned (between Scheme chainage 500–600) over the Mochdre Brook approximately 40 m downstream of the existing B-road Mochdre Brook crossing.
- There will be a 3 m wide farm access track (composed of earth) positioned next to the west abutment approximately 4 m from the channel bank top.

Element C. S5: New bridge over the Dolfor watercourse

- A clear span bridge will be positioned (at Scheme chainage 2500) over the Dolfor Brook. Drawings indicate an approximately sized 8 m × 6 m bridge pier will be positioned adjacent to the brook on the right bank, and that it is likely to impinge on the brook's current course and constrain its lateral movement in the future. The design team has indicated that temporary brook realignment will be necessary during construction works. It is currently uncertain as to whether the brook would be returned to the former alignment post-construction or kept in the alignment of the temporary channel. Lengths of channel would broadly be similar whichever the case.

Element D. S4: Crossing over Green Brook

- Further design work indicates that this crossing (Scheme chainage 230-270 along culvert S4) will be a new box culvert of 1.5 m wide × 1 m high and that it will be 45 m in length. A raised ledge is proposed for mammal passage at this location. An arch structure has been confirmed as not being possible at this location due to visual landscape concerns. Retaining the natural bed by use of a depressed invert level has been considered but the design team consider that the risk of wash out at this location is higher than elsewhere because of the proximity of a large number of properties and the extensive culvert system downstream. Adding a rougher cemented in-layer to the bed of the culvert has not been considered feasible because of headroom constraints and future erosion concerns.
- Upstream of the box culvert, the channel as it appears from Mochdre Industrial Estate is to be realigned to a straighter alignment for approximately 75 m.
- Within this report this element will be discussed further together with the other new culverts under element F.

Element E. Culvert extensions or culvert replacements of extended length relating to minor watercourses that the Scheme crosses (C1, C2, C12, C15)

- Design information indicates that these culvert extensions/replacements will be pipe culverts. C1 requires only the existing culvert headwalls to be replaced, which is likely to lead to a very minimal extension of up to 1 m. The other three culverts are to be replaced by new culverts of extended length with existing culverts understood to be being abandoned. These replacement extensions (at C2a, C12 and C15) are likely to be comprised of double walled corrugated plastic pipes. The culverts will be set at similar levels to existing culverts and there is no inclusion within the designs for depressed invert levels with natural beds because of concerns about sediment washout and associated future maintenance issues.
- For the replacement culverts there will be headwall structures at the inlets and outfalls. It is envisaged that erosion at the transition points between the concrete structures and the natural channel will be managed by the placement of appropriately graded stone over the assessed length of the transitional zone. For the outfall, a short informal “stilling basin” may be created to dissipate energy from the culvert discharge.
- Dry mammal pipes are proposed at the following locations: C2a (approximately 40 m to the east of the new culvert), and at C15 (approximately 250 m to the east of the culvert), at Ch. 38600 to the east of Brimmon Lane Underbridge and to the south of C12.
- At C12, downstream of the culvert extension, a 77 m long realignment is proposed to avoid having to replace additional existing culverting under Lower Brimmon Farm, Kerry Road farm buildings.
- At C2a, the channel is to be realigned downstream of the new culvert up until the outfall to the River Severn.
- At C2, the intention is to recreate a wetland feature within close proximity to the new C2a culvert, but the exact design is still to be confirmed.

Element F New culverts or Multi-plate Arch culvert structures (see Appendix F of this report for further details of Multi-plate Arch structures) relating to minor watercourses that the Scheme crosses (C3, C4, C5, C6, C7, C8, C9, C10, C11, C13, C14)

- Design information indicates that these culverts will take several forms ranging from double walled corrugated plastic pipe culverts to box culverts to Multi-plate Arch bridge structure culverts.
- There will be headwall structures at the inlet and outfall of each culvert. It is envisaged that erosion at the transition points between the concrete structures and the natural channel will be managed by the placement of appropriately graded stone over the assessed length of the transitional zone. For the outfall, a short informal “stilling basin” may be created to dissipate energy from the culvert discharge.
- At locations where the watercourse hydromorphological/ecological value has been assessed as being poor (C3b, C5, C6, C7, C11, C14) a pipe type of culvert without a depressed invert will be used. (Note that at C13 a culvert has been confirmed as no longer required because there is no channel at this location).
- At the C3a and C8 locations (where watercourse hydromorphological/ecological value has been assessed as being reasonable or good) a Multi-plate Arch culvert

is to be used which allows for a total of 3 m of lateral channel movement within the structure. It comprises a modified form of natural bed development.

- At C4 a box type of culvert 1.2 m wide × 1.2 m high is proposed over a 51 m length, which will allow both mammal passage and bat passage along this watercourse. A depressed invert level with a natural sediment bed is confirmed as not possible due to concerns of sediment washout.
- At C9 and C10, 131 m of existing oversized pipe culvert length (within three separate culverts) is to be replaced by two box culverts of 59 m length, (2 m wide × 1.1 m high).
- At the C4, C9, C10 box culvert locations (as was discussed for the S4 box culvert under Element D), consideration of depressed invert levels and rougher beds within the culverts were made, but as previously explained neither were considered feasible.
- At C3b, C9, and C10, realignment and/or deculverting options are to be implemented as part of the new culvert solution. For example, the C9/10 solution includes in-stream rock weirs to improve the flow diversity and fish passage along the reaches that have been opened up.
- A combination of mammal resistant fencing (across the whole scheme), and raised ledges through box culverts will ensure mitigation for mammals as part of the installation of these new culverts.

Element G Cuttings of up to 24 m depth at various locations along the route.

The two largest cuttings are close to Dolfor and are up to approximately 24 m (chainage 2300) and 15 m deep (chainage 2660). Other cuttings are approximately 8–10 m deep. Where there are cuttings along the Scheme there are assumed to be filter drains at either side of the carriageway. These will be sized so that the water table remains below sub-base level of the carriageway.

4.2. Baseline data descriptions

4.2.1. Baseline data collection

Baseline data on the water bodies and the proposed Scheme used to inform this study were collected from the following sources:

- The Environment Agency's web-based "What's in your backyard?" mapping' was used to identify the WFD water bodies potentially affected by the works.
- The Severn RBMP Appendix B (2009) was used to gather data on the names, ID numbers, designation and classification details (including mitigation measures for HMWB) for each surface-water body.
- NRW provided water body 2013 summary sheets as part of a data request.
- NRW provided fisheries and macro-invertebrate data from sites on the Mochdre Brook and macrophyte and diatom data for the River Severn.
- Consultation with NRW staff from the Ecology and Fisheries Department to obtain further information, in particular relating to the quality of the fisheries within the Mochdre Brook and other watercourses relevant to the site.
- The water quality assessment of watercourses – Interim Ecological Survey 2012 (Capita, August 2012).

- The AGC Team provided information about the Scheme, including detailed design drawings, drainage and water quality assessment information and flood risk drawings.
- A walk over survey was carried out on 26 to 28 November 2013 to gain additional aquatic ecological and hydromorphological baseline information.
- NRW complete a 'river biodiversity, geomorphology and fisheries' walkover survey in January 2014 which has also informed this assessment. See Appendix D, within this report, for further information.
- APEM was commissioned by TACP to do a fisheries study of key reaches as agreed with NRW.

4.2.2. Summary of WFD water body classifications

The assessment has screened in elements B, C, D, E, F and G within the Bypass route (refer to Section 5.1). Proposed works could have a potential impact on the Mochdre Brook, the Dolfor watercourse (within the Dingle Valley), the Green Brook (a tributary to the Dolfor watercourse) and a number of minor watercourses. Element B and three of the new culverts under Element F (C3a, C3b, C4) require assessment against the Mochdre Bk – source to conf R Severn (GB109054044730) water body. All other 'surface water related' elements directly relate to the R. Severn – conf Afon Dulas to conf R. Camlad (GB109054049310) water body. In addition Element G is relevant to the groundwater body: Secondary Uplands – Secondary Combined (GB40902G203400).

Figure 2-2shows the location of the water bodies with respect to the Scheme elements and other features described above. Table 4-1 sets out the water body classification information for the three water bodies described above.

Table 4-1 Water body background data from 2013 classifications provided by NRW

Information	R Severn – conf Afon Dulas to conf R Camlad (GB109054049310)	Mochdre Bk – source to conf R Severn (GB109054044730)	Secondary Uplands – Secondary Combined (GB40902G203400)
Approximate water body reporting reach length (km)[3]	51.14	7.62	NA
Approximate water body area (km^2)[4]	NA	NA	2358
Hydromorphological designation	Heavily Modified (Drinking Water, Water Regulation and Water Storage)	Not designated	NA
Current Overall Status/Potential	Moderate	Moderate (Uncertain)	Poor
Current Ecological Status/Potential	Moderate (Quite Certain – WoE)	Moderate (Uncertain)	NA
Current Chemical Status/Potential	Good	Does not require assessment	Fail
Status objective	Good by 2027	Good by 2015	Good by 2027
Element causing a less than Good score	Phytobenthos – Moderate (uncertain)	Fish Moderate (Uncertain)	Drinking Water Protected Area Impact On Surface Waters
Supporting conditions	Mitigation measures – Good (In Place)	Mitigation measures – NA Quantity and dynamics of flows – Supports Good Morphology – Supports Good Chemical -	NA

[3] Length confirmed by NRW (May 2014) within SOC 25 document (it is assumed this length refers to reported water body lengths from the Severn RBMP)

[4] http://maps.environment-agency.gov.uk/wiyby/wiybyController?x=357683.0&y=355134.0&scale=1&layerGroups=default&ep=map&textonly=off&lang=_e&topic=wfd_rivers

Information	R Severn – conf Afon Dulas to conf R Camlad (GB109054049310)	Mochdre Bk – source to conf R Severn (GB109054044730)	Secondary Uplands – Secondary Combined (GB40902G203400)
		assessment not required	
Supporting elements (causing a less than Good score)	Specific pollutants – Moderate (Very Certain) Copper – Fail (Very Certain) Zinc – Fail (Very Certain) Diazinon (Uncertain) Dichlorvos (Very Certain)	NA	NA
Protected area designation or Sites of Special Scientific Interest	Freshwater Fish Directive	Not Designated	Drinking Water Protected Area

Further details on the water bodies have been provided by NRW. The water body summaries can be found in Appendix C of this report.

The River Severn at this location is a HMWB. The R. Severn – conf Afon Dulas to conf R. Camlad water body has been assessed as having a Moderate Ecological Potential, this relates to Moderate phytobenthos status. Relevant mitigation measures are considered to be in place including the measure below:

- There is an operating agreement in place to ensure flows are maintained to support environmental needs and to meet the needs of downstream abstractions.

The Mochdre Bk – source to conf R Severn (GB109054044730) is also assessed as having Moderate Ecological Status, resulting from Moderate fish classification. It is not a HMWB so there are no relevant mitigation measures.

The Secondary Uplands – Secondary Combined (GB40902G203400) is assessed as Poor overall water body status, with Overall Good Quantitative Status and Fail for Overall Chemical status. The Chemical status failure is related to a combination of the impact of abandoned former metal mines in the area.

All internationally designated sites for nature conservation within 30 km of the Scheme are shown in Volume 2, Figure 8.1 of the ES. The only internationally designated site within the Zone of Influence (ZoI)[5] for the Scheme is the Montgomery Canal Special Area

[5] The Zone of Influence (ZoI) concept is used to describe the area over which impacts may occur as a result of the Scheme. Clearly, the relevant ZoI will depend on the ecological receptor concerned. For example, an SAC designated for mobile species such as bats may

of Conservation (SAC), which is located approximately 840 m to the north-east of the Scheme at its closest point. The following designations are noted within the ZoI:

- Montgomery Canal SAC and Site of Special Scientific Interest (SSSI) approximately 840 m to the north east;
- Three additional SSSIs are all located within 2 km of the Scheme boundary to the south and west, Mochdre Dingles SSSI, Penstrowed Quarry SSSI and Gweunydd Penstrowed SSSI;

There are no local Sites of Importance for Nature Conservation (SINC) within the ZoI for the Scheme. Downstream from the R Severn – conf Afon Dulas to conf R Camlad (GB109054049310) water body there are 11 surface or estuarine water bodies along the River Severn/Severn Estuary. All of these water bodies have Moderate Overall Potential.

4.2.3. Hydromorphology baseline

A survey as part of the WFD assessment was undertaken by hydromorphologists and an aquatic ecologist to obtain data to support the detailed assessment on 26–28 November, 2013. At the time of survey, water levels were considered to be around average for the time of year. The proposed Scheme elements were examined at each watercourse crossing location (proposed new/extended culverts and bridges) to see whether mitigation or compensatory enhancements (to offset impacts) were needed.

The watercourses at each location were categorised dependent on their hydromorphology into the following four categories based purely on observations made in the survey:

- Ditch with flow (perennial).
- Ditch without flow (ephemeral).
- Open watercourse in poor condition.
- Open watercourse in reasonable/good condition.

The hydromorphological condition directly impacts available habitat and therefore the aquatic flora and fauna present. For each category a generic hydromorphological description is given below and example photographs can be seen in Figure 4-1. Specific baseline descriptions recorded following the site visit to each of the proposed structure and culvert locations can be found in Appendix B of this report.

Ditch with flow at time of survey (assumed to be perennial): Four out of the 20 watercourse locations examined were assigned to this category. The general hydromorphology of these channels included a straightened channel that had been historically or recently dredged and resembled more of the field drain than a natural open watercourse. Typically, they were less than 2 m bank full width and 1 m bank full depth and had some flow at the time of survey.

Ditch without flow at time of survey (assumed to be ephemeral): Five out of the 20 watercourse locations examined were assigned to this category. The general hydromorphology of these channels was either a ditch or a surface run-off depression where water would flow as storm run-off after rainfall events. No flow was observed at the

be considered within the ZoI at greater distance from the Scheme than an SAC designated for sedentary species or habitats such as ancient woodland, and the same may be true for undesignated receptors.

time of survey. Most channels were dry but some, such as at location C14 (see photo below), had standing water.

Open watercourse in poor condition: Seven out of the 20 watercourse locations were assigned to this category. The general hydromorphology of these channels included a modified channel which was already affected by existing culverts, and often had been straightened or historically realigned to the valley side. The banks along some of the channels such as at S5, downstream of S4 or C15 were artificial and so the channel profile was constrained. One pair of small watercourses in Castell-y-dail woodland (at C5/6) did not appear to have been modified but were vertically active, heavily shaded and there was presence of leaf litter. Some of these channels exhibited signs of recovery, such as at the S4 location.

Open watercourse in reasonable/good condition: Four out of the 20 watercourse locations examined were assigned to this category. The general hydromorphology of these channels included channels that had minimal modifications impacting on the location where scheme works are proposed. Generally they were natural headwater systems with sinuous profiles and fairly steep gradients often flowing through woodland or defined valleys. These channels exhibited a range of features including pool-riffle sequences (Mochdre Brook at S2 location), a knick point (Green Brook at C8 location), woody debris, gravel bars and undercutting of banks etc.

Figure 4-1 Examples of the different categories of watercourses

Ditch with flow at time of survey – photo example below is C12 (Tributary 5 of the R. Severn)	Ditch without flow at time of survey – photo example below is C14 (Ditch 18)
	

Open watercourse in poor condition – photo example below is S5 (Dolfor Brook)	Open watercourse in reasonable/good condition – photo example below is C8 (Green Brook/Black Brook)
	

4.2.4. Biological baseline

A desktop assessment was undertaken to characterise the ecology of the River Severn at, and downstream of, the locations of potential impact. A site visit by an AGC Team aquatic ecology staff member was also carried out on 26–28 November 2013 to visit the location of works along the route. This comprised a visual bank top inspection only. Observations from the site visit are reported below together with additional notes taken from a review of existing reports such as the Environmental Scoping Report (The AGC Team, June 2013), the Interim Ecological Survey, 2012 reports (Capita, August 2012) and surveys undertaken as part of the design development. Where additional ecological data from National Resources Wales were available these are also reported.

The relevant water bodies to the Scheme have been identified as the R Severn – conf Afon Dulas to conf R Camlad (GB109054049310), the Mochdre Brook – source to conf R Severn (GB109054044730) and the Secondary Uplands – Secondary Combined (GB40902G203400). Table 4-1 shows both the River Severn and Mochdre Brook water bodies are considered to have Moderate Ecological Potential.

4.2.4.1.1. Biological descriptions resulting from site visit.

As per the hydromorphological assessment generic biological descriptions are provided below with additional specific details provided in Appendix B of this report.

Ditch with flow at time of survey (assumed to be perennial)

These channels are primarily drainage ditches and although they are filled with water most of the time they offer limited ecological potential with no real channel features or substrate diversity. They are often dredged or modified and generally have limited biological connectivity to the River Severn.

Ditch without flow at time of survey (assumed to be ephemeral)

Minor ditches or surface run-off depressions used for land drainage; these channels are dry more frequently than wet. As a result, they have no channel features and limited or no associated riverine habitat recorded. Most have limited biological connectivity to the River Severn with culverts at their downstream extent. Substrate is generally grass or silt.

Open watercourse in poor condition

These channels are generally culverted within the vicinity, or downstream of, the proposed works, which therefore limits biological connectivity to main rivers downstream. Some channels such as S5, C9, C10 and C11 show some substrate diversity and even some marginal vegetation that could support spawning fish. However, in general most of the channels in this category have uniform cross sections, limited flow and habitat diversity. Japanese knotweed is widespread along one or two reaches (S5, C9 and C10).

Open watercourse in reasonable/good condition

Four channels were considered to be good enough to fall into this category (S2, C3a, C4 and C8). Channels S2 and C8 were the best examples, both demonstrating a variety of habitats and flow types including pools, riffles and glides, i.e. a variety of habitats for fish. In addition, all of the channels offered, to some extent, associated features of bank side roots, overhanging bows or woody debris offering potential cover for fish species. In some cases, however flow was limited such as C3a and C4 that had flow depths of 0.15 m or less. Channel S2 also had good substrate composition and potentially good biological connectivity with no culverts that were immediately obvious. The three other channels in this category are more limited in their biological connectivity, with culverts at, or downstream of, the proposed works location.

4.2.4.1.2. Designated sites

As has been mentioned above (Section 4.2.2) the section of the River Severn in Newtown does not have any ecological or nature conservation designation. The Severn Estuary is designated as both a SAC and Special Protection Area (SPA), however despite being part of the same watercourse, the designation is approximately 170 km to the south east and therefore the potential for indirect impacts is considered highly unlikely.

All international and national designated sites for nature conservation within 10 km of the Scheme are shown in Volume 2 Figure 8.1 of the ES. There are four sites within the vicinity of the Scheme all of which are located within 2 km of the western end of the Scheme, these are as follows;

1. Montgomery Canal SAC/SSSI – Approx 840 m to the North East of the Scheme and designated due to the presence of floating water-plantain (*Luronium natans*). The canal supports the largest and most extensive population of this species in Britain. The canal takes some water from the River Severn downstream of the point where minor watercourses crossed by the Scheme enter the River Severn. An Assessment of Implications of European Sites (AIES) was carried out in order to explore the potential for impact on the site resulting from pollution incidents, but it was not considered that there is potential for any direct or indirect negative impact during construction or operation (see Volume 3, Appendix E.4 of the ES for further detail).

2. Mochdre Dingles SSSI – This site is >1 km to the south (upstream) of the Scheme boundary. It supports semi-natural broadleaved woodland and in particular species rich upland ash woodland. The Mochdre Brook runs through the site. The only element directly affecting the Mochdre Brook is a wide span bridge considerably downstream of the SSSI, as such it is not considered that there is an impact pathway for this site to be affected.

3. Penstrowed Quarry SSSI – This geological SSSI lies approximately 2 km to the south west upstream of the Scheme. It demonstrates an important section of Penstrowed Group sedimentary rocks.

4. Gweunydd Penstrowed SSSI – This SSSI lies approximately 2 km to the south-west upstream of the Scheme. This SSSI supports unimproved neutral grassland with some unimproved acid grassland and Montgomeryshire's best known population of lesser butterfly orchid (*Platanthera bifolia*).

It is assumed that the latter two sites are not in hydraulic continuity with the Scheme area. In a meeting on 8 January 2014 with NRW, they confirmed that there were not groundwater fed wetland sites linked to this aquifer. Therefore, none of these SSSI sites have been assessed within the potential impacts assessment.

There are no local SINC or Regionally Important Geological Sites (RIGS) within the ZoI for the Scheme.

Protected habitats are also found within the study area including ponds, wet woodland, and streams which are Priority Habitats on the UKBAP (The AGC Team, December 2009 Ref: HHC 91371A/ 27a).

Freshwater Fish Directive (now repealed)

This Directive was repealed at the end of 2013 by the EC WFD. The EC Freshwater Fish Directive (FFD) (2006/44/EC) was originally adopted on 18 July 1978 but consolidated in 2006. Now officially part of the WFD, the legislation still seeks to protect those fresh water bodies identified by Member States as waters suitable for sustaining fish populations. For those waters it sets physical and chemical water quality objectives for salmonid waters and cyprinid waters.

Although none of the minor watercourses potentially affected by the proposed Scheme are designated under the FFD, the Mochdre Brook is designated for salmonids in two locations;

- River Severn Confluence Mochdre Brook to Newtown sewage treatment works SO 0865 9080 – SO 1397 9275.
- River Severn Confluence Afon Cerist to confluence with Mochdre Brook SO 0250 9149 – SO 0865 9080.

The Severn downstream of the Scheme location is also designated for Salmonids at the following two locations.

- River Severn Newtown sewage treatment works to confluence of The Mule SO 1397 9275 – SO 1594 9480
- River Severn Confluence of The Mule to Welshpool sewage treatment works SO 1594 9480 – SJ 2352 0726

4.2.4.1.3. Designated species

Within the proposed study area records and surveys indicated otters (*Lutra lutra*) were present on several watercourses crossed by the Scheme (PB/TACP, December 2009 Ref: HHC 91371A/ 27a). Subsequent repeat surveys undertaken during May 2012 found evidence of otters on the River Severn, Mochdre Brook, Green Brook, Dolfor Brook and

a small stream west of Vastre Industrial Estate. An otter spraint was also found on the unnamed watercourse to the extreme western end of the Scheme immediately adjacent to the River Severn. A culvert beneath the A486 Kerry Road was also found to have been used as a holt or lying up site by otters during NRW's inspection in January 2014.

No evidence of Water Vole (*Arvicola* terrestris) was found and it was considered unlikely that this species would be present within the study area. White-clawed Crayfish (*Austropotamobius pallipes*) were also considered unlikely to be present given the populations of Signal Crayfish (*Pacifastacus leniusculu*) present. Surveys undertaken to date suggest Great Crested Newts are not present within the study area (Welsh Government, 2013).

Bullhead (*Cottus gobio*) and Atlantic Salmon (*Salmo salar*) were confirmed as present within the Mochdre Brook.

Other protected species, such as bats or dormice have not been mentioned in this section as they are not considered to be directly related to the WFD objectives set out within Section 2.3.

4.2.4.1.4. Review of Fish data

Fisheries: NRW have provided the latest RBMP classifications for the relevant water bodies. For the Fisheries element, the Severn is classified as Good and the Mochdre Brook as Moderate. NRW also provided fisheries information which covered the Severn and the Mochdre Brook, although none of the data covered the more minor watercourses under consideration. The data show that Salmon (*Salmo salar*), brown or sea trout (*Salmo trutta*) and Bullhead (*Cottus gobio*) were present in September 2011 at locations SO 07226 88430 and SO 08218 86198 2.5 km and 4 km upstream of the proposed development on the Mochdre Brook. Salmon, Bullhead, Eels (*Anguilla Anguilla*), Stone loach (*Barbatula barbatula*) and Minnow (*Phoxinus phoxinus*) are present at various locations surveyed on the Severn. Consultation with NRW (Jason Jones, fisheries officer at NRW, January 2014) has confirmed that the Mochdre Brook is a valued fisheries habitat used by Salmon, and also possibly Eel, and although there are obstructions further upstream, there are currently no impoundments or obstructions to movement around the location of the proposed bypass or downstream. NRW consider that the other watercourses, in particular, the Dolfor and Green Brooks constitute reasonable Brown Trout habitat (and possibly also habitat for Bullhead) and they expect both of these watercourses to support native Brown Trout populations. Other watercourses will also have value in supporting local coarse fish populations. NRW had no fisheries survey data covering the exact locations of the scheme and as a result they carried out a walkover survey in January 2014. The results of the survey identified the existing quality of each of the locations affected together with potential mitigations or enhancements. A copy of NRW's report can be located in Appendix D of this report. NRW recommended that at structures C3a and C8 changes to culvert design could be considered and at C9 and C10 fish habitat improvement works could improve connectivity for fish to the Dingle Brook. The report can be found in full in ES Volume 3, Appendix E.5. In July 2014 TACP commissioned APEM to undertake electric fish surveys of particular reaches that were to be impacted by the scheme. No fish were found in their survey. Fish were deemed to be largely absent from the affected reaches which was thought to be largely a result of downstream culverting and a lack of suitable habitat at culverts C3a and C11. The river around culvert S5 was deemed to have suitable habitat but culverts downstream have

limited the possibility of fish migrating up to this location. The full APEM report is located the ES Volume 3, Appendix E.4.

Macroinvertebrates: The latest 2013 RBMP classification provided from NRW for the relevant water bodies shows the Severn to be High for Macroinvertebrates. The Mochdre Brook is not classified. NRW provided biosys data for various locations along the River Severn and the Mochdre Brook, see Table 4-2. Data for the Mochdre Brook are very old but all the data in general indicate that water quality in the Mochdre Brook and the River Severn is good, Biological Monitoring Working Party (BMWP) on the Mochdre Brook are all >100 indicating good diversity and quality, Average Score Per Taxon (ASPT) maxima are good and in general above six, again indicating good water quality and for all three locations the number of Taxa indicates a diverse macroinvertebrate community. No data were available covering the various drainage channels feeding into the River Severn.

A water quality assessment (sampling macroinvertebrates), done by The AGC Team in 2012, used BMWP methodology to assess three locations: Mochdre Bridge, SO 087 898; Stream adjacent to the A483, SO 106 904; and, stream alongside the Industrial Estate, SO 102 900. Water quality was considered to be very high throughout the proposed route and particularly good on the Mochdre Brook.

Table 4-2 Macroinvertebrate data provided by NRW

Survey Locations	Mochdre Brook various locations 1996–98		Caersws on R. Severn SO 03200 91700 7.5 km upstream 1995–2009		Aberbechan on R Severn SO 14500 93500 2.5 km downstream 1995–2008	
	Min	Max	Min	Max	Min	Max
BMWP	129	179	70	189	35	159
ASPT	6.14	7.16	5.38	6.96	5.27	6.91
Number of Taxa	20	25	13	30	6	25

Macrophytes/Phytoplankton: The River Severn is now classified as Moderate for phytoplankton (NRW 2013). This status has been upgraded from Poor in the 2009 RBMP. No other NRW data were available covering macrophytes and diatoms pertinent to the development area, data were available on the River Severn but this was not considered relevant to this assessment.

4.2.5. Groundwater baseline

4.2.5.1. Geology

4.2.5.1.1. Superficial Geology

The Scheme crosses post glacial deposits, composed of Head Deposits, Alluvial Fan Deposits, Landslide Deposits and Alluvium. Underlying these (or outcropping where the

post glacial deposits are absent) are glacial deposits of Morainic Deposits and Glacial Till (based on BGS 1:50,000 scale mapping).

4.2.5.1.2. Bedrock Geology

The bedrock consists of formations of Silurian age. The uppermost formation is the Bailey Hill Formation, which is composed of interbedded sandstone and siltstone, and is present in the topographically high areas at the top of the valley side. Stratigraphically underlying the Bailey Hill Formation, is the Dingle Mudstone Member. This is composed of siltstone and generally subcrops beneath the superficial deposits along the majority of the bypass route. In the base of the valley, the Nantglyn Flags Formation subcrops beneath the superficial deposits. The Nantglyn Flags Formation is composed of mudstone (based on BGS 1:50,000 scale mapping).

4.2.5.2. Aquifer Classifications

4.2.5.2.1. Aquifer Designations

Superficial Geology

The Alluvium is classified by the Environment Agency as a Secondary A aquifer (Environment Agency, 2014). This is defined as permeable layers capable of supporting water supplies at a local rather than strategic scale, and in some cases forming an important source of baseflow to rivers. These are generally aquifers formerly classified as minor aquifers.

The Alluvial Fan deposits have been classified as a Secondary Undifferentiated aquifer (Environment Agency, 2014). This classification applies to strata where it has not been possible to attribute either category A or B to a rock type. In most cases, this means that the layer in question has previously been designated as both minor and non-aquifer in different locations due to the variable characteristics of the rock type.

The Head Deposits and the Alluvium have been classified as Unproductive Strata (Environment Agency, 2014). These are defined as rock layers or drift deposits with low permeability that have negligible significance for water supply or river baseflow.

Bedrock

All three formations, The Bailey Hill Formation, Dingle Mudstone Member and Nantglyn Flags Formation, are designated as Secondary B aquifers (Environment Agency, 2014). The Environment Agency classify these as aquifers of predominantly lower permeability layers which may store and yield limited amounts of groundwater due to localised features such as fissures, thin permeable horizons and weathering. These are generally the water-bearing parts of the former non-aquifers.

4.2.5.2.2. Groundwater Vulnerability

Superficial Geology

Much of the superficial deposits are classified as Minor Aquifer, High Leaching Potential by the Environment Agency. There are also pockets of Minor Aquifer, Intermediate Leaching Potential (Environment Agency, 2014).

4.2.5.2.3. WFD Groundwater body Status

The groundwater body at the site is named the Severn Uplands Secondary Combined water body (GB40902G203400). This groundwater body status is based on the bedrock geology, and does not include superficial geology (pers comm. Carol Williams, Environment Agency, 13 January 2014).

The overall water body status is classified as Poor, however, this is driven by the Poor classification of Chemical groundwater (GW) Status and the Overall Qualitative Status is Good. This classification was made in 2013 and all categories have remained the same since the previous classification of 2009. This is summarised in Table 4-3.

Table 4-3 Water Body Status Classification for Severn Uplands Secondary Combined

	2009 Classification	2013 Classification	Predicted 2015 Classification
Overall Water Body Status	**Poor**	**Poor**	**NA – (Good by 2027)**
Overall Quantitative Status	Good (low confidence)	Good	Good
Impact on Surface Waters	Good (low confidence)	Good	Good
Impact on Wetlands	Good (high confidence)	Good	Good
Saline Intrusion	Good (high confidence)	Good	Good
Water Balance	Good (high confidence)	Good	Good
Overall Chemical (GW) Status	Poor (high confidence)	Poor	Poor
Drinking Water Protected Area	Poor (high confidence)	Poor	Poor
General Chemical Test	Good (low confidence)	Good	Good
Impact on Surface Waters	Poor (high confidence)	Poor	Poor
Impact on Wetlands	Good (low confidence)	Good	Good
Saline Intrusion	Good (high confidence)	Good	Good

4.2.5.2.4. Source Protection Zone

There are no Source Protection Zones along the route of the Newtown Bypass. The nearest Source Protection Zone is 6.5 km to the west, and is associated with Severn Trent Water Limited's Llandinam source.

4.2.5.3. Groundwater Level

Groundwater levels were monitored as part of the Ground Investigation (The AGC Team, 2013). Preliminary interpretation of results of monitoring during the Ground Investigation works (27 November 2013) and three post field work monitoring rounds (between January and June 2014) show that groundwater levels are generally quite shallow across the site in the superficial deposits (typically 1–2 m below ground level). A notable exception to this is around Dolfor Hill (near the Dolfor Brook), where the groundwater level is deeper at around 10 m below ground level. This is also the location of the deepest cutting.

Groundwater flow is likely to be generally directed from the higher ground of the interfluves towards the River Severn in a broadly south to north direction. The flow is likely to be channelled into the superficial deposits along the valleys but will be locally influenced by variations in geology. Groundwater is likely to be in continuity with the surface water system, with groundwater discharging as baseflow to the main river and side brooks at times when the groundwater level is high. The shallow depths to groundwater in the vicinity of the Newtown Bypass, in the valley setting, are in keeping with this model.

4.2.5.4. Groundwater Receptors

4.2.5.4.1. Groundwater Abstractions

There is one licensed groundwater abstraction within 1 km of the route of the bypass. This is a private abstraction belonging to a property called Glanhafren Hall (abstraction licence number 18/54/01/0441). The licence volume is unknown, but the volume abstracted is likely to be small since the property is domestic.

There are also two licensed groundwater abstractions that are located just over 1 km to the west of the Scheme.

There may be other groundwater abstractions that are unlicensed, and therefore not registered with NRW. The maximum abstraction rate for an unlicensed abstraction is 20 m^3/day.

4.2.5.4.2. Wetlands

There are no designated groundwater dependant terrestrial ecosystems within 1 km of the Scheme.

5. Detailed WFD compliance assessment

This section sets out a summary and interpretation of evidence relevant to the assessment of individual scheme elements. There is discussion regarding the hydromorphology, biology and hydrogeology, where relevant. An assessment of impacts to the downstream R Severn – conf R Camlad to conf Bele Bk water body is provided in Section 5.4, and cumulative impacts are considered within the summary Section 5.3. Recommended mitigation and enhancement measures are also summarised in Section 5.3, shown on a mitigation and enhancement figure (see Appendix E of this report), and are provided in detail in Table 5-1.

5.1. Introduction to the assessment of the hydromorphology, biology and groundwater elements

The physical stream habitat is defined by hydromorphology (i.e. flows and geomorphology) and provides a foundation for the fluvial ecosystem. Hydromorphological change can therefore lead to ecological change. Key hydromorphological elements (as defined by the WFD legislation) to consider within the assessment include:

Hydrological regime:
- Quantity and dynamics of water flow
- Connection to groundwater bodies

River continuity:
- Migration of aquatic organisms
- Sediment transport

Morphological conditions:
- River depth and width variation
- Structure and substrate of the river bed
- Structure of the riparian zone

Hydromorphological conditions and the structure and substrate of the river bed are determined by the interaction of flows, sediment supply and transport dynamics (i.e. rates and patterns of erosion and deposition). Some physical intervention can be beneficial because physical change can maintain, and improve, biodiversity.

Linked to the hydromorphology is the aquatic ecology. The biological elements that should be considered include: the composition and abundance of phytoplankton, macrophytes and phytobenthos, invertebrates and fish communities, as well as critical species (protected sites are ruled out earlier – see Section 4.2.4.1.2).

Usually tributary watercourses would be considered relevant to providing supporting habitat for the FFD and for European eel migratory routes. As discussed in Section 4.2.4.1.4, NRW data have indicated eels are present at certain times of year on the Severn, however no fisheries survey information is currently available for the watercourses affected to confirm their presence/absence in the locality of the Scheme. It

is, however, unlikely that eels will be present in any of the watercourses affected by the scheme except the Mochdre Brook (NRW May 2014 SOC 025 comment ref 78e).

In terms of the hydrogeology there are four elements used to consider the quantitative quality of a groundwater body: impact on surface waters, impact on wetlands, saline intrusion and water balance.

The water balance test examines the available resource of an aquifer and the amount of water required to support the ecology of dependent rivers and abstractions. The test is composed of two components; a comparison of long term average recharge against long term average abstraction, and an examination of the effects of abstraction on low flows.

The surface water test seeks to establish whether groundwater abstraction could be resulting in deterioration in ecological status of any of the surface water bodies supported by the groundwater body.

Impact on wetlands is assessed on the source-pathway-receptor model, where abstractions or regional drainage would be a source, the pathway is hydraulic connectivity between the abstraction, groundwater body and wetland, and the dependency of the wetland ecology on groundwater is the receptor. Each of the aspects are given a score from 0–3 and a total score between 0 (no risk) and 9 (high risk) is generated.

Saline intrusion is of no risk (high confidence) where there is no source for saline intrusion.

5.2. Potential Impacts

The Scheme has a large number of parts including culverts (of several types), bridges, realignments, deculverting and deep cuttings. To avoid repetition, the potential generic impacts are outlined below for the individual hydromorphology and biology elements. This is followed by a summary table of specific impacts per scheme element, which identifies impact, magnitude and current scheme mitigation. Hydrogeological impacts are assessed fully within Section 5.2.4. There was no need to summarise generic impacts followed by specific impacts as part of this element assessment.

5.2.1. New clear-span bridges at S2 (Mochdre Brook) and S5 (Dolfor Brook) – *Scheme elements B and C*

5.2.1.1. Hydromorphological elements

Clear span bridges are not expected to impact directly on the channel at either location, so there would be no impact on the hydrology or continuity of flow. Likewise, they would not impact on the in-channel morphology. The only potential impact that requires further consideration is the impact of the bridge abutments and / or bridge piers, which could potentially have an impact on the structure of the riparian zone (i.e. on the bank top/floodplain), and could fix the channel location and prevent it from being able to migrate across the floodplain in the future.

5.2.1.1.1. Biological elements

Phytoplankton, Macrophytes, Macroinvertebrates and Fish: Bridges cause shading of the channel beneath any new structure and have the potential to lead to a very localised reduction in habitat quality, particularly for macrophytes, but also for macroinvertebrates which inhabit river margins. The use of wide span bridges with a high soffit would mitigate

effects of shading. Bridges are generally considered to have little impact on fish in terms of fish passage, although poorly designed structures could still create barriers. At the water body scale it is unlikely that the impact on habitat quality as a result of shading or on fish passage from new bridges is significant.

Sensitive species: Evidence of otters has been recorded on several watercourses crossed by the Scheme during surveys in 2008, 2012 and during NRW's site inspection in early 2014. Surveys of the Mochdre Brook in 2012 found evidence of use by otters, with abundant suitable lying up sites. Evidence of use by otters was also found on the Dolfor and Green Brook. Any construction around the river bank has the potential to result in the destruction of riverbank or floodplain habitat which could reduce the amount of cover available to otters, severing the otters' territory and removing valuable resource such as shelter and food. Poorly designed bridges or culverts can canalise water creating faster flows, thereby reducing the opportunities for the otter to swim. Lastly, any disturbance to the river bed may affect fish productivity, indirectly damaging the otters' main supply of food. Wide span bridges are sufficiently wide to allow animals dry passage.

5.2.2. Culvert extensions or culvert replacements of extended length (C1, C2a, C12, C15) and New Culverts (S4, C3a, C3b, C4, C5, C6, C7, C8, C9, C10, C11, C14) – *Scheme elements E, D and F*

5.2.2.1. Hydromorphological elements

Scheme modification will result in approximately 622 m of watercourse loss including ditches and natural watercourses. This figure comprises losses from additional culverting (compared to the baseline) and also from total change in channel length. It is a net figure and takes account of some deculverting and increase in channel lengths from proposed realignments. An overall majority of this natural watercourse loss is directly as a result of culverting of channel that was previously open watercourse or a ditch. For individual detail on culvert lengths please refer to Table 5-1 and for detail on cumulative natural watercourse losses please refer to Table 5-2). There will be a need for erosion control measures up and downstream of culvert scheme elements which will need to be further considered within a WFD context at a later design stage. At four locations, there are expected to be culvert extensions or culvert replacements of extended length to make final total culvert lengths between about 19 - 89 m. At 12 locations, there will be new culverts ranging in length between 27 m and 104 m. At C3a and C8 (which were assessed as having a higher hydromorphological/ecological value) a Multi-plate Arch culvert type structure has been proposed to minimize impacts. For further details on this type of system please refer to Appendix F of this report. Over 65 % of the lengths to be impacted are at watercourse locations considered to be an open watercourse and not a ditch or surface run-off feature.

5.2.2.1.1. Hydrological regime

Extending pipe culverts by a few tens of metres (assuming that there is no step change between the bed levels of the two culverts and that the exit from the extension is not perched) is likely to have a localised small impact on the channel flow type along the additional reach. Culverts tend to focus the flow, which leads to an increase in velocity and the flow type to be smoother and more uniform.

New culverts, or replacement culverts of extended length, can have a greater impact on the dynamics of flow compared to extending the culverts. If they are designed poorly with an invert level set too high they can lead to a backwater effect upstream. As described

above, flow through a culvert that does not have an improved bed is more uniform and often increases in velocity. Quantity of flow is not however expected to be affected. To summarise there are likely to be localised impacts to the hydrology as a result of new culverts.

5.2.2.1.2. River continuity

Culverts fragment watercourses by changing the rate of sediment transport and making it more difficult for aquatic species (fish, macroinvertebrates etc.) to pass through them. *(Note that mammal passage has been considered separately within the biological element).* A new culvert may experience a build up of sediment and woody debris within it, or upstream of it, which would further act as a barrier to flow and species migration. Culverts can be designed with mitigations to ensure the bed levels do not exacerbate continuity issues. The invert level of a new culvert can sometimes be depressed so that it is below the natural channel bed (and then infilled with natural sediment held in place in some way, such as baffles) which helps species to continue to migrate through the culvert. New culverts, or replacement culverts of extended length, are likely to have a greater impact in terms of connectivity than culvert extensions as they are completely new modifications. However, other factors such as the baseline hydromorphology also are an important consideration.

5.2.2.1.3. Morphology

Where a new or replacement culvert is located, or an extension of a culvert occurs, there will be a localised impact to the in-channel morphology and a loss of local riparian zone. Culverts fix the position of the channel (unless they are large enough or have no base and can accommodate future lateral or vertical adjustment) and the bed and banks of the channel tend to be artificial. Culverts generally create a uniform morphology with a relatively narrow and deep flow path. The physical installation of a culvert could destabilise the channel and alter sediment dynamics up or downstream. In terms of mitigation, a box culvert is preferable to a pipe culvert because the channel often can retain some degree of lateral movement, (if there is a natural bed). Culverts with depressed invert levels are a preferred option because, as explained above, the channel bed comprises natural substrate and therefore the river retains a greater extent of its connectivity from a sediment transport perspective. Other types of culverts such as Multi-plate Arch systems provide less modification and thus offer a greater degree of natural channel processes, both laterally and vertically. This is the preferred option at locations C3a and C8. As mentioned in Section 5.2.2.1 erosion control measures up and downstream of scheme elements will be further considered at a later design stage.

Culverts often require erosion protection works, either to protect the asset or to prevent sediment washout on active tributaries that have the potential to become destabilised. In addition, sediment maintenance may be required at some locations to prevent the culvert from becoming blocked with sediment. Maintenance procedures generally require easy access that could sometimes have an additional impact on the channel morphology adjacent to the actual structure.

5.2.2.2. Biological elements

Progressive losses of small watercourses through culverting can create wider cumulative impacts on the ecology and morphology of a watercourse. New culverts are likely to have greater impact in terms of potential habitat loss and fragmentation, changed flow regime and loss of daylight than extensions. Box culverts, with a natural bed, are generally preferred as they allow the cross-section of the flow to be kept relatively similar to that of

the natural stream. As has been mentioned above at C3a and C8 a Multi-plate Arch culvert type structure has been proposed to minimize impacts. In particular this solution is likely to allow the bed level of the watercourse to be reassembled using material that resembles natural river bed sediments in its composition and grading. This will help maintain some of the habitat and biological function of the watercourse. For further details on this type of system please refer to Appendix F of this report.

Phytoplankton and Macrophytes: Culverting results in the loss of natural in-stream and bank-side habitats through direct removal and loss of daylight (SEPA, 2006). This reduces to negligible amounts phytoplankton and macrophyte growth within the reach affected. Culverts can also modify the natural flow regime both up and downstream of the structure. The modification in flow can affect phytoplankton and macrophyte communities present, changing them away from the expected natural state and potentially reducing habitat quality at a local level.

Macroinvertebrates: Culverts lead to changes in community composition over the length of the culvert because of the abrupt changes in light conditions and stream bed substrate. In addition, aerial dispersal by aquatic insects through culverts is likely to be reduced. However, the barrier effect of culverts does not necessarily have an effect on benthic communities either side of culverts, indeed the ecological impacts of culverts on benthic invertebrates are more likely to be very local as long as flow remains sufficient to maintain densities in communities either side of culverts.

Fish: As described for bridges, there is potential for permanent severance of fish passage through inappropriate structure design. Culverts, more so than bridges, can reduce the capacity for fish movement. Increased water velocities combined with shallow water depth, 'stepped' culvert entrances and smooth uniform bed all create barriers to fish passage. New culverts are likely to have a greater impact in terms of fish habitat connectivity than extensions. Where the invert level of a new culvert can be depressed with infilled natural sediment this would help maintain fish connectivity through the culvert. Any culvert that is poorly designed could impede fish passage. NRW has advised that for culverts that have been designed following best practice, a length of about 40 m or greater is likely to impact on migratory salmonids. Local fish populations are likely to be impeded by culverts shorter than 40 m. (The AGC Team meeting minutes 8 January 2014).

Sensitive species: Otters are known to be present in the Newtown area. As has been stated for bridges any construction can potentially affect otter habitat. At higher flows pipe culverts may increase velocities such that otters might find it impossible to move upstream through them and instead would try crossing roads. Long pipe culverts may also suffer from limited air space during high flows for free otter passage. Associated mammal fencing, dry pipes, raised ledges and underpasses will all help to create safe crossing points and therefore the avoidance habitat fragmentation.

5.2.3. Modifications such as realignments or deculverting at 2a, C3b, C9a and10, and C12 relating to *Scheme elements D and F*

5.2.3.1. Hydromorphological elements

Some of the Scheme elements involve options such as slight channel realignment and/or deculverting of existing access track culverts (or the A483 culvert in the case of C9/10) as part of the overall solution. As long as these modifications take account of hydromorphological channel form and features during realignment design, and the

riparian zones are planted appropriately (ideally to encompass habitat betterment), then it is expected that they would be beneficial to the Scheme and be a form of mitigation. In general, realignment and deculverting are techniques that reduce the extent of culverting and improve the channel's hydrology, continuity and morphology. They could also allow the channel to be reconnected to its floodplain if realignments are positioned appropriately.

5.2.3.2. Biological elements

5.2.3.2.1. Phytoplankton, Macrophytes, Macroinvertebrates and Fish:

Realignment has the potential to change existing flow regimes within the locality. Change to the existing velocity profile is likely to cause a shift change in the existing ecology present. In itself this is not problematic, as some variation in marginal vegetation within a watercourse increases habitat diversity. Overall realignment, if carried out in an ecologically sensitive manner, should present a good opportunity for improvement. In addition, opening up (where deculverting) of existing channels enhances habitat diversity for all elements. If, on the other hand, the realignment uses open culverts this could lead to permanent habitat simplification and could create further barriers to fish passage.

5.2.3.2.2. Critical sensitive species:

Otters are present within the local area, therefore there is potential for habitat loss, disturbance and physical damage of habitats used by the otter through the realignment option. Continuity of the river corridor should be maintained to ensure safe passage of otter at all times. The use of mammal resistant fencing, dry pipes, raised ledges and underpasses where appropriate will all assist in creation of safe crossing points avoiding the fragmentation of otter habitats.

5.2.4. Cuttings along the Scheme length – *Scheme element G*

The Scheme involves cuttings of up to 24 m depth at various locations along the route. The two largest cuttings are close to the Dolfor Brook and are approximately 24 m and 15 m deep. Other cuttings are approximately 8–10 m deep. Since groundwater was commonly found to be approximately 1–2 m below ground level, the cuttings would intercept the groundwater.

There will be no direct pumped abstraction during the construction or operational phases. However, there would be seepage (in-direct abstraction) and subsequent local drawdown due to cutting below the water table. At the cuttings, emerging groundwater would seep out and flow down the cutting face and be collected at the base. Seepage would then be diverted to the nearest watercourse and would feed into the River Severn. There is no planned mitigation to reduce the seepage. Therefore, the impact of the proposed cutting on the groundwater body, and any linked surface water ecosystems, is considered below.

5.2.4.1. Groundwater quantity elements

The following section will consider impacts to each of the four groundwater WFD quantity elements in turn.

Water Balance: Groundwater removed by drainage at cuttings would be returned to the surface water system and therefore would be lost to the groundwater balance.

The quantities of the long term average recharge to the groundwater body, and the long term average groundwater abstraction used in the WFD assessment are not available to

this study. However, considering the large size of the groundwater body (2358 km^2), the quantity of groundwater lost through the seepage at cuttings is likely to be negligible compared to the overall recharge quantities; therefore it is expected that the development would have no impact on the status of this element at the water body scale.

Locally, the drainage at cuttings may divert groundwater flows and result in a lowering of the water table. Lowering of the water table could impact on wells and boreholes used for abstraction by reducing the flow into the borehole and potentially dewatering the pump or borehole. However, the only known groundwater abstractions in the vicinity are adjacent to the River Severn and groundwater levels and flows at these locations would be dominated by the relationship with river levels. It is therefore considered unlikely that the development would have any effect on existing groundwater users.

Impact on Surface Waters: The seepage from the cuttings would remove groundwater from the aquifer that may have otherwise flowed into watercourses as baseflow. However, the seepage would be discharged into the watercourses and would flow to the River Severn, therefore overall flow would be maintained or increased, supporting the ecological status of downstream surface water bodies (the R Severn – conf Afon Dulas to conf R Camlad (GB109054049310), and the Mochdre Bk – source to conf R Severn (GB109054044730)).

Impact on Wetlands: There are no wetland habitats within 1 km of the Scheme. Therefore, there would be no effect on the status of Impact on Wetlands, which would remain Good with high confidence.

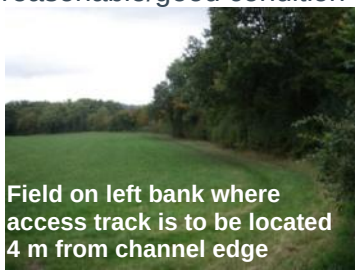
Saline Intrusion: There is no source for saline water intrusion within the Severn Uplands – Secondary Combined groundwater body. Therefore the status would remain Good with high confidence.

5.2.5. Summary of specific surface water body impacts

Table 5-1 below identifies specific impacts per scheme element and identifies, and quantifies, any impact, its magnitude and potential mitigation. It is structured by element type i.e. bridges, then culverts, then other. Within each element category the structures/culverts are grouped and ordered by hydromorphological classification. This is so that similar impacts are grouped together and it is easier to check that a consistent level of mitigation has been applied for each category.

For reference, the element locations in relation to the water bodies can be seen on Figure 2-2 earlier in the document.

Table 5-1 Consideration of hydromorphological and biological impacts at individual scheme element locations

Scheme code/WB assessed against	Hydromorphological classification/Photo	Specific impacts and magnitude	Relevant mitigation or enhancements (For further detail please refer to the mitigation and enhancement figure within Appendix E of this report).
New bridge crossing			
S2 Mochdre Bk – source to conf R Severn	Open watercourse in reasonable/good condition  Field on left bank where access track is to be located 4 m from channel edge	• The new bridge crossing will be a clear-span bridge and so would pose no direct impacts to the channel hydromorphology. The West abutment on the left bank of the channel will be set back by approximately 6 m from the channel. It is however located within the floodplain. The East abutment is set at a higher elevation and is outside of the floodplain. • Restricted habitat loss/habitat simplification from shading (minimised by approx. 12 m soffit height) leading to very localised reduced macrophyte and macroinvertebrate diversity for approx 20–30 m. Impacts on fisheries and otters is considered to be negligible. • A farm access track is to be positioned about 4 m from the left bank of the channel could impact on the riparian morphology or pose future impacts to the banks if the channel moves laterally. • A search of historical maps on ‘old-maps.co.uk’ revealed that the channel at this location has remained in a fixed position since at least 1886.	• The West abutment and farm access track will be at least 3 m away from the Mochdre Brook bank top so there will be no impact directly to the channel or the riparian zone.

		The reason for this is related to a mill structure about 20 m downstream (at Gladulais Farm) which means that this reach is likely to remain stable in the future. • There would be localised and relatively small-scale impacts to the watercourse. Direct impacts to the channel and riparian zone have been largely mitigated against through the design process.	
S5 R Severn – conf Afon Dulas to conf R Camlad	Open watercourse in poor condition 	• The new bridge crossing will be a clear-span bridge, however drawings indicate that an approximately 8 m × 6 m bridge pier will be positioned adjacent to the Brook on the right bank. A temporary channel realignment of the channel is proposed (assumed to be into the right bank) during construction of the bridge, but that the channel may be returned to its former alignment post the construction works. • The bridge pier is considered likely to have a small but direct impact on the channel because it appears to be positioned on the bank edge. It will also constrain the channel's lateral movement in the future and prevent it from being able to move laterally. The existing channel at this location is already constrained by urban influences such as the Coach Park and the Middle Dolfor Road and thus there would be minimal hydromorphological change from the existing situation. • Permanent realignment of the channel away from the bridge pier would be the preferred WFD option from a hydromorphological perspective.	• Japanese knotweed will need to be treated and prevented from spreading during the construction works any temporary realignment of the channel.

		• Temporary or permanent realignment of the channel into the right bank is likely to lead to complications because of the 'made' ground conditions and in particular the presence of Japanese knotweed in the area. • Restricted habitat loss/habitat simplification from shading (minimised by approx. 20 m soffit height) leading to very localised reduced macrophyte and macroinvertebrate diversity for approx 20–30 m. Impacts on fisheries and otters considered to be negligible. • There would be minimal permanent impact to the hydromorphology or ecology of the channel.	
New culverts/culvert extensions and associated modifications including realignments and/or deculverting			
C3a (new) Mochdre Bk – source to conf R Severn	Open watercourse in reasonable/good condition 	• The length of the existing watercourse to be culverted is approximately 122 m. The proposed culvert is approximately 82 m in length. Therefore there is a loss of 40 m of channel length and the realigned route will have an average steeper gradient than the existing watercourse. *In total at culverts 3a and 3b –see below row in table- there will be a loss of natural channel of approximately 118 m.* • A typical daily flow estimate is about 5l/s. Low flows on this reach have been considered not conducive to the design of a viable fish pass (The AGC Team, April 2014 – see Appendix F of this report). • The reach to be culverted is a small woodland channel that is considered to be a fairly significant loss to local morphology and ecological	• Instead of a pipe culvert a Multi-plate Arch culvert system has been selected by the design team to take onboard NRW's requirements at this location such as a more natural bed and a wider culvert to allow lateral movement of the channel. • Mammal passes to ensure connectivity for otters/badger etc. • The culvert will have erosion control measures (for further details see Section 4.1 Element F) up and downstream of the structure. The exact designs at the transition points between the natural and artificial channel will need to be managed with respect to WFD

		connectivity. In particular, local fisheries could be fragmented and local otter movements may be impaired if the culvert were to be designed poorly. • The culvert proposed at this location is a 3 m span Multi-plate Arch system, which allows a natural type bed to be constructed to preserve a degree of sediment dynamics and some of the habitat and biological function. Due to the steepness of the culvert bed-check structures within a natural–like sediment layer need to be incorporated to maintain a balance between erosion and deposition rates. The design is expected to facilitate the installation of a suitable mammal pass. For further culvert design details please refer to Appendix F of this report. • Appropriate design and implementation of the Multi-plate Arch culvert will minimize impacts to the channel hydromorphology and biology.	throughout the detailed design process.
C4 (new) Mochdre Bk – source to conf R Severn	Open watercourse in reasonable/good condition	• Approximately 51 m of a small woodland channel will be culverted (6 m of this was previously culverted by an access track). • The culvert is to be a box type of culvert 1.2 m wide × 1.2 m high, which would accommodate otter, badger and bat passage. It will not have a depressed invert level and the bed through the culvert will be concrete. • The box culvert should minimize some of the impacts to the channel hydromorphology and mammals. Fragmentation of local fish populations and other aquatic ecology remains a risk.	• Box type culvert instead of a pipe culvert will maintain the channel width and therefore lessen some of the hydromorphological and aquatic ecological impact. • Culvert would accommodate bats, otter and badger passage. • The culvert will have erosion control measures (for further details see Section 4.1 Element F) up and downstream of the structure. The exact designs at the transition points between the natural and

			artificial channel will need to be managed with respect to WFD throughout the detailed design process.
C8 (new) R Severn – conf Afon Dulas to conf R Camlad	Open watercourse in reasonable/good condition 	• The length of the existing watercourse to be culverted is approximately 115 m. The proposed culvert is approximately 76 m in length. There will be a loss of approximately 101 m of channel length (*14 m of new channel at the entrance and exit to the new culvert will be realigned as part of the works*) and the overall realigned route will have an average slightly steeper gradient than the existing watercourse. • A typical daily flow estimate is about 17 l/s. Low flows on this reach have been considered not conducive to the design of a viable fish pass (The AGC Team, April 2014 – see Appendix F of this report). • The reach to be culverted is a natural section of headwater channel. This is considered to be a fairly significant loss to local morphology and ecological connectivity, in particular local fisheries	• Instead of a pipe culvert a Multi-plate Arch culvert system has been selected by the design team to take onboard NRW's requirements at this location such a more natural bed and a wider culvert to allow lateral movement of the channel. • Mammal pass to ensure connectivity for otters/badger etc. • NRW requested that a clear span bridge be considered at this location, but the design team consider the Multi-plate Arch options to be appropriate to the magnitude of impact at this location. • The culvert will have erosion control measures (for further details see Section 4.1 Element F) up and downstream of the structure. The

		could be fragmented by poor culvert design and local otter movements may be impaired. • The culvert proposed at this location is a 3 m span Multi-plate Arch system, which allows a natural type bed to preserve a degree of sediment dynamics and some of the habitat and biological function. Due to the steepness of the culvert bed-check structures within a natural–like sediment layer need to be incorporated to maintain a balance between erosion and deposition rates. The design is expected to facilitate the installation of a suitable mammal pass. For further culvert design details please refer to Appendix F of this report. • Appropriate design and implementation of the Multi-plate Arch culvert will minimize longer term impacts to the channel hydromorphology and biology.	exact designs at the transition points between the natural and artificial channel will need to be managed with respect to WFD throughout the detailed design process.
C3b (new culvert and realign) Mochdre Bk – source to conf R Severn	Open watercourse in poor condition 	• The watercourse at this location flows in an east to west direction and would be impacted since it would be beneath an embankment. • Instead of culverting at this location it is proposed that the channel will be realigned to the north, (along the toe of the embankment) which is assumed to be a more natural alignment for this artificially perched channel. The approximately 64 m realignment as shown on the design drawings is a fairly straight channel that is constrained by an access track on the left bank. At the downstream end of the realignment there will be a 40 m length new pipe culvert (600 mm diameter) without a	• Realignment instead of a longer culvert length is deemed to be a better option • The 64 m length to be realigned will have a slightly improved channel riparian habitat because of tree, shrub and hedgerow planting within the vicinity. • The 3b culvert will have erosion control measures (for further details see Section 4.1 Element F) up and downstream of the structure. The exact designs at the transition

		depressed invert level. This will in part replace about 16 m of small access track culverts within the vicinity. The new road culvert will present localised morphological and ecological issues. There will also be a slight loss of channel length associated with the realignment and culvert orientation. *In total at culverts 3a – see above row in the table - and 3b there will be a loss of natural channel of approximately 118m*. • The realignment as part of the 3b element will be of little hydromorphological benefit compared to baseline conditions, but it is acknowledged that an open channel is better than a longer culvert length. The channel riparian habitat will be slightly improved (see mitigations). Opportunities for improving the biodiversity benefits of the realignment should be explored further as part of the detailed design process.	points between the natural and artificial channel will need to be managed with respect to WFD throughout the detailed design process.
C5/C6 (new) R Severn – conf Afon Dulas to conf R Camlad	Open watercourse in poor condition 	• Approximately 47 m (C5) and 65 m (C6) of poor quality headwater channel will become culverted under the Scheme, which is considered to be a loss. • The culverts are to be pipe culverts (900 mm diameter) without depressed invert levels. There is a change in gradient half way along the culverts. • NRW[6] expressed a general requirement for consideration of a culvert with a depressed invert level at all locations where the assessment had categorised the channel as an open watercourse.	• The culverts will have erosion control measures (for further details see Section 4.1 Element F) up and downstream of the structures. The exact designs at the transition points between the natural and artificial channel will need to be managed with respect to WFD throughout the detailed design process. • The mitigation design for this area has been developed to encourage

[6] NRW presented their opinion to the scheme design and mitigation options at a meeting on 8 January 2014 (The AGC Team, January 2014)

		However, at these locations NRW acknowledged that these channels were not sensitive watercourses and so depressed invert levels would not be a requirement. Minimal impact on channel hydromorphology and biology is thus expected.	mammals to remain to the south of the road and cross at the C4 box culvert to the west.

S4 (Now understood to be a new culvert) R Severn – conf Afon Dulas to conf R Camlad	Open watercourse in poor condition 	• Approximately 45 m of poor quality watercourse (but that is in the process of naturally recovering) will become culverted under the Scheme, which is considered to be a loss to the existing biodiversity and morphology of the channel. • The culvert is to be a box culvert (1.5 m wide × 1 m high) without a depressed invert level. • NRW [7]expressed a general requirement for consideration of a culvert with a depressed invert level at all locations where the assessment had categorised the channel as an open watercourse. The design team considered use of a Multi-plate Arch structure at this location, however it was not considered feasible due to gradients and available space. A depressed invert level for the box culvert was also considered, but the design team concluded that the risk of wash out at this location was higher than elsewhere because of the proximity of a large number of properties and the extensive culvert system downstream. The addition of a rougher cemented layer to the bed of the culvert was also considered to be inappropriate at this location. • Upstream of the box culvert the channel is to be realigned to a straighter alignment for approximately 75 m. • In total, there will be approximately 48 m of natural watercourse lost to the scheme (assuming appropriate realignment). However some of the	• Box type culvert instead of a pipe culvert will maintain the channel width and therefore lessen some of the hydromorphological and aquatic ecological impact. • Culvert would accommodate otter and badger passage. • The culvert will have erosion control measures (for further details see Section 4.1 Element F) up and downstream of the structure. The exact designs at the transition points between the natural and artificial channel will need to be managed with respect to WFD throughout the detailed design process. • Net de-culverting of 79 m total length of the Dolfor watercourse approximately 500 m downstream provides some mitigation for impacts at this location within the local area.

[7] NRW presented their opinion to the scheme design and mitigation options at a meeting on 8 January 2014 (The AGC Team, January 2014)

		watercourse length to be realigned is a reach that has been identified as a naturally recovering channel and so its modification is unfortunate. • The box culvert should minimize some of the impacts to the channel hydromorphology and mammals. Fragmentation of local fish populations and other aquatic ecology remains a risk. • There will be localised impact to the channel hydromorphology and biology at this specific location. Some mitigation is proposed on the main Dolfor channel of which the Green Brook is a tributary (see right).	
C9/10 (new) R Severn – conf Afon Dulas to conf R Camlad	Open watercourse in poor condition 	• There are currently 115 m of poorly designed pipe culverts along this reach of the Dolfor Brook (the A483 road culvert and two access track culverts). Following the Scheme works these existing culverts will be removed. The total length of two new 2 m wide × 1.5 m high box culverts will be approximately 59 m, and the watercourse will follow a slightly altered alignment. The culverts will not have a depressed invert levels. There will be a net deculverting of 72 m. The gain of natural channel length at this location has been taken account of in natural watercourse loss calculations and has been used to offset some losses elsewhere. • The opening up of the channel and slight realignment creates opportunities to improve the channel morphology and habitat by using a series of instream rock weirs to provide variety and	• Net de-culverting of sections (72 m) of the Dolfor watercourse with enhancements to include instream rock weirs to improve the flow diversity along reaches that have been opened up. • Box type culvert instead of a pipe culvert will maintain the channel width and therefore lessen some of the hydromorphological and aquatic ecological impact. • Culverts will accommodate otter and badger passage and there will be otter fencing provided at this location to reduce the risk of road deaths. • The culvert will have erosion control measures (for further details see Section 4.1 Element F) up and

		diversity of flow, which will be beneficial for fish passage of local species. • Depressed invert levels for the box culverts were considered, but the design team concluded that the risk of wash out at this location was higher than elsewhere because of the proximity of a large number of properties and the extensive culvert system downstream. The addition of a rougher cemented layer to the bed of the culvert was also considered to be inappropriate at this location. • The new box culverts should minimize some of the impacts to the channel hydromorphology and mammals. Fragmentation of local fish populations and other aquatic ecology remains a risk.	downstream of the structure. The exact designs at the transition points between the natural and artificial channel will need to be managed with respect to WFD throughout the detailed design process.
C11 (new) R Severn – conf Afon Dulas to conf R Camlad	Open watercourse in poor condition 	• Approximately 45 m of relatively poor quality watercourse within a headwater system will become lost to the Scheme at this location within a new 104 m long culvert. There is existing culverting at this location under access tracks and the field. Overall this is considered to be a loss to the existing biodiversity and morphology of the channel. • The culvert is to be a pipe culvert of (1200 mm diameter) without a depressed invert level. • Downstream of the new culvert is another existing field pipe culvert of 50 m in length and 600 mm diameter. There will be an approximate 10 m break (of open channel) between the two culverts. Consideration to deculvert the downstream 50 m length of culvert was made but because of landowner constraints has not been taken forward.	• The culvert length has been minimised and the design does include a break between the new and existing downstream culvert systems, which is of some benefit to the aquatic ecology. • At C11 there is an underpass suitable for mammals about 300 m north-east of the culvert location. • The new culvert will have erosion control measures (for further details see Section 4.1 Element F) up and downstream of the structure. The exact designs at the transition points between the natural and artificial channel will need to be managed with respect to WFD

		• NRW[8] expressed a general requirement for consideration of a culvert with a depressed invert level at all locations where the assessment had categorised the channel as an open watercourse. At this location, the design team did not consider it a feasible option. • There will be localised impact to the channel hydromorphology and biology at this specific location.	throughout the detailed design process.
C15 (ext./replacement) R Severn – conf Afon Dulas to conf R Camlad	Open watercourse in poor condition 	• The existing 58 m of pipe culvert is to be replaced by an 82 m length of pipe culvert (900 mm diameter and without a depressed invert level) along a slightly different alignment to the original culvert. The net effect will be that approximately 30 m of additional watercourse will become culverted under the Scheme, which is considered to be a loss to the existing biodiversity and morphology of the channel. • NRW[9] expressed a general requirement for consideration of a culvert with a depressed invert level at all locations where the assessment had categorised the channel as an open watercourse. However, at this location it was acknowledged that the watercourse was in poor condition and that no further mitigation would be required.	• A dry pipe suitable for mammal passage is to be installed to the East of the culvert. • The culvert will have erosion control measures (for further details see Section 4.1 Element F) up and downstream of the structure. The exact designs at the transition points between the natural and artificial channel will need to be managed with respect to WFD throughout the detailed design process. • No other WFD mitigation included in the current Scheme design.
C1 (ext.) R Severn – conf Afon	Ditch with flow (assumed to be perennial)	• The existing culvert under the A489 (19 m in length) will have its headwalls replaced and there will be a minimal extension related to this of up to 1 m. There will therefore be minimal impacts at this	• Indirect mitigation by ditch creation along the Scheme fence line.

[8] NRW presented their opinion to the scheme design and mitigation options at a meeting on 8 January 2014 (The AGC Team, January 2014)
[9] NRW presented their opinion to the scheme design and mitigation options at a meeting on 8 January 2014 (The AGC Team, January 2014)

Dulas to conf R Camlad		location to an already poor quality modified channel. • NRW[10] seemed satisfied that at locations that were classified as ditches, culvert impacts would be indirectly compensated for by a significant length of ditch creation along the Scheme fence line.	
C2a (ext./replacement) R Severn – conf Afon Dulas to conf R Camlad	Ditch with flow (assumed to be perennial) 	• There is currently an existing 27 m long culvert for this watercourse to pass under the A489. The design team considered extending this culvert to accommodate the new road, however, because the culvert extension was modelled to be flowing uphill a replacement culvert has been located approximately 10 m to the east and the channel downstream of the A489 realigned. In addition, a new outfall structure is to be located where the tributary flows into the River Severn. • The new culvert is to be approximately 71 m in length and of pipe type without a depressed invert level. There will be a manhole about 50 m along its length, which will receive flows from a Scheme attenuation pond outflow ditch. In total, this replacement culvert equates to a 44 m increase in length in culverting. The channel realignment	• There is to be a dry mammal pipe located within the vicinity of this culvert, approximately 40 m to the east. • The replacement culvert will have erosion control measures (for further details see Section 4.1 Element F) up and downstream of the structure. The exact designs at the transition points between the natural and artificial channel will need to be managed with respect to WFD throughout the detailed design process. • Indirect mitigation by ditch creation along the Scheme fence line.

[10] NRW presented their opinion to the scheme design and mitigation options at a meeting on 8 January 2014 (The AGC Team, January 2014)

		downstream of the structure will offset the loss of channel length upstream of the replacement culvert, assuming the realignment is designed with appropriate hydromorphological and aquatic ecological considerations. • The new scheme alignment will also cause loss of a wetland feature immediately upstream of the existing A489 culvert, which is considered a significant loss. There are plans to recreate this feature either online immediately upstream of C2a or on the attenuation pond outflow drainage ditch. Designs are still to be confirmed.NRW[11] seemed satisfied that at locations that were classified as ditches, culvert impacts would be indirectly compensated for by a significant length of ditch creation along the Scheme fence line	• The replacement of a wetland feature is to be considered at two locations. • In addition an attenuation pond to the south-east of the Llanidloes roundabout (if designed appropriately) could also offer some wetland ecological benefits.
C12 (ext./replacement) R Severn – conf Afon Dulas to conf R Camlad	Ditch with flow (assumed to be perennial) 	• The existing 11 m culvert (450 mm diameter) under the A489 is to be replaced by a larger capacity 1200 mm diameter approximately 82 m in length pipe culvert (without a depressed invert level). The existing culvert will be abandoned and the new culvert will follow a slightly different alignment to the south. • Downstream of the replacement culvert the channel is to be realigned to the south of Lower Brimmon Farm, Kerry Road buildings for approximately 77 m in length. The realignment will bypass a section of existing culverting (approximately 15 m in length) under the farm buildings and so will be of hydromorphological and	• Culvert replacement to a larger capacity culvert would improve the upstream hydromorphology. • A dry pipe will be provided to the south of culvert C12. (and associated fencing of the road). • The culvert will have erosion control measures (for further details see Section 4.1 Element F) up and downstream of the structure. The exact designs at the transition points between the natural and artificial channel will need to be managed with respect to WFD

[11] NRW presented their opinion to the scheme design and mitigation options at a meeting on 8 January 2014 (The AGC Team, January 2014)

		aquatic ecological benefit assuming that the channel is designed appropriately. • Loss of relatively 'poor quality' natural channel length will predominantly be to the west of the original culvert and will be about 62 m in terms of extent. There will however be benefits to the reach upstream of this point because the replacement culvert is to have a larger capacity and will therefore lead to improve flows.	throughout the detailed design process. • The downstream realignment should offset the loss of natural channel caused by upstream culverting at this location. • In addition there will be (as for other options) indirect mitigation by ditch creation along the Scheme fence line.
C7 (new) R Severn – conf Afon Dulas to conf R Camlad	Ditch without flow (assumed to be ephemeral) 	• Approximately 76 m of a natural surface water drainage feature will become culverted under the Scheme through a 900 mm diameter pipe culvert leading to loss of existing ephemeral ditch habitat. The pipe culvert will not have a depressed invert level. However, NRW seemed satisfied that at locations that were classified as ditches, culvert impacts would be indirectly compensated for by a significant length of ditch creation along the Scheme fence line.	• Indirect mitigation by ditch creation along the Scheme fence line. • The culvert will have erosion control measures (for further details see Section 4.1 Element F) up and downstream of the structure. The exact designs at the transition points between the natural and artificial channel will need to be managed with respect to WFD throughout the detailed design process. • The mitigation design for this area has been developed to encourage mammals to remain to the south of the road and cross at the C4 box culvert to the west.
C13 R Severn – conf Afon	Ditch without flow (assumed to be ephemeral) No photo available	• The design team have confirmed that a culvert is no longer required at this location (there is no water feature present).	• N/A

Dulas to conf R Camlad		• This row within the table has been left in to avoid confusion from previous iterations of this report.	
C14 (new) R Severn – conf Afon Dulas to conf R Camlad	Ditch without flow (assumed to be ephemeral) 	• Scheme designs indicate that a natural surface water feature (a pond) will be impacted by the road Scheme. The area of pond lost will be replaced downstream of the new road. The outflow tributary from the feature will be approximately 32 m shorter in length but there will be no severance of its outflow. • NRW considered impacts to the outflow would be indirectly compensated for by a significant length ditch creation along the Scheme.	• Pond will be extended to mitigate for impacts to it. • Indirect mitigation by ditch creation along the Scheme fence line. • The culvert will have erosion control measures (for further details see Section 4.1 Element F) up and downstream of the structure. The exact designs at the transition points between the natural and artificial channel will need to be managed with respect to WFD throughout the detailed design process.
Other			
No scheme code – watercourse near Penygelli (realign) R Severn – conf Afon Dulas to conf R Camlad	Ditch with flow (assumed to be perennial) 	• The scheme drawings indicate that the Scheme will no longer impact on an approximately 80 m length of a modified flow feature. Realignment along the toe of the embankment will now no longer be required. • This row within the table has been left in to avoid confusion from previous iterations of this report.	• N/A

5.3. Cumulative impacts assessment

The individual hydromorphological, biological and quantitative hydrogeological elements have been considered individually within Section 5.2 of this assessment. Physico-chemical impacts were scoped out of the detailed assessment. Section 5.3.1 considers cumulative effects of the Scheme to water body hydromorphology and aquatic ecology. Water quality impacts resulting from the new road and drainage strategy are to be fully assessed within the Newtown EIA Drainage and Water Environment Chapter. Appropriate mitigation will be put in place to ensure compliance with WFD water quality objectives.

Regarding in combination effects with other planned developments within the vicinity of the Scheme, the ES considers:

- those which require a statutory EIA (two wind farms and a grid connection – but none have yet been granted planning consent);
- single turbine applications at multiple locations (all of which are greater than 1 km from the scheme);
- four urban e.g. residential, school or church related developments; and
- a new windfarm access road.

These in combination effects to water body hydromorphology and aquatic ecology are considered below within Section 5.3.2.

5.3.1. Within scheme cumulative effects

In terms of cumulative impacts the potential loss of each channel type as a result of Scheme modification is presented in Table 5-2 below. In total approximately 886 m (net figure[12]) of natural watercourse could potentially be lost through culverting or realignment by the Scheme across two water bodies, the Mochdre Brook – source to conf R Severn (GB109054044730) and the R Severn – conf Afon Dulas to conf R Camlad (GB109054049310). In terms of percentage lost per water body, approximately 2 % of the reported water body length on the Mochdre Brook and approximately 1 % of the reported water body length on the River Severn water body (GB109054049310) are likely to be lost through culverting. It is however important to note here that the total water body lengths which include the various tributaries and headwaters are not currently reported under the WFD. Their inclusion would make both the Mochdre Brook and the Severn water bodies much greater in terms of their overall length, and subsequently the percentages impacted would be considerably reduced.

The assessment considers that approximately 67 % of the watercourse lengths lost would be ‘small’ open watercourses compared to ditches. Approximately 42 % (268 m) are watercourses currently in good/reasonable condition. For these open watercourses some direct mitigation is proposed to mitigate against the level of impact.

In addition to the culverting (and small amount of deculverting) of watercourses some realignments are proposed:

- downstream of C2a (to the confluence with the River Severn which will in part offset loss of channel length to the existing C2 culvert);

[12] The calculation of loss of natural watercourse lost to the scheme has included the net deculverting at the C9 and C10 location. The 79 m of deculverting has been subtracted from the culverting total and the calculation has also taken account of total realignment change.

- upstream of C3b (for a 64 m relatively straight length of only small hydromorphological benefit, but that will incorporate some riparian planting of ecological benefit);
- a temporary realignment (of approximately 10 m in length) at the S5 bridge location is needed during construction of the bridge pier which may ultimately become the permanent channel;
- upstream of S4 (for an approximately 100 m relatively straight length - that will offer limited hydromorphological/ecological benefits because at this point the channel baseline indicated that recovery was occurring);
- at the C9/10 locations in conjunction with deculverting works (note this is a slight realignment only); and,
- downstream of C12 (for an approximately 77 m length to bypass existing culverting of an approximate 15 m length under the Lower Brimmon Farm, Kerry Road farm buildings, that will, if designed appropriately, be of benefit to hydromorphology and aquatic ecology).

The Scheme has also included some direct and indirect mitigation and some compensatory enhancements as a form of mitigation to offset localised adverse impacts. Appropriate design should help to ensure minimal impact to the channel hydromorphology and biology at individual locations. Details of the proposed mitigation are included in Table 5-1, also represented on a mitigation and enhancement figure (see Appendix F of this report) and are summarised below:

- At S2, the west abutment and farm access track will be at least 3 m away from the Mochdre Brook bank top.
- Where it occurs, Japanese knotweed should be prevented from spreading during the construction works. This is particularly relevant at S5.
- To prevent fragmentation of local fisheries and other aquatic ecological species Multi-plate Arch structures are to be used instead of pipe or box culverts at C3a, and C8. These are on watercourses considered to be of relatively good quality both hydromorphologically and ecologically. These structures include a depressed invert level with a natural like sediment layer on the channel bed. For further information, please refer to Appendix F within this report.
- To reduce the impact to the hydromorphology and aquatic ecology, box culverts instead of pipe culverts, are proposed at C4, S4, C9 and C10. Although these will not have a depressed invert level or a natural sediment bed they will maintain the channel width.
- At appropriate locations (as specified below) mammal passes will be installed to ensure connectivity. Dry pipes will be installed close to C2a and C15. Multi-plate Arch bridge structures will incorporate a raised mammal ledge at C3a and C8. Box culverts will incorporate a raised ledge at C4, S4, C9 and C10. At C12 a larger 1200 mm diameter culvert is to be installed and a raised mammal ledge will be included. At C11 there is an underpass suitable for mammals about 300 m north-east of the C11 culvert. In addition mammal fencing will be provided at all scheme locations. The C4 box culvert will also allow bat movement along the watercourse.
- At C3b upstream of the culvert there will be an approximate 64 m length of channel that will be realigned along a fairly straight alignment next to a track. However, the channel riparian habitat will be slightly improved by tree, shrub and hedgerow planting within the vicinity.

- At C9 and C10 there will be a combination of deculverting and culverting along a similar alignment to the existing channel. The net effect will be deculverting of approximately 72 m.
- A wetland feature is to be recreated near to C2a, but the exact design is still to be confirmed.
- At C12 a larger capacity culvert will improve the hydromorphology of the reach upstream as the current culvert is undersized creating backwater conditions upstream. Downstream of this culvert the channel is to be realigned for a length of approximately 77 m to the south of Lower Brimmon Farm, Kerry Road farm buildings. The realignment will by-pass a section of existing approximate 15 m length culverting under the farm buildings.
- Nearby C14 a pond that will be impacted by the new road is to be extended to the north and south.
- The loss of the watercourses classified as ditches (approximately 214 m) will be indirectly compensated for by the creation of fence line ditches for the full length of the bypass.
- All culverts will have erosion control measures up and downstream of the structures. The exact designs at the transition points between the natural and artificial channels will need to be managed with respect to WFD throughout the detailed design process.

Table 5-2 Summary of natural watercourse channel length to be lost to scheme modifications by hydromorphological type.

Hydromorphological categorisation	Natural watercourse channel length losses from both culverting and total realignment length change (m)	Proportion of total to be lost (%)
Ditch with flow (perennial)	95	15
Ditch without flow (ephemeral)	107	17
Open watercourse in poor condition	167	27
Open watercourse in reasonable/good condition	253	41
Total	**622**	NA

Note – The categories each individual watercourse has been allocated to can be found by referring to Appendix B of this report. Those showing signs of recovery to previous modification were allocated to the 'Open watercourse in poor condition' category.

The groundwater assessment has shown that there are no impacts on the groundwater bodies identified.

Overall, it is considered that the proposed works on the elements hydromorphologically classified to be ditches (C1, C2, C7, C12 and C14) are unlikely to have any net cumulative adverse impacts on the Mochdre Brook – source to conf R Severn water body

(GB109054044730) or R Severn – conf Afon Dulas to conf R Camlad (GB109054049310) catchment WFD classification, because of the extent of indirect mitigation proposed.

Where the Scheme affects open watercourses of poor/good quality (approximately 634 m locations C3a, C3b, C4, C5, C6, C8, C9, C10, S4, S5, C11, and C15) the direct mitigation (such as shorter culvert lengths at C3b and C11, the Multi-plate Arch structures at C3a and C8, the wetland feature recreation at C2a, and the net deculverting at the C9 and C10 locations) would lessen the adverse impacts arising from the Scheme. However there is still likely to be a residual adverse impact associated at a majority of these locations (especially due to the extensive use of pipe or box culverts without natural type beds), which cumulatively, at the Scheme scale, would have a degree of effect on the ecology and hydromorphology of the watercourses. The magnitude of the residual impact is extremely difficult to quantify. Other indirect mitigation is also proposed which could locally offset adverse impacts such as the downstream realignment at C12, improvements to the hydromorphology in association with the C9/10 works, and mammal pass considerations at several locations.

At the Mochdre Brook – source to conf R Severn and River Severn – conf Afon Dulas to conf R Camlad water body scales, the scale of the cumulative residual adverse impacts is considered unlikely to be significant. During final design stages care should be taken to reduce as many localised adverse impacts as possible by ensuring all feasible direct and mitigation has been incorporated and that mitigation such a the realignments and erosion control structures are designed appropriately to reduce additional impact and where possible enhance the scheme in terms of WFD.

5.3.2. In combination cumulative effects with other developments

Out of the planned development directly listed under Section 6.3 only one of the developments, the Heol Treowen Residential Development and Access scheme has been assessed as having the potential to cause cumulative effects. All other developments are not adjacent to a watercourse or are greater than 2 km from the scheme.

The Heol Treowen development has had planning permission granted with associated Section 73 applications requiring conditional consent. The development boundary southern extent appears to be a tributary of the River Severn (WC14 see Appendix A within this report for more details), which is the same watercourse that C11 is impacting on. It is considered likely that the development scheme would have appropriate mitigation in place and therefore be unlikely to impact on the channel form or its ecology. Therefore, no in-combination cumulative impacts have been identified.

5.4. Assessment of impacts on downstream R Severn – conf R Camlad to conf Bele Bk water body (GB109054049700) and beyond

The WFD status objectives require consideration of downstream water bodies in terms of whether there would be any deterioration in classification elements or whether they would be prevented from attaining their objectives. Downstream of the proposed works there are 14 water bodies to the Severn Estuary, all of which are classified as being Moderate Ecological Potential. The immediate water body downstream of the works is the R Severn – conf R Camlad to conf Bele Bk water body (GB109054049700).

Water quality is considered one of the main mechanisms by which the proposed works could impact on the downstream water body; and the Scheme EIA will ensure there is appropriate water quality mitigation in place to be compliant with WFD objectives.

The River Severn is designated as a migratory European eel and Atlantic salmon route, although none of the minor watercourses potentially impacted as part of this Scheme are designated for either eels or salmon. Some salmon/trout or eel migration into the minor watercourses is thought possible especially on the Mochdre Brook, because this tributary is one of the few assessed as part of the Scheme that is not already culverted in its lower reaches. The Scheme has considered mitigation of the culverts, and eel passage is not expected to be impeded additionally as a result of the Scheme.

No adverse impacts to the downstream water bodies are therefore expected.

5.5. Summary of impacts

Table 5-3 within this section summarises the facts about the Scheme impacts and considers whether they are compliant with water body objectives for the Scheme as a whole. The objectives that are to be assessed include

Objective 1: The Scheme will not cause deterioration in any element of water body classification.
Objective 2: The Scheme will not prevent the WFD status objectives from being reached within the water body or other downstream water bodies.
Objective 3: The Scheme will not negatively impact critical or sensitive habitats within the water body.
Objective 4: The Scheme will contribute to the delivery of the Severn RBMP, which the assessed water bodies are situated within.

Table 5-3 Scheme impact and compliance with water body objectives summary

Newtown Bypass scheme element	Summary of assessment evidence
New bridge crossings (S2 andS5) *Scheme elements B and C* and water body summary details	• Bridge crossings will be clear-span bridges with a soffit height of at least 12 m so will pose no direct impacts to the channel hydromorphology. • There would be very localised reduced macrophyte and macroinvertebrate diversity for approx 20–30 m due to shading at both bridge locations. • At S2 the proximity of an abutment within the floodplain and a farm access track adjacent to the watercourse is not considered to be an issue because it will be at least 3 m away. • At S5 a bridge pier is to be located adjacent to the Dolfor Brook on the right bank which will require a short temporary realignment of the channel and once the channel is replaced could further constrain its lateral movement in the future. • A mitigation relating to Japanese Knotweed at S5 has been included. • S2 relates to the Mochdre Bk water body that has Moderate Ecological Status and a water body objective to achieve Good status by 2015. The fish element caused a less than Good status classification. • S5 relates to the Severn water body which has Moderate Ecological Potential and a water body objective to achieve Good status by 2015. The phytobenthos element caused a less than Good status classification.
New culverts/culvert extensions/ culvert replacements of extended length and associated modifications including realignments and/or deculverting *Scheme elements E, D and F* and water body summary details	• There are four locations where there will be a culvert extension or replacement culvert of extended length to make final total culvert lengths between about 19-82m. At 12 locations there will be new culverts ranging in lengths of between 27m and 104 m. • Over 65% of the lengths to be impacted by scheme modification are at watercourse locations considered to be an open watercourse and not a ditch or surface run-off feature. • At culvert locations C3a, C4, C5/6,C8,S4, C9 and10 and C11 the hydromorphology was categorised as open watercourse and NRW requested the design team consider mitigation such as depressed invert culverts as well as morphological improvements (as a form of compensatory enhancement). • At locations C3a and C8 the design team have selected a Multi-plate Arch culvert system which allows for a total of 3 m of lateral channel movement within the structure. It comprises a modified form of bed development and so should preserve a degree of sediment dynamics and some of the habitat and biological function in the longer term. • At C4, S4, C9 and C10 box culverts instead of pipe culvert are to be installed which will maintain channel width. They do not

	incorporate a natural sediment bed because of maintenance and downstream washout concerns. • Deculverting and/or realignment options have been proposed as part of the culverting options at several locations (C2a, C3b, S4, C9 and10, C12) some of which help to mitigate locally for the adverse culvert impacts. This is especially true at C9 and C10 where net deculverting of 72 m is proposed, and at C12 where there will be a 77 m realignment downstream of a replacement (albeit extended) culvert. • Mammal passes will be installed at appropriate locations with a majority of culverts having passage within close proximity through use of raised ledges, underpasses or dry pipes. • At culvert locations considered to be ditches, or watercourses that offer the least quality habitat (i.e. C15) in general no direct mitigations (with exception of culvert upstream and downstream erosion control measures) are proposed. At these locations, indirect mitigation related to ditch creation along the Scheme fence line is considered to offset impacts. (An exception to this is a C12 where a realignment – as mentioned above - is proposed). • Culverts C3a, C3b and C4 relate to the Mochdre Bk water body, but all other culverts relate to the Severn water body. Both water body statuses and objectives are described in the row above covering bridges.
Cuttings along the Scheme length *Scheme elements G* **and water body summary details**	• The Scheme involves cuttings of up to 24 m depth at various locations along the route. The two largest cuttings are close to the Dolfor Brook. Since groundwater was commonly found to be approximately 1–2 m below ground level, the cuttings would intercept the groundwater. - There would be seepage (in-direct abstraction) and local drawdown due to cutting below water table. At the cuttings, emerging groundwater would seep out and flow down the cutting face and be collected at the base. Seepage would then be diverted to the nearest watercourse and would feed into the River Severn. - There is no planned mitigation to reduce the seepage. - The Severn Uplands Secondary Combined groundwater body (GB40902G203400) status is based on the bedrock geology, and does not include superficial geology (pers. comm. Carol Williams, Environment Agency, 13 January 2014). - The overall water body status is classified as Poor, however, this is driven by the Poor classification of Chemical (GW) Status, and the Quantitative Status is Good. - The target overall status is Good by 2027. - The quantity of groundwater lost through the seepage at cuttings is likely to be negligible compared to the overall recharge quantities; therefore it is expected that the development would have no impact on the status of this element at the water body scale.

	- The seepage from the cuttings would remove groundwater from the aquifer that may have otherwise flowed into watercourses as baseflow. However, the seepage would be discharged into the watercourses and will flow to the River Severn, therefore overall flow will be maintained or increased, supporting the ecological status of downstream surface water bodies - In addition the assessment considered that there would be no impact to the WFD quality elements 'Impact on surface waters' or 'Saline intrusion'.
Cumulative and downstream impacts	• The extent of indirect mitigation (i.e. the creation of scheme ditches) ensures that the proposed works on watercourses classified as ditches are unlikely to have any net adverse in Scheme cumulative impacts. • Where the Scheme affects open watercourses (approximately 420 m) the direct mitigation would lessen the adverse impacts, however there is still likely to be a residual adverse impact which cumulatively at the Scheme scale would have a degree of effect on the ecology and hydromorphology of the watercourses. This is extremely difficult to quantify. • In combination scheme cumulative effects have been considered and only one development at Heol Treowen (within close proximity to WC14 see Appendix A within this report for more details) is relevant to consider and it is thought likely that the development scheme would have appropriate mitigation in place. No in-combination cumulative impacts have therefore been identified. • At the water body scale the cumulative impacts are overall considered unlikely to be significant. • The likely pathways for impacts to downstream water bodies were considered to be water quality or impacts to fish passage. The assessment considers that there would be sufficient mitigation built into the Scheme to allow WFD water quality standards to be met (see the Newtown Drainage and water environment EIA chapter for further information). In terms of fish passage salmon, trout and eel migration are only considered possible on the main Mochdre Brook (which is not impacted by culverting by the Scheme).
Consideration of the water body objectives	**Objective 1** • For deterioration to have occurred within a water body the scale of the impact has to be at the whole water body scale. • Of the Scheme elements the new culverts, culvert extensions and culvert replacements of extended length appear to have the greatest impact on the water environment and are likely to lead to localised hydromorphological and aquatic ecological impacts. In addition the cuttings are likely to lead to in-direct abstraction and local drawdown of the water table. This however is unlikely to be considered significant at the water body scale, given this assessment has considered potentially likely relatively small scale and localised impacts only. There is

	therefore unlikely to be deterioration of individual water body elements. • Mitigations (of direct and indirect type) have been set out to lessen the impact of localised surface water deterioration for many scheme impacts and it is considered that the net and cumulative deterioration (compared to the present baseline) at the water body scale would remain relatively small. **Objective 2** • The Scheme works are considered unlikely to prevent the two surface water body objectives from being achieved by their 2015 and 2027 targets. The additional culverting would not aid an improvement in fish migration, (which is a failure of the Mochdre Brook water body). However, because the main culverting impacts are on tributary channels to the main reported reach, and the tributary already has extensive culverting before the confluence with the Mochdre Brook, it is considered, that the impact is not significant enough to prevent the water body objective from being reached. For the River Severn water body a similar logic can be applied in that the element causing a less than Good status is phytobenthos, and that since the localised impacts are only to tributaries, at the scale of the extensive Severn water body the impacts are unlikely to prevent attainment of the objective. • In terms of the groundwater assessment the water body current Poor status is driven by Chemical (GW) Status and since the Scheme impacts are more likely to affect quantitative groundwater status it is considered that the scheme is unlikely to prevent the groundwater body objective of Good by 2027 from being reached. **Objective 3** • Throughout this assessment there are not considered to be any impacts on critical or sensitive aquatic species (or wetland sites as part of the groundwater assessment) providing appropriate culvert design. • For watercourses considered to be used by more terrestrial species such as otters and bats, appropriate access in the form of mitigation has been included within the Scheme. **Objective 4** • The Scheme does not directly help either water body move towards GEP/GES by their target dates by incorporating enhancements that would directly work to overcome the elements that have caused the overall status to be classified as Moderate. In the case of the Severn water body (which is a HMWB) there are no mitigation measures considered not in place so there is no action list available to try and support. However, enhancements relating to hydromorphology along some reaches adjacent to culvert works, such as at C9, 10 and

	12 would be expected to contribute generally to the overall aims of the WFD. **Other considerations** • The Scheme would not impact on the downstream River Severn – conf R Camlad to conf Bele Bk water body water body: • – by preventing status objectives from being achieved (Objective 2), or • – by preventing the delivery of the Severn RBMP (Objective 4). • An Article 4.7 test is required only if the Scheme would cause deterioration in water body status or would prevent the water body from meeting its ecological objectives. • This assessment recommends that an Article 4.7 test is not required because at the water body scale there would be no deterioration in water body status and the water body objectives would not be prevented from being reached.

5.6. Summary of recommended mitigation and compensatory enhancements

The mitigation and compensatory enhancements have been summarised within Section 5.3, represented on a mitigation and enhancement figure (see Appendix E of this report), and are presented in full per individual scheme element within Table 5-1.

6. Conclusion

6.1. Conclusion

The Scheme WFD compliance assessment has been undertaken by The AGC Team on behalf of the Welsh Government in accordance with available Environment Agency guidance, as directed by NRW (who are one of the competent authorities for ensuring compliance with the WFD).

It is NRW's responsibility to review the assessment, consider the evidence, and determine whether they consider the Scheme to be compliant. Throughout the design process NRW have provided useful and pragmatic feedback on the design of Scheme elements. This has been undertaken through meetings and by providing the AGC Team with comments following a site walkover visit and on draft versions of the ES. Where it was considered possible, the AGC Team have incorporated recommendations into the design.

NRW will review this assessment as part of the final Newtown ES. Compliance of this Scheme with WFD objectives cannot be stated until NRW (together with any partner organisations that they deem necessary, such as Powys Council) have approved the assessment.

6.2. Report recommendations

Mitigation and enhancement measures that are considered essential to achieve compliance with the WFD are summarised within Section 5.3 and are presented in full per individual scheme element within Table 5-1. They are also shown within a mitigation and enhancement figure (see Appendix E of this report).

It is recommended that the WFD compliance assessment is reviewed and updated at the detailed design stage to ensure that no changes have been made which impact on whether the Scheme is WFD compliant and to ensure any other mitigation or enhancement measures required by the competent authorities are included within the design of the Scheme.

Three advisory points that need further consideration in relation to WFD compliance throughout the detailed design process are as follows:

At the S5 bridge location permanent realignment of the channel away from the bridge pier on the right bank would be the preferred WFD option from a hydromorphological perspective. Temporary realignment of the channel during construction works would need to mitigate against the spread of Japanese knotweed so this would not pose a constraint to a permanent realignment.

Current design information only makes general reference to erosion control measures upstream and downstream of the culvert works. It is envisaged that erosion at the transition points between the concrete headwall structures and the natural channel will be managed by the placement of appropriately graded stone over the assessed length of the transitional zone. At the culvert outfall, a short informal "stilling basin" may be created to dissipate energy from the culvert discharge. The details of the erosion control measures will need to be further considered within a WFD context at a later design stage.

At several locations (C2a, C3b, C9/10, S4, S5, C12) channel realignments are proposed as part of the works and these realignments will require further design at the detailed design stage. It is recommended that a geomorphologist is involved in this design process of these elements to ensure the design is based on hydromorphological principles and will maximise the biodiversity benefit. This will additionally help offset the localised adverse impacts from culverting that are present across the Scheme.

7. References

The Scheme datasets are referenced within

Table 2-1 *and to avoid duplication are not included within the reference list below.*

British Geological Survey (2014): 1:50,000 series maps.

Environment Agency (December 2009), Annex B Severn River Basin District.

Environment Agency (January 2014). What's in your backyard?, website accessed 13/1/14.http://maps.environment-agency.gov.uk/wiyby/wiybyController?ep=datatopics&lang=_e

Environment Agency (July 2012) Water bodies for the Water Framework Directive, Guidance note (final), issued July 2012, Internal EA Guidance.

NRW (2013) Data request information (5105742//1/60/61/ 008).

NRW (January 2014) Newtown Walkover, (NRW Site walkover survey report), Received by email from Jim Davies 11/02/14 (See Appendix D of this report).

NRW (May 2014) A483/A489 Newtown Bypass, Schedule of comments and Responses (SOC 025).

NRW (January 2014) NRW Walkover notes, Issued by email to the TACP team. (Note this is presented within Appendix D of this report).

SEPA (2006) – Culverting of Watercourses: position statement and supporting guidance (Version 1.2 Dec 2006).

The AGC Team (December 2009) A483/A489 Newtown Study DMRB Stage 2 Environmental Impact Assessment Volume 1a Report. December 2009. Report Number HHC 91371A/ 27a.

Capita (August 2012) A483/A489 Newtown By-Pass Interim Ecological Surveys 2012 – Water quality Assessment of Watercourses using the Biological Monitoring Working Party (BMWP) Methodology August 2012.

The AGC Team (November 2013) A483/A489 Newtown Bypass, WFD initial Compliance assessment, Report Reference 5105742/ENV/WFD/RT207.

The AGC Team (2013) 131127 – G336 Fieldwork Monitoring Records BHs.xls.

The AGC Team (January 2014) A483-A489 Newtown-Bypass-NRW Water Resources meeting 08 01 14 -FINAL-issued, Meeting minutes received by email 23/01/14.

The AGC Team (July 2014) Newtown Bypass Environmental Statement (internal working draft).

The AGC Team (April 2014) Outcomes of WFD review and NRW comments at Culverts C3a and C8, Report Reference: 5105742/ENV/CU/RT216/D1 (See Appendix F of this report).

The EC Freshwater Fish Directive (2006/44/EC).

Water Framework Directive (Directive 000/60/ec) (2001) implemented in England and Wales by the Water Environment (Water Framework Directive) Regulations (SI 3242/2003).

Welsh Government (2006) The Newtown Planning Objectives and Pre-Appraisal Report.

Welsh Government (2007) Key Stage 2 Study.

Welsh Government (2013) Environmental Scoping Report June 2013.

Appendices

Appendix A. Watercourse names and crossing locations

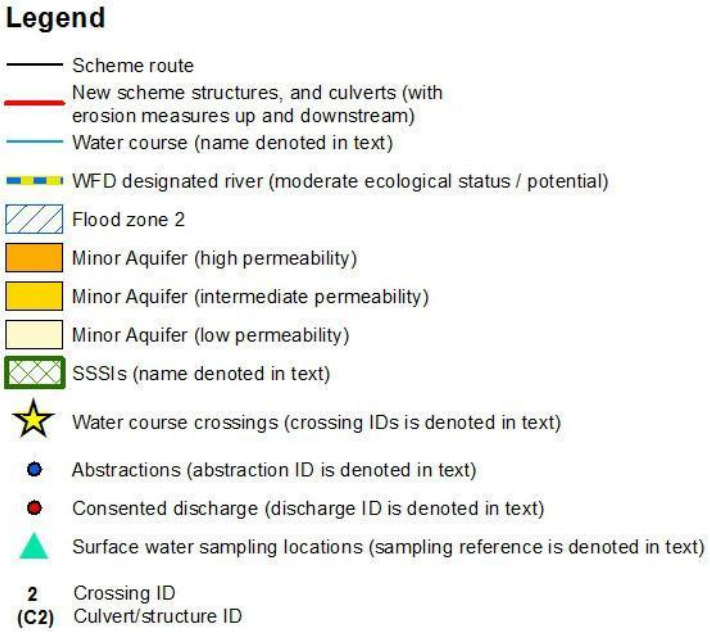
A.1. Watercourse names and crossing locations data table

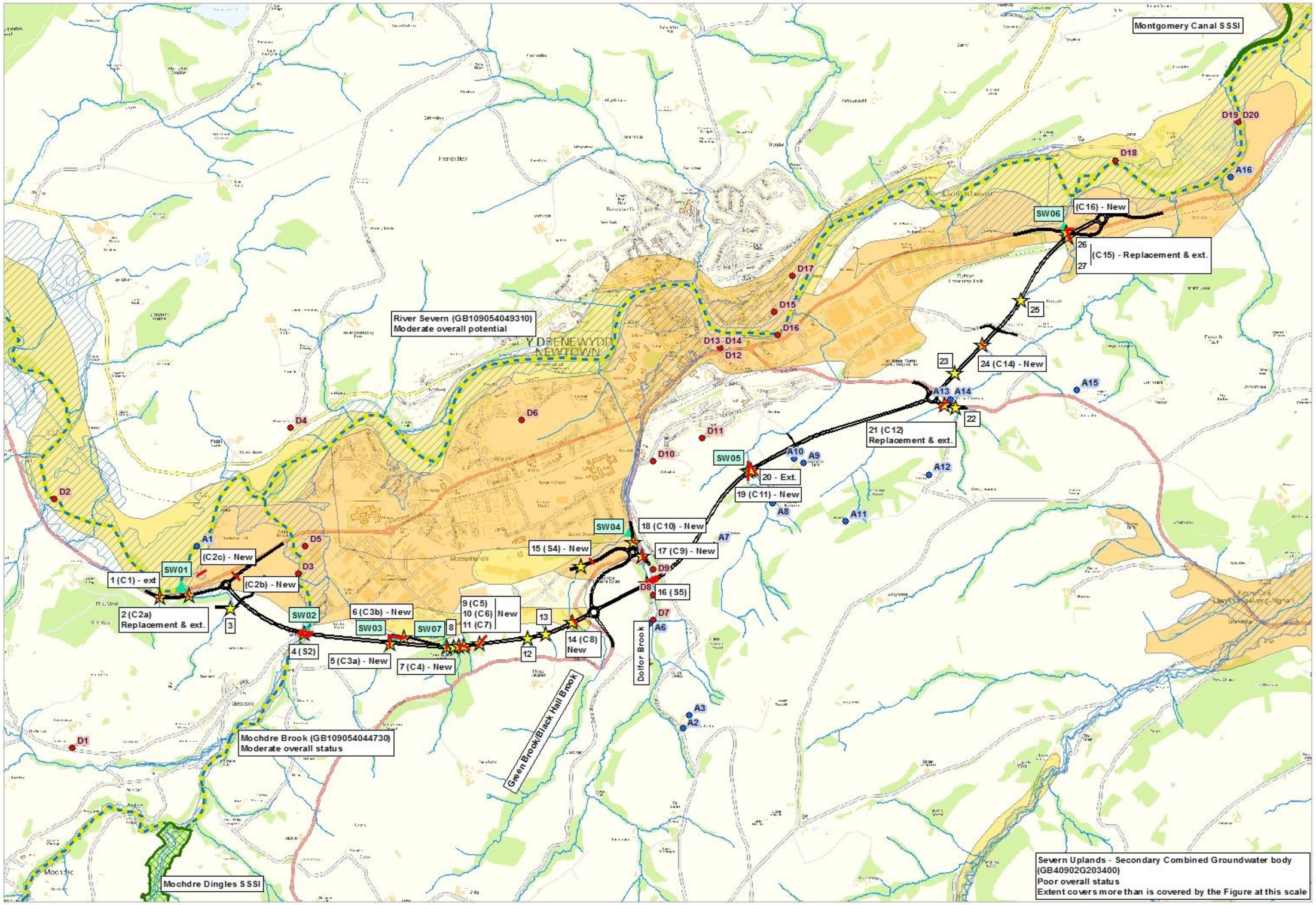
Watercourse reference	Name	Crossing reference	Structure/culvert reference	Scheme chainage (m west to east)
WC1	Tributary 1 of River Severn	1	C1	375 west of 0
WC2	Tributary 2 of River Severn	2	C2a	300m west of 0
		3	n/a (existing culvert – no works required)	150
WC3	Mochdre Brook	4	S2	500
WC4	Tributary 1 of Mochdre Brook – south of College Coleg Powys Fronlas Farm	5	C3a	1000
WC5	Un named Stream at Castell y Dial (Tributary 2 of Mochdre Brook)	6	C3b	1100
		7	C4	1300
WC6	Unknown	8	n/a (no culvert required at this location)	1350
WC7	Tributary 3 of River Severn – course culverted north under Mochdre Industrial Park	9	C5	1395
WC8	Tributary 4 of River Severn	10	C6	1400
WC9	Tributary 5 of River Severn	11	C7	1500
WC10	Ditch 10	12	n/a (no culvert required at this location) – flow diverted to C8	1800
WC11	Ditch 11	13	n/a (no culvert required at this location – flow diverted to to C8)	1900
WC12	Green Brook/ Black Hall Brook	14	C8	2000
		15	S4 (Originally proposed as a bridge but later changed to a culvert)	Mochdre Industrial Estate
WC13	Dolfor Brook 1	16	S5	2500
		17	C9	Middle Dolfor Road
		18	C10	Middle Dolfor Road
WC14	Tributary 6 of River Severn	19	C11	3350
WC15	Tributary 7 of River Severn	20	n/a (New culvert not required because it is already culverted)	3375
WC16	Tributary 8 of River Severn	21	C12	75 south east of 4450 Lower Brimmon
WC17	Tributary 9 of River Severn	22	n/a (new culvert not required because it is already culverted)	145 south east of 4450 Lower Brimmon

Watercourse reference	Name	Crossing reference	Structure/culvert reference	Scheme chainage (m west to east)
WC18	Surface water feature 18	23	n/a (C13 has been removed from the scheme – no culvert is required)	4600
WC19	Ditch 19	24	C14	4850
WC20	Tributary 10 of River Severn	25	n/a (no culvert required because the stream's source is at this location and it is not impeded by the Scheme)	5200
		26	C15	5600
		27	C15	5600

A.2. Watercourse names and crossing locations figure

(Figure overleaf)




Montgomery Canal SSSI
River Severn (GB109054049310)
Moderate overall potential
Mochdre Brook (GB109054044730)
Moderate overall status
Mochdre Dingles SSSI
Green Brook/Black Hall Brook
Dolfor Brook
Severn Uplands - Secondary Combined Groundwater body (GB40902G203400)
Poor overall status
Extent covers more than is covered by the Figure at this scale
1 (C1) - ext
(C2c) - New
(C2b) - New
2 (C2a) Replacement & ext.
3
4 (S2)
5 (C3a) - New
6 (C3b) - New
7 (C4) - New
9 (C5) 10 (C6) 11 (C7) New
14 (C8) New
15 (S4) - New
16 (S5)
17 (C9) - New
18 (C10) - New
19 (C11) - New
20 - Ext.
21 (C12) Replacement & ext.
22
23
24 (C14) - New
25
26
27
(C15) - Replacement & ext.
(C16) - New
SW01
SW02
SW03
SW04
SW05
SW06
SW07
A1
A2
A3
A6
A7
A8
A9
A10
A11
A12
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A14
A15
A16
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D19
D20

Appendix B. Detailed summary of Atkins (as part of the AGC Team) survey findings per watercourse crossing location

Table B-1 Summary of scheme impacts on watercourses and WFD Survey descriptions

(Table B-1 - apart from the final column - was assembled following a site visit undertaken December 2013. All baseline and design estimates were correct at that point in time).

Categorisation key

	Ditch with flow (perennial)
	Ditch without flow (ephemeral)
	Open watercourse in poor condition
	Open watercourse in reasonable/good condition

Structure code/Name of watercourse *(if known)* *In order of west to east across the scheme*	**Water body to be assessed against**	**Description of proposed current option**	**Photo**	**Hydromorphological baseline description** (e.g. channel/bank modification, vegetation, trees, shading, land use, etc)	**Aquatic ecological baseline description** (e.g. vegetation, biological connectivity, habitat potential)	**Channel estimates (m)** 1.Flow width 2.Bank full width 3.Flow depth 4.Bank full depth 5 Bed composition breakdown	**Original estimate (Dec 2013) of scheme culvert lengths.** **(Note that figures presented for culvert extensions are for total culvert lengths and not just extensions).** (Approx. – calc. from CAD [13] structure layer).	**Updated estimate of natural channel length losses from both culverting and total realignment length change (based on data at the design freeze June 2014)**
C1 Unnamed watercourse	R Severn – conf Afon Dulas to conf R Camlad (GB109054049310)	Culvert extension		The 1.5 m wide straightened channel had a very steep gradient and was lined with trees. It appeared to be more of a drainage feature than a watercourse. A small amount of flow was observed. There was an obstruction (old wall and debris) 5 m above the culvert steps. Channel has a high sediment load.	The channel is a steep-sided drainage feature. No channel features were recorded and the substrate was composed entirely of silt, with leaf litter covering the bed substrate. At its confluence with the River Severn the channel drops 2.5 m down stone steps to the road (A489), it is culverted under the road and drops a further 5 m down stone steps where the channel enters the River Severn. This reach showed no appropriate habitat available for fish or invertebrates and there was no biological connectivity to the River Severn.	1. 0.2–0.5m 2. 1.5 3. 0.05 4. 0.3 5. Silt: 100%	20m	1m
C2 Unnamed watercourse	R Severn – conf Afon Dulas to conf R Camlad (GB109054049310)	Culvert extension		The channel has been historically straightened and dredged along a field boundary. It was about 1 m wide and up to 0.5 m deep. There was a wetland feature on the left bank immediately upstream of the existing culvert which would be lost by the culvert extension. Land use was wooded on the left bank with fields on the right bank. The channel had a high sediment load and high volumes of leaf litter. A small amount of flow was observed. The existing 0.5 m diameter culvert exit was set about 0.5 m above the R. Severn.	The channel is an ephemeral drainage ditch with no channel features or associated habitat recorded. The channel shows limited biological connectivity as a result of the 0.5 m culvert under the A489.	1. 0.3 2. 1 3. 0.05 4. 0.3–0.5 5. Clay 100%	30m	47m

[13] CAD dataset received in September 2013

S2 Mochdre Brook	ELEMENT SCREENED OUT DURING THE INITAL ASSESSMENT	New wide span bridge		A natural 10m wide channel with erosional and depositional features visible e.g. exposed bedrock, gravel/pebble bars, pool and riffle sequences. Tree lined with ruderal vegetation on the banks. Channel banks are 2–3 m high and are composed of clay. The existing road bridge narrowed the channel to approximately 3m. Upstream of the bridge is a 0.4 m high weir above a natural bed rock waterfall. Some bank protection was observed on the left bank.	The channel shows significant diversity through this reach, with a number of channel features being recorded. A variety of flow types were recorded, including riffles, pools and glides, providing good habitat for fish. The substrate composition provided further diversity. Tree-lined banks offered the associated features of bankside root and overhanging bows, resulting in additional habitat and potential cover for fish respectively. There was a 0.4 m high weir structure upstream of the road bridge. It was not considered to pose barrier to salmonids or some coarse fish species.	1. 3.5–4 2. 10 3. 0.3–0.7 4. 2–3 5. Bedrock: 15% Cobble: 35% Pebble: 30% Gravel: 10% Silt: 10%	NA	NA
C3a Unnamed watercourse	Mochdre Bk – source to conf R Severn (GB109054044730)	New culvert		The small 0.5 m channel is representative of a natural headwater system. It flows through a woodland and has a fairly steep gradient. The banks are composed of clay and silt. Woody debris is observed. There were no modifications along the reach to be lost through culverting, however the channel is already culverted under an access track approximately 50m downstream.	A small woodland stream exhibiting some diversity of habitat including eroding banks, woody debris and exposed bank side roots. However flow was limited to a depth of approximately 0.15 m and biological connectivity is limited as a result of a culvert through the farmyard downstream and upstream of its confluence with the Mochdre Brook.	1. 0.5 2. 2 3. 0.1–0.2 4. 1 5. Cobble: 10% Pebble: 30% Gravel: 30% Sand: 10% Silt: 20%	70m	122m

C3b Unnamed watercourse	Mochdre Bk – source to conf R Severn (GB109054044730)	New culvert	  	This tributary channel has been modified by culverting, realignment and dredging and is effectively a drainage channel along the reach where the impact will occur. It is already culverted twice under an access track and a wall. Between the two culverts is a 10m length of wet channel with no perceptible flow. Upstream of the second culvert is a 0.3 m wide dry ditch which is embanked. Bank height is approximately 0.5m. Water was observed 50m upstream so it was assumed that water was being lost through groundwater seepage.	The channel is an artificial drainage ditch with flow only appearing intermittently. The channel has a grass substrate for much of the reach and shows very limited in-channel diversity. Furthermore the channel is culverted at an access track at its downstream extent providing a barrier to any potential fish migration.	1. 0–0.3 2. 0.5 3. 0 4. 0.5 5. Grass substrate for majority of the reach.	80m	3m
C4 Unnamed watercourse	Mochdre Bk – source to conf R Severn (GB109054044730)	New culvert		The tributary channel at this point is representative of a natural headwater system. It has a wetted width of 1m, but bank full width of approximately 3m. It is located within a steep valley in Castell-y-dail Woodland and has a slightly sinuous form. The channel also has a high volume of woody debris. Heavy shading from trees limits the bank side vegetation. Downstream of this point is a natural waterfall approximately 2m high.	The channel shows some diversity of habitat with woody debris and exposed bank side roots and a diversity of substrate. However flow is limited with a total depth of 0.1 m and the channel has no biological connectivity with the River Severn as a result of two culverts at its downstream extent	1. 1 2. 3 3. 0.1–0.2 4. 0.5–1 + 5. Cobble: 10% Pebble: 50% Gravel: 20% Sand: 10% Silt: 10%	30m	45m
C5_C6 Unnamed watercourse	R Severn – conf Afon Dulas to conf R Camlad (GB109054049310	Realign channels upstream of the scheme and reduce their velocity before being culverted under the road.		Within the steep Castell-y-dail woodland are two very small tributary channels. They are 0.3–0.5 m wide with a 0.2 m wetted width. There is very little flow and the channels are heavily shaded with a large volume of woody debris and leaf litter. The tributaries of vertically active but are constrained from moving laterally because of trees stabilising the banks.	Heavily vegetated woodland streams with very little flow. Limited habitat availability, the channel is disconnected from the River Severn as a result of culverting through Newtown.	1. 0.2 2. 0.5 3. 0.02 4. 0.5 5. Silt/clay covered by leaf litter.	60m and 60m	46 m and 68m
C7 Unnamed watercourse	R Severn – conf Afon Dulas to conf R Camlad (GB109054049310)	New culvert		The feature is a run-off depression which had no flow at the time of survey. It was at the edge of the woodland where gradient was extremely steep.	A dry woodland stream with no available habitat for aquatic fauna. The channel has no connectivity to the River Severn as a result of culverting through Newtown.	1. NA 2. NA 3. 0 4. NA 5. Earth/clay covered by leaf litter.	70m	75m

Additional scheme element between C7 and C8 Unnamed watercourse	R Severn – conf Afon Dulas to conf R Camlad (GB109054049310)	New culvert?		This feature is a historic drainage channel, and is currently a hillside hollow. Historically it would have been dredged and widened. At the scheme location (upstream of the photo) the feature was marked by a hedgerow but no flow was visible at the time of survey	A dry depression likely used for land drainage. No flow or associated habitat for aquatic fauna.	1. NA 2. NA 3. 0 4. NA 5. Grass substrate.	30m	0m
Additional scheme element between C7 and C8 Unnamed watercourse	R Severn – conf Afon Dulas to conf R Camlad (GB109054049310)	New culvert?		This feature is an ephemeral ditch along a field boundary. The ditch was 0.3 m wide and was vegetated with grass suggesting flow had not regularly occurred for some time.	At the location of proposed culvert the tributary is a minor ditch with no flow, lined by a hedge on the right bank. Downstream of the proposed development the ditch becomes more formalised with field drains entering the channel and evidence of active erosion. However flow is not enough to provide habitat for fish and the channel is culverted at the downstream extent.	1. 0 2. 0.3 3. 0 4. 0.5 5. Grass substrate.	30m	0m
C8 Green Brook	R Severn – conf Afon Dulas to conf R Camlad (GB109054049310)	New culvert		Sinuous channel within steep sided valley. Representative of a natural headwater system. Channel exhibited many erosional and depositional features. Knick point observed within the reach to be impacted by the scheme. There was a small floodplain on the left bank. Land use is agricultural fields. Trees are present semi continuously along both banks.	A natural section of channel showing a variety of habitats including woody debris, exposed bank side roots and eroding cliffs. Channel features include pools, riffles and glide, providing a variety of habitats for fish. Some marginal vegetation (brooklime) noted, but wrong time of year to assess vegetation cover. No barriers immediately downstream, however the tributary is eventually culverted through Newtown.	1. 0.5–1 2. 2–3 3. 0.05 – 0.75 4. 0.5–1.5 5. Cobble: 15% Pebble: 255 Gravel: 30% Sand: 10% Clay: 10% Silt: 10%	60m	101m

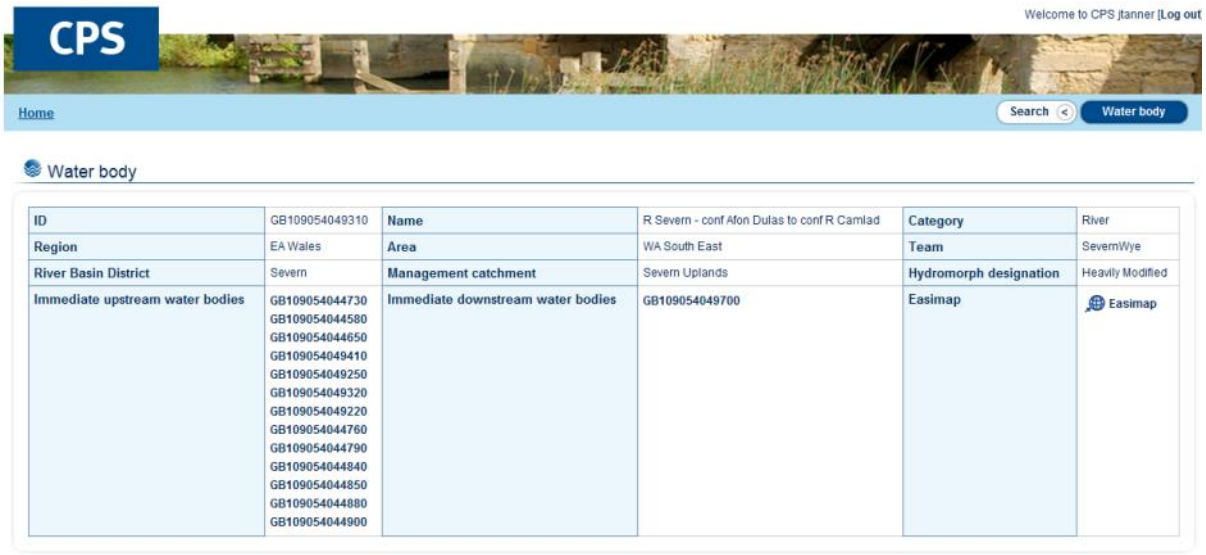
S4 Green Brook	R Severn – conf Afon Dulas to conf R Camlad (GB109054049310)	New culvert		The channel has been modified. Immediately upstream of this point the channel is culverted under an industrial estate and straightened along a hedgerow. At the proposed culvert location the channel is recovering and has some sinuosity. Marginal and bank top vegetation are present. A ford is present at the crossing.	This channel has some diversity of substrate and marginal vegetation (brooklime covering approximately 10% of channel), but limited channel features and therefore habitat diversity. Immediately downstream of this site the channel is culverted at a number of locations through Newtown.	1. 0.25–0.75 2. 1 3. 0.25–0.5 4. 0.1 5. Pebble: 20% Gravel: 555 Sand: 10% Silt: 15%	20m	41m
S5 Dolfor Watercouse (Dingle Valley)	R Severn – conf Afon Dulas to conf R Camlad (GB109054049310)	New wide span bridge with river realignment into the right bank.		The 0.5–1 m wide channel has been historically straightened and dredged, with some vegetation clearance work having been recently carried out. The channel is likely to have been historically moved against the steep valley side. It is also embanked on both sides. Trees are present on the left bank with a coach park on the right bank. The right bank is composed of made ground.	This modified section of channel shows some substrate diversity, but overall limited channel complexity (i.e. absence of woody features, and limited flow types). Japanese knotweed is widespread along this reach. The channel is culverted at the roads upstream and downstream of this reach.	1. 0.5–1 2. 3 3. 0.05–0.3 4. 1 5. Cobble: 10% Pebble: 40% Gravel: 40% Sand: 5% Silt: 5%	NA	NA
C9 and C10 Dolfor Watercouse (Dingle Valley)	R Severn – conf Afon Dulas to conf R Camlad (GB109054049310)	New culverts	  	The Dolfor Watercourse is culverted under the A483 through a 1.5 m diameter culvert (see first photo). Downstream of this point is an open reach where the channel is 1–1.5 m wide with gabion bank protection on both banks. After approximately 10m is a second similarly sized culvert (approximately 100m in length). Downstream the reach is heavily shaded but has better morphology in general with some sinuosity and a riffle sequence. The channel is then culverted for a third time under an access track, before passing through a trash screen and then into a fourth culvert (which extends) for approximately 500m until just south of Plantation Lane. In general the channel is incised, has been historically dredged, and is embanked. It has relatively poor morphology due to the extensive culverting and associated bank protection.	Both of these sites are situated on heavily modified sections of channel with uniform cross-sections and flow type and consequently limited channel features. The channel is dominated by unbroken wave flows with a gravel substrate, potentially providing good spawning habitat. However the channel is culverted at a number of locations resulting in multiple barriers to fish migration. Furthermore two of these culverts have incised around the base resulting a drop of approximately 0.4m. Japanese knotweed is widespread with evidence of recent cutting.	1. 1.5 2. 3 3. 0.1 4. 5–7 5. C9 Boulder: 10% Cobble: 20% Pebble: 20% Gravel: 40% Sand: 5% Silt; 5% C10 Cobble: 30% Pebble: 30% Gravel: 30% Silt: 10%	Assumed to be two culvert extensions one, 37 m long and another 22 m long.	-79m

C11 Unnamed watercourse	R Severn – conf Afon Dulas to conf R Camlad (GB109054049310)	New culvert		At the impact zone the left channel has been historically straightened along a field boundary. It was approximately 30cm wide and the silty banks were vegetated with grass. Isolated trees were present along the reach. The right channel to be culverted no longer exists (it has been historically infilled). Downstream of the impact zone the channel is currently culverted under a hillock where it joins the tributary.	The channel has been previously modified for the purpose of land drainage and is culverted across the field downstream of the proposed development. The reach crossing the proposed development site has some substrate diversity and marginal vegetation was recorded. However overall the channel shows limited diversity of habitats with a uniform cross-section and few channel features recorded.	1. 0.3 2. 1 3. 0.05 4. 0.3–0.5 5. Pebble: 20% Gravel: 45% Sand: 10% Silt: 25%	90m	45m
C12 Unnamed watercourse	R Severn – conf Afon Dulas to conf R Camlad (GB109054049310)	Culvert extension		The channel within the impact zone is approximately 1 m wide. It has recently been dredged most likely by the farmer to improve field drainage. It has been over widened and over deepened by about 0.1 m below the natural clay bed. There is a slight embankment along the left bank. The culvert under the A489 has too small capacity (being only 0.5 m wide) and causes flow to be ponded upstream of it along the reach.	A heavily modified section of channel with evidence of extensive dredging, resulting in limited habitat potential; no channel features or substrate diversity. The channel lacks biological connectivity as a result of the road culvert downstream of the site, which is 0.5 m wide and impounding flows upstream.	1. 1 2. 2 3. 0.05 4. 1 5. Clay; 20% Silt: 80%	40m	59m
C13 Unnamed watercourse	R Severn – conf Afon Dulas to conf R Camlad (GB109054049310)	New culvert	No photo taken	No watercourse feature was observed at this location. Only a hedgerow was present.	No comment.	1. NA 2. NA 3. NA 4. NA 5. NA	30m	NA
C14 Unnamed watercourse	R Severn – conf Afon Dulas to conf R Camlad (GB109054049310)	New culvert		At the scheme location the feature is an ephemeral ditch. After a period of rainfall water accumulates in a pond to the north which only discharges along the ditch when levels meet a certain threshold (because of the topography). The channel is approximately 1.5 m wide and had standing water at the time of survey. The banks and bed were vegetated with grass and there was some shade provided by semi continuous trees.	An ephemeral channel, likely realigned for field drainage. Being ephemeral in nature the channel shows little habitat diversity, with imperceptible flows and a substrate entirely composed of silt.	1. 0.5 2. 1.5 3. 0.03 4. 0.3 5. Silt: 100%	30m	32m

Additional scheme element near Penygelli Unnamed watercourse	R Severn – conf Afon Dulas to conf R Camlad (GB109054049310)	Potential realignment likely to be required		The water feature is a ditch (beneath a hedgerow) with a small amount of flow at the time of survey. The channel width is approximately 1 m wide.	Tributary primarily for drainage. Grass substrate covered by leaf litter, no available habitat for aquatic fauna.	1. 0.3 2. 1 3. 0.03 4. 0.5 5. Grass substrate	80m	NA
C15 Unnamed watercourse	R Severn – conf Afon Dulas to conf R Camlad (GB109054049310)	Culvert extension		The channel has been historically dredged and straightened but there is slight sinuosity indicating a degree of recovery. It is approximately 1 m wide (bank top). There are farm buildings adjacent to the channel on the left bank. There are several obstructions along the reach observed: it is culverted under the railway, culverted under the A489, and there are debris blockages e.g. an old water trough.	Historically re-sectioned and realigned with a uniform cross-section and limited channel features. Some substrate diversity, providing potential invertebrate habitat, however much of the downstream extent is smothered by silt. The channel is culverted as a result of the rail line upstream and road downstream providing a significant barrier to fish.	1. 0.3 2. 1 3. 0.05 4. 0.5 5. Cobble: 5% Pebble: 5% Gravel: 10% Silt: 80%	60m	37m

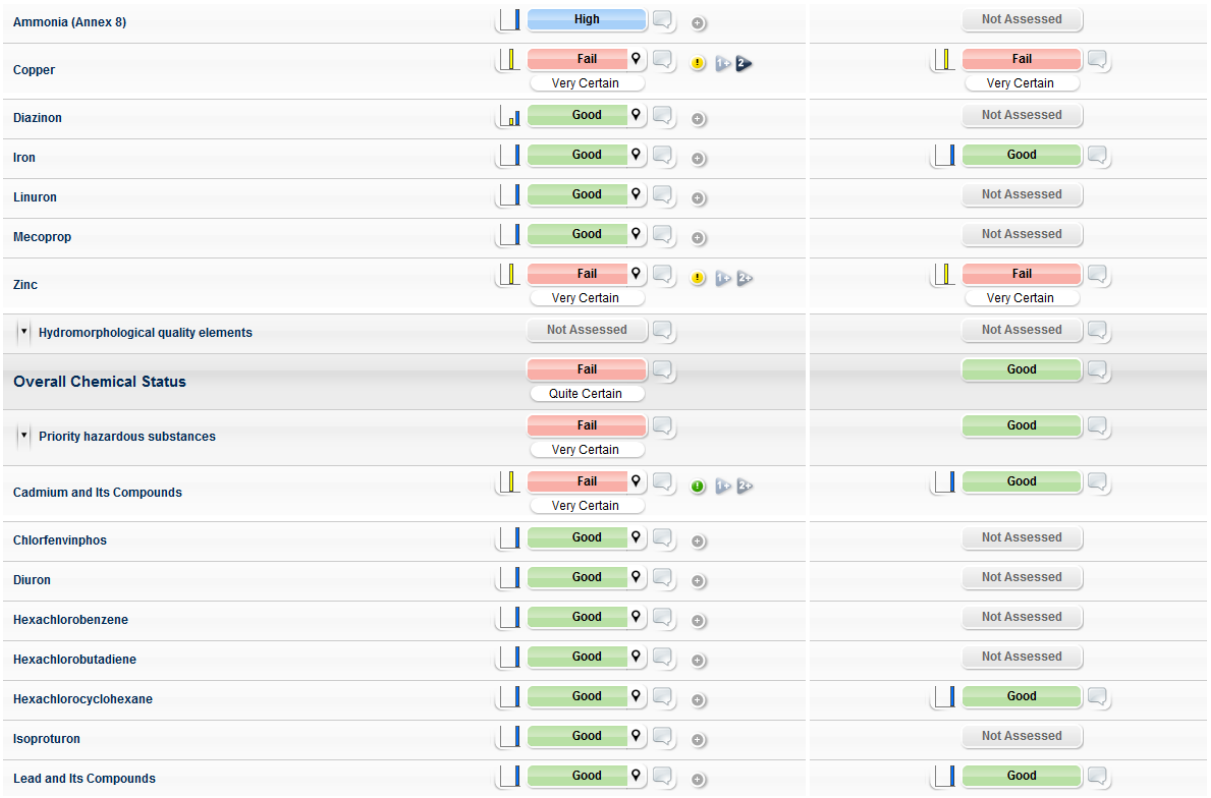
Appendix C. Water body summary information (2013) provided by NRW

- R Severn – conf Afon Dulas to conf R Camlad water body (GB109054049310)



ID	GB109054049310	Name	R Severn - conf Afon Dulas to conf R Camlad	Category	River
Region	EA Wales	Area	WA South East	Team	SevernWye
River Basin District	Severn	Management catchment	Severn Uplands	Hydromorph designation	Heavily Modified
Immediate upstream water bodies	GB109054044730 GB109054044580 GB109054044650 GB109054049410 GB109054049250 GB109054049320 GB109054049220 GB109054044760 GB109054044790 GB109054044840 GB109054044850 GB109054044880 GB109054044900	Immediate downstream water bodies	GB109054049700	Easimap	Easimap

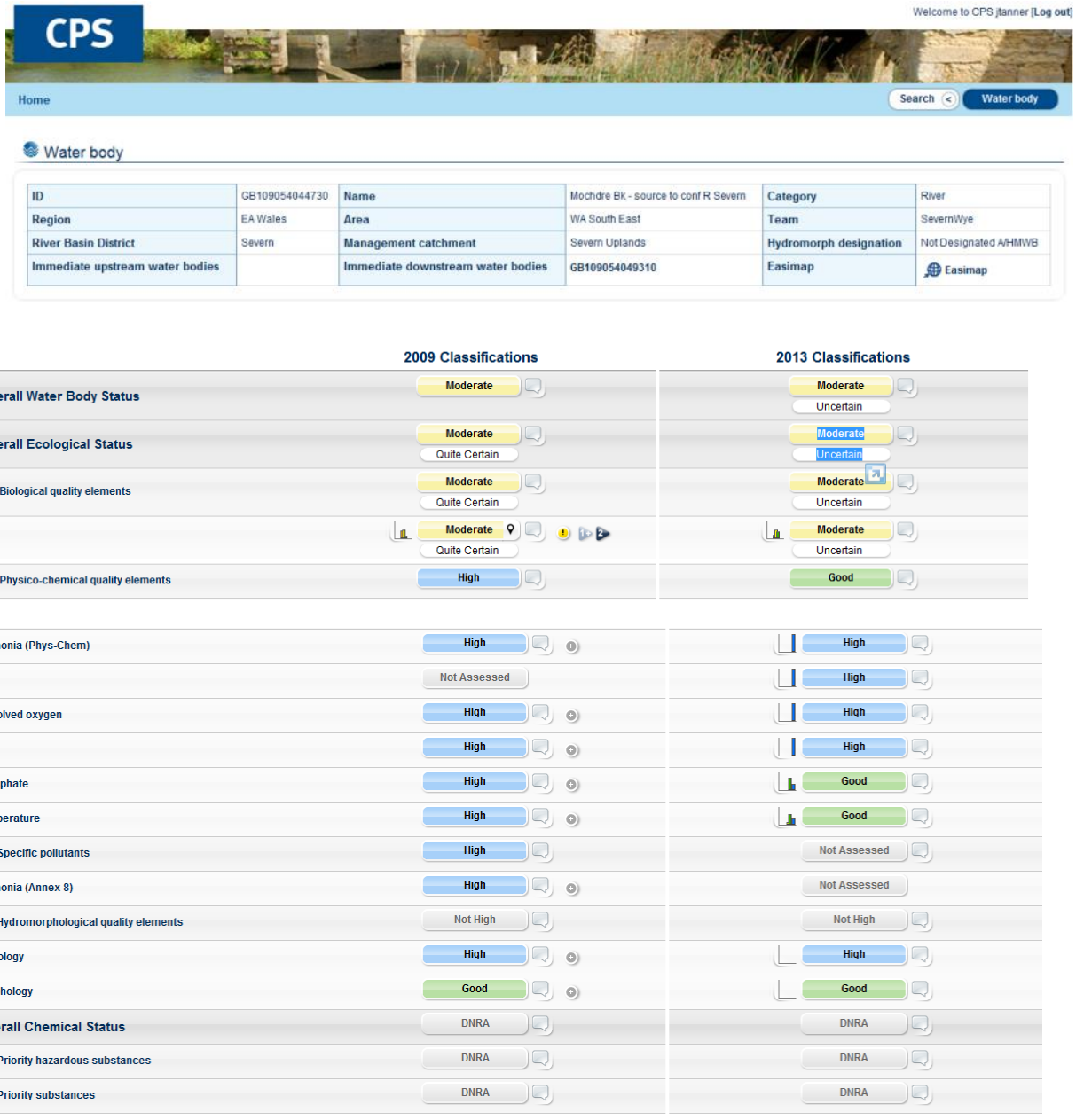
	2009 Classifications	2013 Classifications
Overall Water Body Potential	Poor	Moderate Quite Certain
Overall Ecological Potential	Poor Quite Certain	Moderate Quite Certain
Biological quality elements	Poor Very Certain	Moderate Uncertain
Fish	Poor Very Certain	Good
Invertebrates	High	High
Phytobenthos	Poor Very Certain	Moderate Uncertain
Supporting elements (Surface Water)	Good	Good
Mitigation Measures Assessment	Good	Good
Physico-chemical quality elements	High	Good
Ammonia (Phys-Chem)	High	High
BOD	Not Assessed	High
Dissolved oxygen	High	High
pH	High	High
Phosphate	High	Good
Temperature	High	Good
Specific pollutants	Moderate Very Certain	Moderate Very Certain
2,4-dichlorophenoxyacetic acid	Good	Not Assessed



Metals failures driven by metal mines upstream.

MEASURE: There is an operating agreement in place to ensure flows are maintained to support environmental needs and to meet the needs of downstream abstractions.

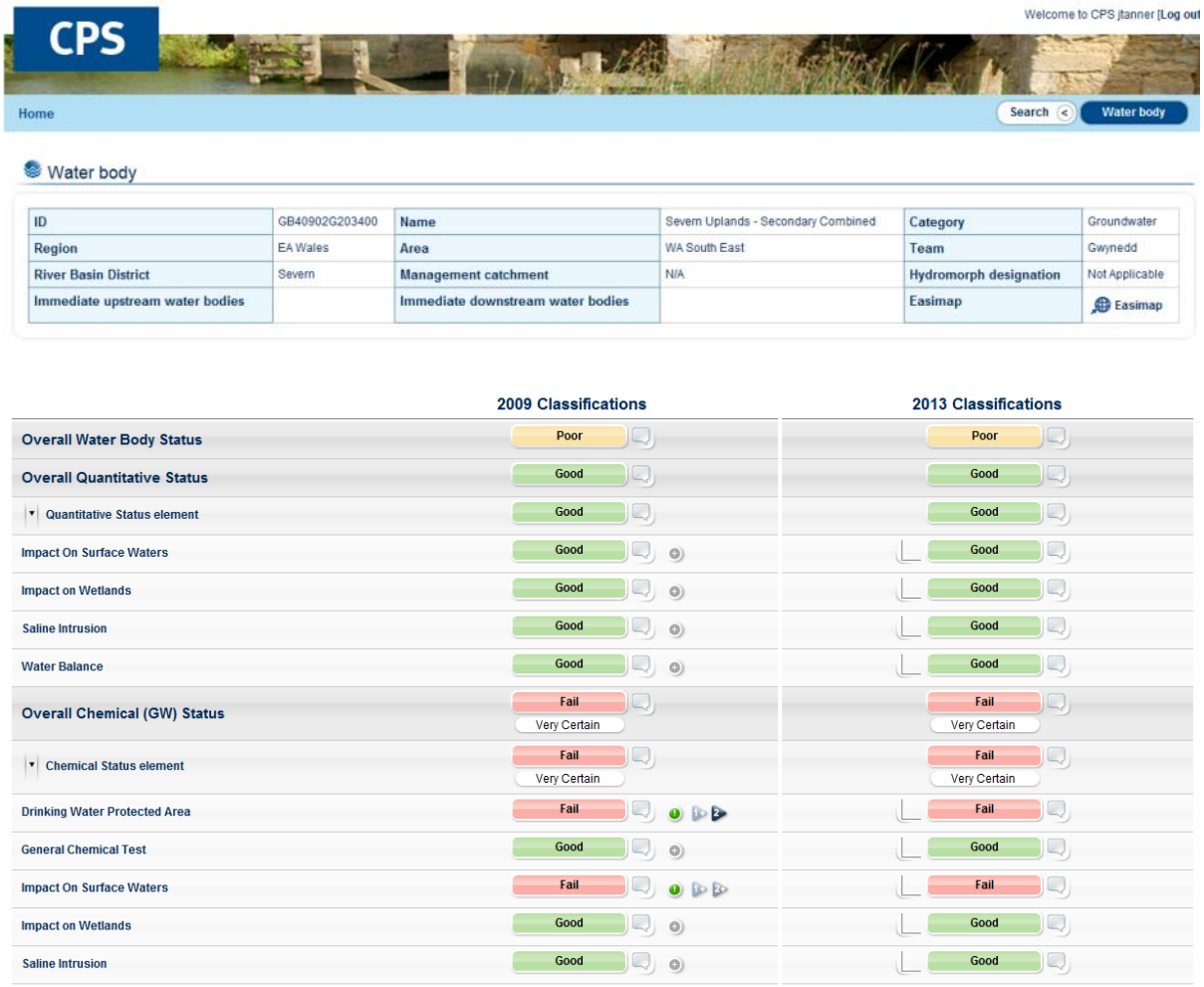
- Mochdre Bk – source to conf R Severn water body (GB109054044730)



Fish failure driven by barriers and habitat

Two fish sites, Mochdre Brook site is at Good status, other site on headwaters of Cwm-y-Rhiwdre Brook is at Poor status based on 3 trout when expect 14. There is a SRT Walkover report on file.

- GB40902G203400 Severn Uplands Secondary Combined



ID	GB40902G203400	Name	Severn Uplands - Secondary Combined	Category	Groundwater
Region	EA Wales	Area	WA South East	Team	Gwynedd
River Basin District	Severn	Management catchment	N/A	Hydromorph designation	Not Applicable
Immediate upstream water bodies		Immediate downstream water bodies		Easimap	Easimap

	2009 Classifications	2013 Classifications
Overall Water Body Status	Poor	Poor
Overall Quantitative Status	Good	Good
Quantitative Status element	Good	Good
Impact On Surface Waters	Good	Good
Impact on Wetlands	Good	Good
Saline Intrusion	Good	Good
Water Balance	Good	Good
Overall Chemical (GW) Status	Fail Very Certain	Fail Very Certain
Chemical Status element	Fail Very Certain	Fail Very Certain
Drinking Water Protected Area	Fail	Fail
General Chemical Test	Good	Good
Impact On Surface Waters	Fail	Fail
Impact on Wetlands	Good	Good
Saline Intrusion	Good	Good

The surface water chemical failures are primarily as a result of the impact of abandoned former metal mines in the area. GW Drinking water measures: Recommends: Continue with COGAP CSF; GW Protection Policy GP3; NVZ action plans; EPR 2010. To reduce N: Agronomist advice; winter cover crops; Alternative management of crops /fertilizer/ livestock/yards/slurry.

Downstream water body names and overall potential, (Environment Agency, December 2009)

- R Severn – conf R Camlad to conf Bele Bk – GB109054049700 – Moderate Overall Potential
- R Severn – conf Bele Bk to conf Sundorne Bk – GB109054049142 – Moderate Overall Potential
- R Severn – Sundorne Bk to conf M Wenlock–Farley Bk –GB109054049141 – Moderate Overall Potential
- R Severn conf M Wenlock–Farley Bk to conf R Worfe – GB109054049143 – Moderate Overall Potential
- R Severn – conf R Worfe to conf R Stour – GB109054049145 – Moderate Overall Potential
- R Severn – conf R Stour to conf River Teme – GB109054049144 – Moderate Overall Potential
- R Severn – conf R Teme to conf R Avon – GB109054039760 – Moderate Overall Potential
- R Severn – conf R Avon to conf Upper Parting – GB109054044404– Moderate Overall Potential
- Severn Upper –GB530905415403 – Moderate Overall Potential
- Severn Middle – GB530905415402– Moderate Overall Potential
- Severn Lower – GB530905415401 – Moderate Overall Potential

Appendix D. NRW Walkover notes January 2014

Walkover carried out in late January 2014 during high flow conditions and comments are based on the conditions we observed at the time.

Culvert 1 (unnamed watercourse)

River Biodiversity

- Watercourse with seasonally flow entering River Severn downstream.
- Otters travel the watercourse and spraint was found in the culvert on flood debris during walkover. Any culvert extension should maintain access for otters and consider options to prevent animals getting onto the road (otter proof fencing etc.)

Culvert 2 (unnamed watercourse)

River Biodiversity

- Watercourse with seasonal flow immediately adjacent to River Severn providing access to an area of wet woodland. This has high potential for use by otters. Any proposals to create new wetland should also consider future use by otters and any risks posed by the road that may need to be mitigated for (roadside fencing)
-

Stream 2 (Mochdre Brook)

River Biodiversity

- New wide span bridge proposal will require some tree works, some trees support features suitable for bats. More detailed bat survey information needed – further liaison with John Messenger recommended.

Fisheries

- The Mochdre Brook supports populations of Atlantic salmon, brown trout and bullhead. Considered a sensitive site but proposals for a clear span structure should mitigate impacts.

Culvert 3a (unnamed watercourse)

River Biodiversity

- Watercourse requiring culvert and a separate Mammal underpass. Will also require badgers proof fencing to guide mammals into the underpass.
-

Geomorphology

- This is a nice section watercourse of presenting good natural flow diversity, dynamic equilibrium and environmental potential. Wider than stated; approx 1.5 m to 2 m wide on average. The watercourse is relatively steep, but it has incised and meandered to largely accommodate this change. Whilst still mobile, with unconsolidated bank sides, it is in a state of dynamic equilibrium with the exception of the downstream section near the existing culvert where excess gravels have dropped out due to the reduction in gradient. Given the quality of the watercourse upstream, in addition to the mobile bank/bed material, the gradient and the

potential to destabilise the reach it is recommended that a structure providing ~5 m lateral movement that does not involve removing the bed is implemented (e.g. clear span, large bottom-less culvert, large flexi-arch).

Fisheries

- Appears to represent reasonable fish habitat and may support populations of brown trout and bullhead. The current proposals would result in the direct loss of 70m of habitat. A structure that spans the watercourse and maintains the natural bed should be considered (e.g. pre-cast, span structure).

Culvert 3b (unnamed watercourse)

River Biodiversity

- Watercourse/ditch line of low biodiversity interest. Realignment creates the opportunity to improve its biodiversity value through meandering, fencing from livestock and planting with trees and shrubs to improve habitat connectivity.
-

Culvert 4, 5, 6 (Lie within Castell y Dial woodland)

River Biodiversity

- The whole area needs extensive bird and bat surveys (further liaison with John Messenger). Many potential species may occur here including schedule 1 species of breeding bird such as Red Kite, Buzzard, Raven. Many mature trees support bat features such as holes, splits, cracks and loose bark. Some trees have hazard beam features suitable for rare species such as Barbastelle bat. The woodland itself with dense patches of holly as understory may also be attractive as a foraging area for Lesser Horseshoe bats, a species requiring special care in relation to road construction. Detailed bat survey data will be required to inform any tree felling and mitigation requirements.

Geomorphology (C5 and 6)

- The steep sides, deeply incised, and highly sinuous channels in parts are likely to be highly unstable if disturbed (e.g. dug up and replaced within a culvert). This instability is likely to be further exacerbated when the trees are removed. As such box section culverts in these locations would need to be a minimum of 3 m wide, probably 5m, with considerable consideration related to the depth of bed in order not to result in a “hanging” culvert in future years. However, given their gradient and mobility this is likely to be very difficult to predict and as such culverts are likely to cause geomorphological instability and significantly increase future liabilities. At present the watercourses have high levels of erosion through deep incision, however their mobility is significantly constrained due to the presence of the trees. Given the above it is recommended that the beds are left alone and bottom-less culverts or flexi-arch solutions are derived.

(C4 - Same as C5 and C6 but with some less sinuosity but greater incision due to the large steep valley. Culverts are not recommended. Beds are recommended to be left alone and bottom-less culverts or flexi-arch solutions are derived.)

Culvert 7 (unnamed watercourse)

River Biodiversity

- Watercourse seasonally flowing beside dense hedge of hazel and other shrubs/trees. Likely to provide commuting and foraging for bats and possibly dormice. Bat survey data should be used to inform culvert design (over-sized culvert will allow passage of mammals through under the road).
-

Culvert 8 (Green Brook)

River Biodiversity

- New Culvert proposed but a clear span bridge, large bottom-less culvert or large flexi-arch would be better options to maintain the ecological connectivity of the feature under the road. The tree lined brook and adjacent woodland provides excellent looking bat habitat – a detailed assessment of bat use and presence of bat roosts is required to inform design and mitigation measures. Signs of otters were also located on the brook downstream suggesting that the species hunts and explores the watercourse. Potential otter resting sites might occur among tree roots of adjacent large trees within 20 – 30m of the watercourse.

Fisheries

- A natural watercourse comprising good quality fish habitat. We would expect the Green Brook to support populations of brown trout and bullhead. The proposals will result in the direct loss of 60m of habitat and, more importantly, if inappropriately designed will lead to further habitat fragmentation. A structure that spans the watercourse and maintains the natural bed should be considered (e.g. pre-cast, span structure).

Geomorphology

- The Green Brook in this location is mobile and is actively eroding and incising as the watercourse meanders tightly, with very high sinuosity in parts, in order to reduce the presently very steep gradient. A very large >10m wide box culvert may be possible if a >1.5 m deep natural bed can be formed. However, this has a high likelihood of destabilising the bed (as it would be uncompacted loose replaced substrate) post construction which would cause further erosion which may subsequently block the downstream culverts causing flooding. As such a structure providing ~5 m lateral movement that does not involve removing the bed is advised (e.g. clear span, large bottom-less culvert, large flexi-arch).

Stream 4 (Green Brook)

River Biodiversity

- Culvert proposed but a clear span bridge or large flexi-arch should be considered (or an over-sized culvert to encourage stream meandering and earth banks to form inside). Streamside vegetation cover includes dense bramble domes as potential resting sites for otters; a recent spraint was located containing frog bones suggesting local hunting along this stream.

Fisheries

- The channel has been modified here and provides poorer habitat quality than upstream but it is beginning to re-naturalise. This short section of watercourse is isolated by culverted sections up and downstream so it's potential to support fish population is compromised. Less of a priority from a fisheries perspective but a structure that spans the watercourse and maintains the natural bed should be considered (e.g. pre-cast, span structure).
-

Geomorphology

- Green Brook is trying to renaturalise itself at this point. Clear span or flexi-arch would be preferred but if a culvert is required a large box section would is recommended with enough room for the watercourse to meander (~5 m wide) and provide a 600mm deep natural bed.

Stream 5 (Dolfor Brook)

River Biodiversity

- High span bridge proposed should protect ecological connectivity of the Dingle Valley but the works will require some extensive earth moving and tree felling which should be mitigated for. Many mature trees support bat features such as holes, splits, cracks and loose bark. Some trees have hazard beam features suitable for rare species such as Barbastelle bat. The woodland itself with dense understory may also be attractive as a foraging area for Lesser Horseshoe bats, a species requiring special care in relation to road construction. Detailed bat survey data will be required to inform any tree felling and mitigation requirements.

Fisheries

- The proposed clear span structure should maintain fish passage and limit the impact on this watercourse. We welcome the possibility of re-aligning this watercourse in order to improve the channel morphology and habitat.
-

Culvert 9 and 10 (Dolfor watercourse)

River Biodiversity

- Heavily culverted in places with trash screens. Weirs and fast flowing water may pose a problem to the upstream movement of otters that could be forced to leave the watercourse and cross the existing A483 (otter road deaths have been recorded here in the past). Otter spraint was located at time of site visit. The New culverts and potential channel realignment have the opportunity to incorporate features for otters and minimise risk of road death. As with previous comments survey for bat use will also inform any required mitigation measures especially is Lesser horseshoe bats are present.

Fisheries

- The existing culverts under and alongside the A483 are poorly designed, from an ecology perspective, and form complete barriers to fish migration. More detail on proposals to de-culvert and re-align the Dolfor and Green Brooks in this area would be welcomed. The new single culvert should be designed such that it does not present a barrier to fish migration. It is recommended the poorly designed culvert that takes the brook under the A483 is replaced as part of this development.

Geomorphology

- We recommend this section is deculverted, if possible, and the straightened Green Brook meandering. There is a large gradient difference on the Dolfor and as such would require significant meanders within the adjoining field to dissipate this energy. This field (near to the new roundabout) could be turned into a woodland area for public enjoyment, increased habitat, and potentially be used as a flood storage area if the culverts are prone to flooding downstream. These options are likely to require the importation of material to form the features required.

Culvert 11 (un-named watercourse)

Fisheries

- Appears to represent reasonable fish habitat and may support populations of brown trout and bullhead. A structure that spans the watercourse and maintains the natural bed should be considered (e.g. pre-cast, span structure).

Culvert 12 (un-named watercourse)

River Biodiversity

- Culvert is under A486 at Lower Brimmon Farm and includes a higher level pipe (dry at the time of survey and found to contain an **otter resting site** by way of collected hay bedding with fresh spraint present). Replacement of the culvert will need to ensure that no otters are present and that safe access for otters under the road is provided. A separate high level mammal pipe may be required here.

Fisheries

- The watercourse in the vicinity of the development has been modified and comprises relatively poor habitat for fish. Having said that, opportunities to improve on the existing culverts and morphology should be investigated.

Culvert 13

River Biodiversity

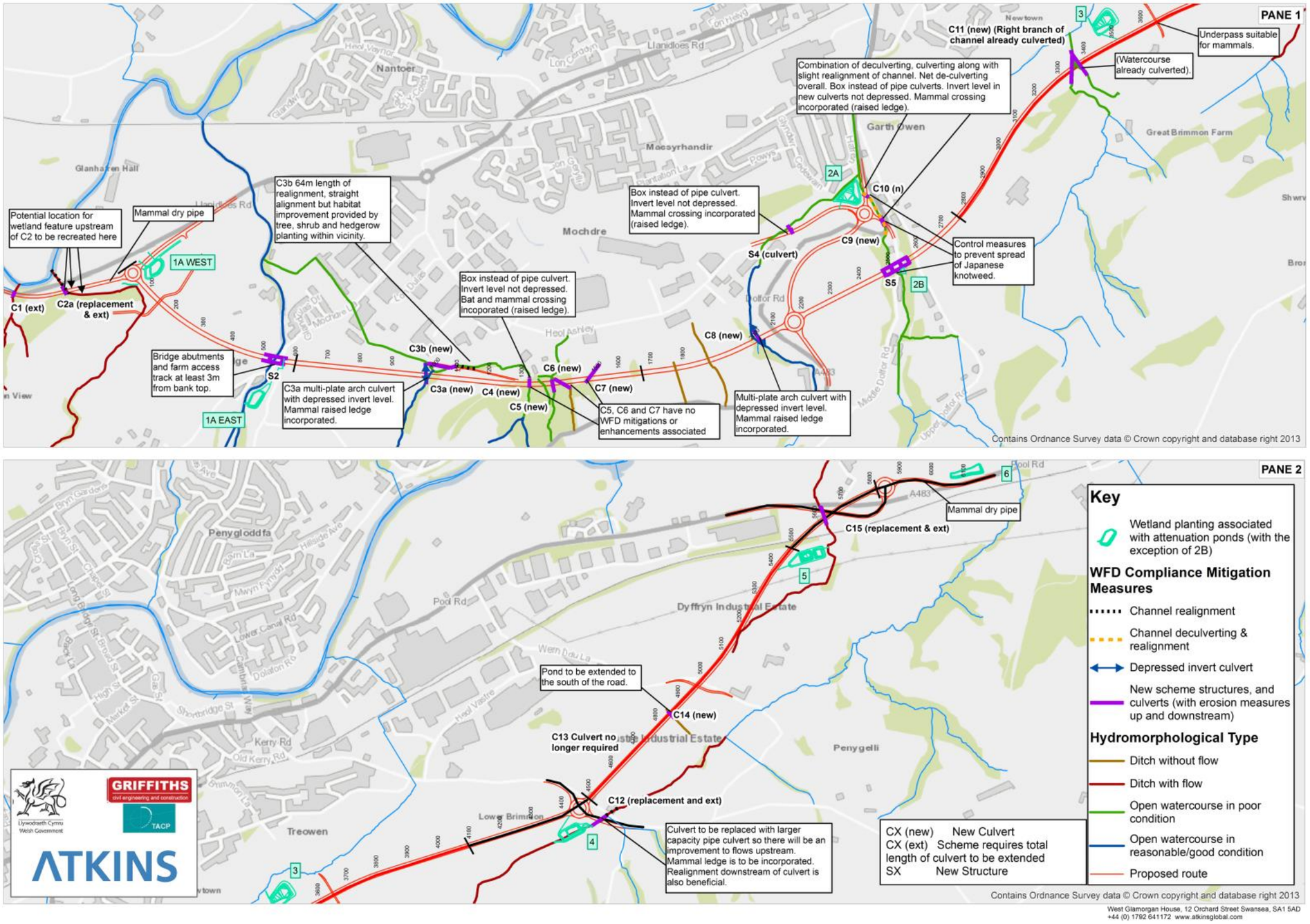
- Some surface water ditch flow at time of the survey. Disused barn adjacent to the site has high potential for bat use (including as a night roost for Lesser horseshoe bats). Detailed survey required to inform of impacts and any mitigation measures required.
-

Culvert 15 (extension)

River Biodiversity

- Stream connects to tree and hedge-lines and so may be important for bats. Disused barn adjacent to the site has high potential for bat use (including as a night roost for Lesser horseshoe bats). Detailed survey required to establish impacts and any mitigation measures required.

WFD Mitigations and enhancements overview figure


PANE 1
Potential location for wetland feature upstream of C2 to be recreated here
Mammal dry pipe
C3b 64m length of realignment, straight alignment but habitat improvement provided by tree, shrub and hedgerow planting within vicinity.
Box instead of pipe culvert. Invert level not depressed. Mammal crossing incoporated (raised ledge).
Box instead of pipe culvert. Invert level not depressed. Mammal crossing incorporated (raised ledge).
Combination of deculverting, culverting along with slight realignment of channel. Net de-culverting overall. Box instead of pipe culverts. Invert level in new culverts not depressed. Mammal crossing incorporated (raised ledge).
C11 (new) (Right branch of channel already culverted)
Underpass suitable for mammals.
(Watercourse already culverted).
Control measures to prevent spread of Japanese knotweed.
Bridge abutments and farm access track at least 3m from bank top.
C3a multi-plate arch culvert with depressed invert level. Mammal raised ledge incorporated.
C5, C6 and C7 have no WFD mitigations or enhancements associated
Multi-plate arch culvert with depressed invert level. Mammal raised ledge incorporated.
C1 (ext)
C2a (replacement & ext)
C3a (new)
C3b (new)
C4 (new)
C5 (new)
C6 (new)
C7 (new)
C8 (new)
C9 (new)
C10 (n)
S2
S4 (culvert)
S5
1A WEST
1A EAST
2A
2B
Nantoer
Llanidloes Rd
Glanhafren Hall
Mochdre
Maesyrhandir
Garth Owen
Great Brimmon Farm
Heol Ashley
Doltor Rd
Middle Doltor Rd
Upper Doltor Rd
A483
Contains Ordnance Survey data © Crown copyright and database right 2013
PANE 2
Mammal dry pipe
C15 (replacement & ext)
Pond to be extended to the south of the road.
C14 (new)
C13 Culvert no longer required
C12 (replacement and ext)
Culvert to be replaced with larger capacity pipe culvert so there will be an improvement to flows upstream. Mammal ledge is to be incorporated. Realignment downstream of culvert is also beneficial.
Penygloddfa
Pool Rd
Dyffryn Industrial Estate
Penygelli
Lower Brimmon
Treowen
Kerry Rd
Old Kerry Rd
Key
Wetland planting associated with attenuation ponds (with the exception of 2B)
WFD Compliance Mitigation Measures
Channel realignment
Channel deculverting & realignment
Depressed invert culvert
New scheme structures, and culverts (with erosion measures up and downstream)
Hydromorphological Type
Ditch without flow
Ditch with flow
Open watercourse in poor condition
Open watercourse in reasonable/good condition
Proposed route
CX (new) New Culvert
CX (ext) Scheme requires total length of culvert to be extended
SX New Structure
Contains Ordnance Survey data © Crown copyright and database right 2013
GRIFFITHS
civil engineering and construction
TACP
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Appendix E. Outcome of WFD review and NRW comments at Culverts C3a and C8 – April 2014.

(Note – The report contained within Appendix E is a draft version and is based on draft design details pre the June 2014 design freeze. Some of the lengths quoted within the report are therefore inconsistent with those noted in the main WFD detailed assessment report. Following feedback from NRW, prior to the submission of the final ES version 5105742/ENV/CU/RT216/D1 will be updated with current design details).

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PROJECT: A483/A489 Newtown Bypass

Report Title: Outcome of Water Framework Directive Review and NRW Comments at Culverts C3a and C8

Issue: D1

Status: Draft – for NRW comment

D1	Apr 2014	Draft	ARH	DMH/HR	
Issue	Date	Status	Written	Reviewed by	Authorised by Project Manager

Executive Summary

This report summarises the proposed mitigation measures against Water Framework Directive (WFD) for submission to Natural Resources Wales (NRW) for comment and in response to the Site Walkover Visit undertaken by NRW in January 2014.

Mitigation measures are put forward for proposed culverts C3a and C8. These culverts will replace sections of watercourse that have been identified, via site inspections and consultation with Natural Resources Wales, as being of relatively high quality in terms of geomorphology and aquatic ecology. In addition, for C8 NRW identified that without due design consideration, the proposed culvert could lead to further habitat fragmentation.

The proposed mitigation measures consist of creating a natural type bed within the culvert, and "oversizing" the culvert in order to maintain a corridor within which some geomorphological functionality is preserved.

The current proposal consists of a 3 m span arch culvert. The culverts will provide at least 1 m of clearance from the bed to the soffit.

Due to the oversized nature of the culverts, the estimated depths of flow during spate conditions do not exceed approximately 300mm. This design will allow the inclusion of an elevated ledge (mammal pass), running alongside one of the springing points for the length of the structure. The mammal passes will ensure connectivity for otters and badgers.

Impacts on existing habitat and habitat connectivity have been considered. Both culverts will result in less variety of habitats within the affected reach. The lack of light and the hard edges to the channel in the culvert are the main factors in the reduction in habitat variety. However, the natural type bed will preserve some biological function and productivity, and the mammal pass will mitigate potential impacts on habitat connectivity.

Both culverts will be steeper than the sections of watercourse they would replace; this will cause a general increase in flow velocity through the affected reaches.

The potential for habitat fragmentation was identified as a particular concern for C8. Therefore flow velocities were estimated for the existing natural channel and the proposed culvert scenarios. Average flow velocity in the existing scenario was estimated to be approximately 0.6m/s at an average depth of 70mm. The peak velocity at the steepest section of the existing reach is estimated to be 0.75m/s. Average velocity for the same flow through the proposed culvert is estimated to be just over 1m/s at a depth of 150mm.

The deeper flow is considered to be a slight improvement for swimming fish, but the increase in velocity is likely to be an adverse impact for smaller species and less mature/ smaller individuals amongst any trout population.

It is considered that a natural sediment bed will preserve some of the habitat and biological function, particularly for invertebrates, of the existing watercourse. As a result, potential adverse biological impacts on fish habitat downstream may be mitigated.

Sediment dynamics will be preserved by providing a top surface layer of river sediment with a material grading that could contribute to active geomorphological processes. This design approach is considered to be a practical option for balancing the need for active geomorphology with the need to manage erosion risks to an acceptable level.

Further mitigation will be provided by the installation of grade control structures within the culvert, and the construction of sediment traps downstream of the culverts.

1. The Project

1.1. Context

The Welsh Government proposes to provide a bypass to the south of the town of Newtown in Powys, which will link the A489 and A483 Trunk Roads.

Newtown is a pinch point on the network and the junction of the A483 and A489 regularly suffers from traffic congestion. The A483/A489 at Newtown forms part of the north-south and east-west transport corridors linking areas such as Mid Wales and the West Midlands in England. Further industrial development of Newtown is believed to be hampered by transport/congestion issues.

Historically, extensive work has been undertaken to identify traffic problems in Newtown, Powys, dating back to 1969 when a study to investigate possible bypass routes was commissioned because of the proposed expansion of the town. The result of this study led to a Preferred Route being announced and protected in 1973.

The protection of the route was relaxed in 1989 and certain developments have encroached onto the protected route at the south western end and on Upper Dolfor Road. Over the years the area has seen industrial development along the trunk road corridor together with housing within the town and more recently the development of a number of retail stores having direct access onto the trunk road.

1.2. Background

The Welsh Government commissioned an independent study to examine the transport problems associated with the A483(T) and A489(T) through Newtown. The Newtown Planning Objectives and Pre-Appraisal Report (February 2006) concluded it was unlikely that further traffic management measures, improvements in public transport or a combination of such measures, would have a significant impact on alleviating the problems. A road improvement or bypass option, which removes the low headroom restrictions and reduces congestion within the town, was likely to be the only acceptable solution.

In December 2007 the Welsh Government commissioned a Key Stage 2 (KS2) Study to investigate options to resolve the transport problems in Newtown. The study was conducted and options appraised in accordance with the Welsh Transport Planning and Appraisal Guidance (WelTAG), taking into account the numerous policies, plans and strategies including undertaking a Health Impact Assessment. The study placed specific emphasis on the social, economic and environmental impacts.

A Public Consultation Exhibition was held between 8th and 10th September 2009 in Newtown and in October 2010 the Deputy First Minister announced a preferred route which has been protected for planning purposes.

1.3. The Scheme

The A483/A489 Newtown Bypass preferred route is a 5.8 km route to the south of Newtown. It links into the A489 Llanidloes Road to the west of Newtown by way of a roundabout. It crosses over Mochdre Brook then runs south of Mochdre Industrial Estate and interfaces with the A483 at Dolfor Road by way of a roundabout. (The northern section of the A483 will incorporate a new direct link into the Mochdre Industrial Estate from a second roundabout which also connects with Middle Dolfor Road).

From the A483 roundabout the bypass runs in a north easterly direction and crosses over Middle Dolfor Road and under Upper Dolfor Road. The alignment then generally follows the line of the original TR111 route and lies south of the Vastre and Dyffryn Industrial Estates. There is an at-grade roundabout that links into the A489 Kerry Road.

It then crosses over the main Cambrian railway line east of Dyffryn Industrial Estate before tying into the existing A483 Pool Road to the east of Newtown by way of a roundabout located north of the existing Pool Road.

In addition to the bypass the Scheme includes some de-trunking works that incorporate online footway widening improvements along Pool Road and New Road through Newtown.

1.4. The Project Objectives and reason for the Project

1.4.1. Welsh Government Objective and Mission Statement

The Welsh Government's objective is to provide a bypass to the town of Newtown in accordance with the findings of the KS2 scheme, and to include the commitments made at the Public Consultation undertaken as part of this study. This is to be carried out through appointment of a design and build Contractor under an Early Contractor Involvement (ECI) contract to be managed following the principles of PRINCE2 project management system and to deliver the works to programme, budget, and with due regard to the Welsh Ministers policies.

The Welsh Government's mission is to:

> *''Promote the vision and transport strategy described in the Welsh Government's 'One Wales: Connecting the Nation', the Wales Transport Strategy, and the National and Regional Transport Plans''.*

1.4.2. Scheme/Planning Objectives

Seven specific Transport Planning Objectives (TPOs) have been identified for the scheme. These will be achieved by the successful ECI Contractor and several other stakeholders, namely Powys County Council/TraCC (Objectives 1, 4 and 5) and Welsh Government (Objectives 2, 3, 6 and 7). The objectives are detailed below:

Objective 1 – Maintain economic base

- Maintain economic base of Newtown measured by levels of local employment by the date in the local development plan (2025).

Objective 2 – Meeting relevant environmental targets

- Within Newtown settlement boundary limit and within 200m of the scheme;
- Meet targets and comply with appropriate environmental legislation and policies by 2018;
- Reduce greenhouse gas emissions along Pool Road and New Road by 3% from 2008 levels, by 2018 (in accordance with Wales Transport Strategy).

Objective 3 – Removing through traffic from local roads

- Reduce through traffic on Heol Treowen, Plantation Lane and Milford Road by 50% over 2008 levels by 2018;
- Reduce HGVs on Heol Treowen, Plantation Lane by 90% from 2008 levels, by 2018.

Objective 4 – Increasing level of usage for non-car forms of transport

- For travel with origin and destination within Newtown, achieve modal shift of 10% from car to non-car forms of transport (cycling, walking and public transport), over 2008 levels, by 2018;
- For travel with origin or destination within Newtown, achieve modal shift of 2% from car to public transport, over 2008 levels, by 2018.

Objective 5 – Integration of public transport

- Within Newtown limit interchange penalty linking bus services and train services to 20 minutes, by 2018;
- Within Newtown, during morning and evening peak hours (0700-0900 and 1600-1800) limit interchange penalty between bus services to 10 minutes, by 2018.

Objective 6 – Improve journey time consistency (North-South, East-West)

- Reduce journey times during morning and evening peak hours (0800-0900 and 1615-1715) on A489/A483 between A470/A489 junction (Caersws) and A483/B4389 junction (Aberbechan junction) by 10% by 2018;
- Reduce journey times during morning and evening peak hours (0800-0900 and 1615-1715) on A489/A483 between A483/unnamed C class Road at 'The Dingle, and A483/B4389 junction (Aberbechan junction) by 10% by 2018;
- Reduce journey times during morning and evening peak hours (0800-0900 and 1615-1715) on A489/A483 between A483/unnamed C class Road at 'The Dingle', and A470/A489 junction (Caersws) by 10% by 2018.

Objective 7 – Reduction in accidents

- Within Newtown settlement boundary limit, reduce road traffic accidents on A483(T), A489(T), Heol Treowen, Plantation Lane and Milford Road by 25% by 2018.

2. Purpose of this Report

This note describes the proposed measures to be incorporated into the design of culverts to carry watercourses under the proposed Newtown Bypass. Natural Resources Wales has previously indicated preferences for culvert designs that mitigate adverse Water Framework Directive (WFD) impacts in relation to stream crossings along the route of the bypass.

3. Introduction

3.1. Overall Scheme

The bypass follows a route that passes south of Newtown. There are a number of watercourses in this area, comprising tributaries and sub-tributaries of the River Severn, which runs through Newtown. These watercourses vary in size. Clear-span bridge structures are proposed across Mochdre Brook and the Dingle brook, and a box culvert is proposed over the watercourse through Castel-y-Dail woodland. Smaller watercourses are to be routed beneath the new road through culverts.

3.2. Natural Resources Wales Opinion

Natural Resources Wales has provided a list of target measures[14] to be incorporated into the design of the proposed culverts along the route of the Scheme. NRW'S response to the scoping report regarding culverts is as follows:

- Potential watercourse crossings should be of clear span structures in preference to culverting to prevent barriers to fish migration and impact on habitat quality and connectivity.

Where there is no viable alternative to a culvert, it is necessary to incorporate mitigation measures in order to reduce any adverse impacts.

3.3. Sites Selected to incorporate WFD measures

Two of the culverts along the Scheme are on sections of watercourse that have been identified as being of relatively good quality, and would therefore represent a fairly significant loss with regard to the WFD. The culverts that have been considered in liaison with NRW and identified are:

- Culvert C3a on the unnamed watercourse south of Coleg Powys Farm, west of Castell y Dial
- Culvert C8 on the Green Brook.

[14] "Newtown Walkover", NRW 11th Feb 2014

The proposals for mitigating the adverse impacts of constructing culverts, and a summary of the analyses that have been undertaken, are presented in the following sections of this report.

3.4. Water Framework Directive Objectives

Culverting a section of a watercourse can potentially contribute to a reduction in key fluvial processes, which are conducive to a variety of biological and ecological functions. These include[15]:

- Stream bed material transport;
- Woody debris transport;
- Biological productivity;
- Water quality benefits;
- Fish migration;
- Wildlife passage
- Surface water/ ground water connectivity; and
- Natural flood attenuation;

This technical note sets out the practical measures being put forward to mitigate the adverse impacts associated with proposed culverts C3a and C8.The sections of watercourse that will be affected by these particular culverts have been identified, with the agreement of Natural Resources Wales, as the two sections that have the highest existing levels of quality in terms of geomorphology and aquatic ecology.

The note also sets out the practical limitations of what can reasonably be achieved within the confines of the proposed culvert layouts and the estimated flow conditions in the watercourses.

[15] 2014 Stormwater Management Manual, Appendix A.4: Culverts and Outfalls. City of Portland Environmental Services

4. Existing Watercourses – General Characteristics

An initial assessment of the watercourses along the Scheme has been carried out by the designer's WFD team to inform the design development. This WFD assessment which is referenced below was based on an earlier version of the road alignment. As a result the stream lengths quoted differ from those used in the design of the mitigation measures described below. The WFD assessment will be updated based on the latest Scheme alignment following discussion of the proposed mitigation measures with NRW.

4.1. Unnamed Watercourse at proposed culvert C3a

4.1.1. Length and Gradient

Between the inlet and outfalls for the proposed culvert, the length of the existing watercourse is approximately 110 m. Over this distance, the watercourse drops some 6.5 m in elevation. The proposed culvert would be approximately 85 m in length, giving an estimated gradient of 0.076 (1 in 13). The culvert follows a realigned route that is approximately 25 m shorter than the existing watercourse. The new culvert will therefore, have a steeper average gradient than the existing watercourse.

4.1.2. WFD Assessment

This watercourse has been assessed by the designer's WFD team as follows:

- Approximately 70m of a small woodland channel will be culverted which is considered to be a fairly significant loss to local morphology and ecological connectivity, in particular local fisheries could be fragmented by poor culvert design and local otter movements may be impaired.

4.1.3. Flow Information

The estimated 1% (1 in 100) annual chance flood flow, (including climate change allowance of 20%), for this stream is estimated to be 0.8m^3/s.

We have prepared a high level estimate of the typical daily flows for a tributary of this nature. Over the course of a year, the average flow in the watercourse is estimated to be in the region of 5 l/s (i.e. 0.005 m^3/s).

The seasonal average flow for the period running from October to May, which is an important period in the lifecycle of migratory salmonids, is estimated to be 6.3 l/s.

4.2. Green Brook at proposed culvert C8

4.2.1. Length and Gradient

The length of the existing watercourse between the proposed culvert inlet and outfall is approximately 83m. Over this distance, the watercourse drops some 3.5 m in elevation, giving an existing average gradient of 0.042 (1 in 23.7). The proposed culvert follows a realigned route that is approximately 8 m shorter than the existing watercourse at 75 m long. Therefore, the new culvert will have a slightly steeper average gradient than the existing watercourse at 0.0465 (1 in 21.5).

4.2.2. WFD Assessment

This culvert has been assessed by the WFD team as follows (noting that stream channel lengths have changed as noted at the start of this section):

- Approximately 60 m of a natural section of headwater channel to be culverted which is considered to be a fairly significant loss to local morphology and ecological connectivity, in particular local fisheries could be fragmented by poor culvert design and local otter movements may be impaired.

7.1.2. Flow Information

The estimated 1% (1 in 100) annual chance flood flow, including 20% climate change allowance, for this structure is approximately 2.24 m^3/s.

We have calculated a high level estimate of the typical daily flows for a tributary of this nature. Over the course of a year, the average flow in the watercourse is estimated to be in the region of 17 l/s (i.e. 0.017 m^3/s).

The seasonal average flow for the period running from October to May is approximately 25.4 l/s.

5. Proposed Mitigation Measures

5.1. General

The potential mitigations that have been identified by the WFD team are similar for both culverts. They can be summarised as follows:

- Mammal passes to ensure connectivity for otters and badgers and bats etc.
- Depressed invert culvert.
- Oversize, large span culverts instead of pipe culverts.

5.2. Proposed Culverts

The proposed culverts are not limited to providing the hydraulic capacity required for the land drainage function, but are instead “oversized” in order to accommodate some degree of natural channel processes.

The culvert designs that have been considered are pre-cast concrete pipe sections, box culverts and proprietary on-site fabrication systems. Pre-cast pipe sections have been ruled out as the width necessary to accommodate a degree of natural channel processes (approximately 3 metres), would result in an exceptionally large diameter pipe that would not be cost effective or particularly practical to construct in comparison with readily available alternatives.

A pre-cast box culvert solution has been considered, but the size of structure needed and the complexities foreseen in transporting such sections and handling them on site, have rendered the pre-cast solution unfavourable. An in-situ culvert structure could overcome the logistical challenges of the pre-cast option; however, due to the scale of the culverts (a 3-metre clear span and over 80 metres in length), it is likely that in-situ reinforced concrete is unlikely to be the most cost-effective solution.

The preferred culvert solution is based on a proprietary system known as “Multi-plate Arch”, which is marketed by Asset International (although similar systems may be available from alternative suppliers). The system consists of a corrugated metal arch structure which is transported to site in component form and assembled in-situ.

Unlike a typical pre-cast culvert, the Multi-plate system does not incorporate a solid invert between the springing points of the arch; consequently, this solution provides some freedom to develop the optimal solution for incorporating a natural bed within the culvert.

It is proposed to construct a separate concrete invert at a depressed level relative to the springing points, as shown in Figure A below. This, in turn, will allow the bed level of the watercourse to be built back up with material that resembles natural river bed sediments in its composition and grading.

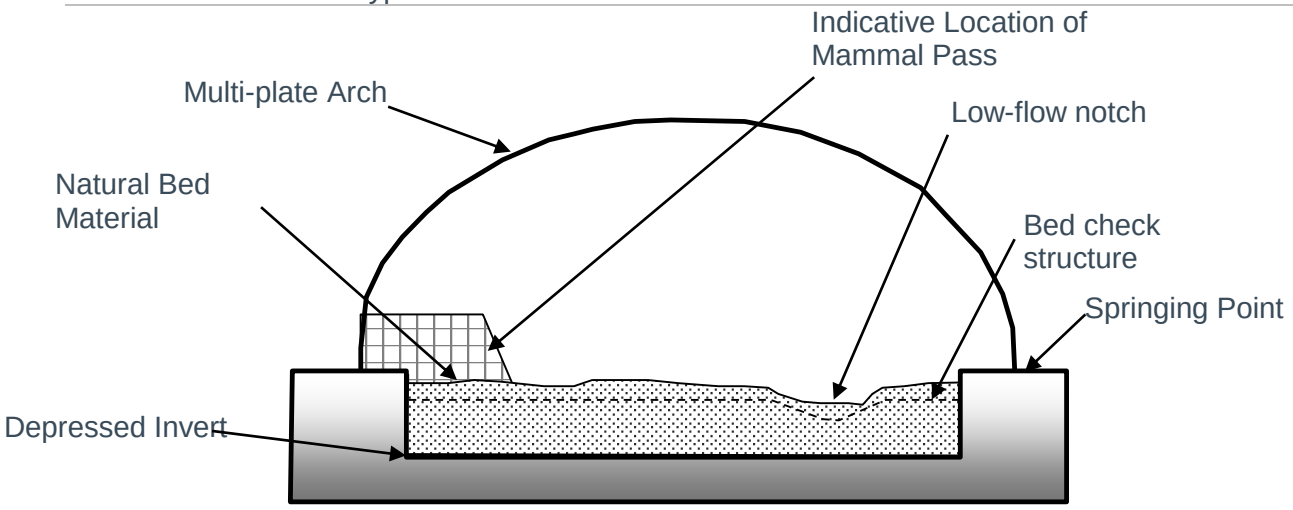

Figure A: Cross-section sketch showing depressed bed concept

The current proposal consists of a 3 m span arch culvert. The height from bed to soffit level will depend on the level of the depressed invert relative to the springing points. However, it is considered that it will be possible to provide sufficient clearance of at least 1 m from the bed to the soffit.

Due to the oversized nature of the culverts, the estimated depths of flow during spate conditions do not exceed approximately 300mm. This design will allow the inclusion of an elevated ledge (mammal pass), running alongside one of the springing points for the length of the structure. The precise height and arrangement of the ledge will be confirmed during the detailed design. The mammal passes will ensure connectivity for otters and badgers.

One of the objectives of this proposal is to preserve sediment continuity upstream and downstream of the new structures. However, due to the steepness of the proposed culverts, it is considered necessary to include bed-check, or “grade control” structures on the base slab in order to increase the likelihood that the respective rates of sediment erosion and deposition in the culvert are generally in balance. The general concept is shown in Figure B below.

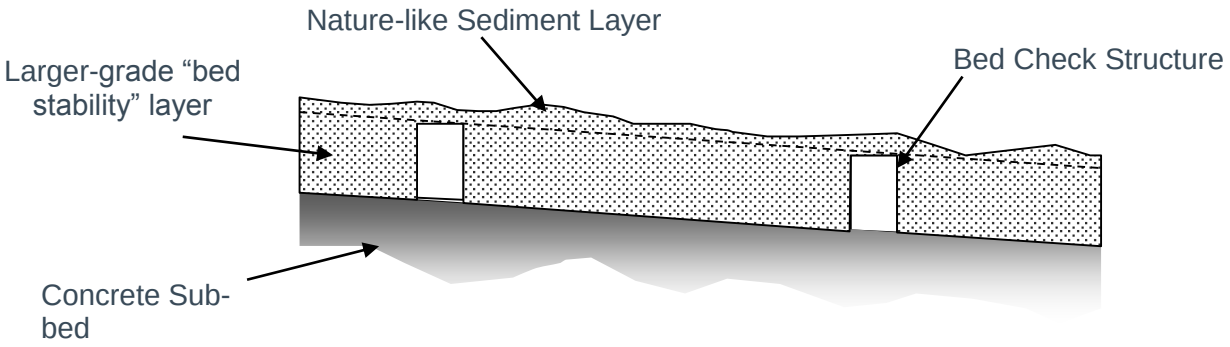

Figure B: Schematic Long Section through Culvert

It is proposed that the bed-check structures should not reach to the full height of the bed material. This is in order to allow continued potential for sediment continuity through the culverts, whilst ensuring that a minimum thickness of the bed layer benefits from the necessary degree of grade control.

The bed material within the culvert will be well-graded and laid in two principle strata along the invert. The lower stratum will consist of a higher proportion of larger size sediments, which will be sized to resist mobilisation during relatively high flows through the culverts.

A fundamental aspect of natural sediment processes is that sediment particles are moved around, and through, the fluvial system by the energy of the flowing water; a process that will be active in the current natural situation. In order to ensure that the natural process continues to be active once the proposed culverts have been constructed, the upper layer of the bed will consist of a smaller proportion of larger sediments, and will therefore be more conducive to the preservation of sediment continuity throughout the watercourse.

This design approach is considered to be a practical option for balancing the need for active geomorphology with the need to manage erosion risks to an acceptable level. Further mitigation will be provided by the construction of sediment traps downstream of the culverts.

5.3. Flow Characteristics

The average velocity and depth of flow has been estimated for the average flow conditions described in Chapter 4. It is suggested that the figures below could facilitate a more informed assessment of the potential for habitat fragmentation caused by the new culverts.

Culvert C3a

It is estimated that a continuous, narrow 'V'-shaped channel conveying the seasonal average flow at the culvert's design gradient would result in a depth of 8cm at a velocity of 0.9m/s.

Culvert C8

It is estimated that a continuous, narrow 'V'-shaped channel conveying the seasonal average flow at the culvert's design gradient would result in a depth of 15cm at a velocity of just over 1m/s.

5.3.1. Fisheries Impacts

The estimated flow in C3a is considered to be too small to allow the design of a viable "fish passage" solution in the typical context of guidelines in the Environment Agency Fish Pass Manual.

For C8, the average flows in the watercourse are considered to be at the lower limit of what can reasonably be expected to satisfy the requirements for a "fish passage" solution in the typical context of guidelines in the Environment Agency Fish Pass Manual. The potential for further habitat fragmentation was identified as a particular concern for C8. Therefore in order to assess the impact, flow velocities have been estimated for the existing natural channel as well as the proposed culvert scenario

The estimated average velocity in the current watercourse, based on the average flow between October and May, is 0.59 m/s; the peak velocity at the steepest section of the existing watercourse is 0.75 m/s. Estimated flow depths vary between 4 cm and 12 cm.

The deeper flow in the new culvert is considered to be an improvement for swimming fish, but the increase in velocity is likely to be an adverse impact for smaller species and less mature/ smaller individuals amongst any trout population.

The small flows through the watercourses could potentially sustain a system of pools as part of a heterogeneous channel formation designed to mimic natural watercourse features. This would marginally increase the effective flow length of the culvert, thereby reducing average velocities and providing some areas for fish to rest. Whilst this would help to preserve habitat connectivity, it is considered that overall, the steeper gradient and higher velocities will generally adversely affect habitat connectivity.

In terms of direct loss of habitat, it is likely that the lack of light in the culvert will inhibit the recreation of the existing habitats within the culvert itself. However, for both culverts, it is considered that a natural sediment bed will preserve some of the habitat and biological function, particularly for invertebrates, of the existing watercourse, such that potential adverse biological impacts on fish habitat downstream are mitigated.

5.4. Sediment Mobility

An outline assessment has been undertaken to estimate the minimum particle size (i.e. of the stones in the imported sediments) necessary to reduce the risk of sediment mobilisation. In this assessment, the minimum stable particle size (*D*) for a given channel is estimated as a function of the channel geometry (*R* = hydraulic radius) and gradient (S_0), as shown below:

$$\frac{RS_0}{D} = 0.0924$$

The assessment has been based on a 1% (1 in 100) annual chance flow including climate change allowance in each culvert. This indicates the minimum stone size necessary to ensure a low risk of erosion of a substantial proportion of the bed material even during a comparatively low probability flood event.

The minimum stable particle size is estimated to be approximately 90mm for C3a, and 120mm for C8. These are indicative estimates of particle size, and a more rigorous assessment would need to be undertaken as part of the detailed design development of this concept.

As stated in Section 5.2, it is proposed that the bed layer will consist of two layers: a lower layer containing a larger proportion of larger particles to provide a relatively stable base, and a top layer with a greater proportion of natural river sediments in order to preserve a relatively active layer for sediment dynamics.

6. Conclusions

- Constructing the Newtown Bypass will result in some loss of some natural watercourse at the road crossings.
- This report focuses on the culverting of two sections of watercourse, referred to as culverts C3a, and C8 along the route of the Bypass. It considers measures to mitigate adverse effects against Water Framework Directive objectives.
- The C3a culvert will be approximately 25 m shorter than the section of watercourse it replaces. This means that it will have a steeper average gradient than the existing stream.
- Culvert C8 is also shorter than the stream it replaces, although the reduction in length is less and so therefore, is the change in gradient.
- For culverts C3a and C8 it is proposed to use a proprietary fabrication system that allows the culverts to be erected on site, and a natural type bed formation to be constructed.
- The risk of sediment mobilisation and hence erosion of the imported culvert bed for C3a and C8 has been assessed, and minimum bed particle size estimated. Flood flows (i.e. infrequent occurrences) have been estimated for this purpose.
- Monthly average (i.e. typical) flows have been used to make an assessment of the likely flow depth and velocity through the culverts. This has been done in order to facilitate assessment and evaluation of the potential habitat fragmentation that may result from the construction of the culverts.
- The objective of the proposed designs is to achieve the most viable balance of water depth and velocity, given the amount of flow and the culvert gradients, for supporting local and migratory movements of fish.
- For culvert C8, which NRW identified habitat fragmentation as a particular concern, flow velocities have been estimated for the existing stream in order to allow an assessment of the impact of culvert construction. In the existing scenario, the average flow velocity between October and May is approximately 0.6m/s at a depth of approximately 7cm. In the proposed culverts, the same flow would create a velocity of around 1m/s, at a depth of 15cm.
- The deeper flow is considered to be an improvement for swimming fish, but the increase in velocity is likely to be an adverse impact for smaller species and less mature/ smaller individuals amongst any trout population.
- The small flows through the watercourses could potentially sustain a system of pools as part of a heterogeneous channel formation designed to mimic natural watercourse features and habitats. However, it is also considered likely that the lack of light in the culvert will be the major inhibiting factor in the potential recreation of a natural ecosystem.
- For culverts C3a and C8, it is considered that a natural sediment bed will preserve some of the habitat and biological function, particularly for invertebrates, of the existing watercourse. As a result, potential adverse biological impacts on fish habitat downstream can be mitigated.
- Sediment dynamics will be preserved by providing a top surface layer of river sediment with a material grading that could contribute to active geomorphological processes.
- All flows, velocities and particle size estimates in this report are considered to be preliminary, and have been prepared in support of option identification and development. All parameters should be confirmed during the detailed design.

Llywodraeth Cymru
Welsh Government



A483/A489 NEWTOWN BYPASS

WFD Initial Compliance Assessment

November 2013

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TACP
CORDEROY
CAPITA


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D5	13/08/14	Final version for ES	K Skinner	J Wall	D Rowlands
F	25/09/14	Final version for ES	K Skinner	J Wall	D Rowlands

Table of Contents

List of abbreviations

Abbreviation	Definition
The AGC Team	Alun Griffiths Contractors Team
EA	Environment Agency
ECI	Early Contractor Involvement
EIA	Environmental Impact Assessment
ES	Environmental Statement
FFD	Freshwater Fish Directive
GCS	Good Chemical Status
GEP	Good Ecological Potential
GES	Good Ecological Status
GW	Groundwater
HMWB	Heavily Modified Water Bodies
KS2	Key Stage 2
NRW	Natural Resources Wales
RBMPs	River Basin Management Plans
SAC	Special Area of Conservation
SPA	Special Protection Area
SSSI	Sites of Special Scientific Interest
TPOs	Transport Planning Objectives
TraCC	Trafnidiaeth Canolbarth Cymru
WFD	Water Framework Directive
WelTAG	Welsh Transport Planning and Appraisal Guidance

1. The Project

1.1. Context

The Welsh Government proposes to provide a bypass to the south of the town of Newtown in Powys, which will link the A489 and A483 Trunk Roads.

Newtown is a pinch point on the network and the junction of the A483 and A489 regularly suffers from traffic congestion. The A483/A489 at Newtown forms part of the north-south and east-west transport corridors linking areas such as Mid Wales and the West Midlands in England. Further industrial development of Newtown is believed to be hampered by transport/congestion issues.

Historically, extensive work has been undertaken to identify traffic problems in Newtown, Powys, dating back to 1969 when a study to investigate possible bypass routes was commissioned because of the proposed expansion of the town. The result of this study led to a Preferred Route being announced and protected in 1973.

The protection of the route was relaxed in 1989 and certain developments have encroached onto the protected route at the south western end and on Upper Dolfor Road. Over the years the area has seen industrial development along the trunk road corridor together with housing within the town and more recently the development of a number of retail stores having direct access onto the trunk road.

1.2. Background

The Welsh Government commissioned an independent study to examine the transport problems associated with the A483(T) and A489(T) through Newtown. The Newtown Planning Objectives and Pre-Appraisal Report (February 2006) concluded it was unlikely that further traffic management measures, improvements in public transport or a combination of such measures, would have a significant impact on alleviating the problems. A road improvement or bypass option, which removes the low headroom restrictions and reduces congestion within the town, was likely to be the only acceptable solution.

In December 2007 the Welsh Government commissioned a Key Stage 2 (KS2) Study to investigate options to resolve the transport problems in Newtown. The study was conducted and options appraised in accordance with the Welsh Transport Planning and Appraisal Guidance (WelTAG), taking into account the numerous policies, plans and strategies including undertaking a Health Impact Assessment. The study placed specific emphasis on the social, economic and environmental impacts.

A Public Consultation Exhibition was held in September 2009 in Newtown and in October 2010 the Deputy First Minister announced a preferred route which has been protected for planning purposes. Further Public Consultation Exhibitions have been held by the AGC Team in July 2013 and April 2014. A revised TR111 was announced by the Minister in March 2014.

1.3. The Scheme

The A483/A489 Newtown Bypass is a 5.8km bypass to the south of Newtown. It would commence at the new A489 'Llanidloes Roundabout' to the west of Newtown adjacent to the River Severn and would pass through the Glandulas Holiday Home Park. Flood compensation would be provided as the Scheme passes across floodplain and a section of known Roman Road would be left in situ within the flood compensation area. An overbridge would be provided to access the southern section of the Holiday Home Park and a new section of bridleway.

The Scheme would pass into cutting before passing over the Mochdre Brook on a clear span bridge. The structure would also cross Mochdre Lane and the upper Mochdre Lane. An underpass would be provided to the east of the Mochdre Bridge to facilitate access south of the Scheme for Coleg Powys. It would pass across the agricultural fields on embankment and in cutting to accommodate the undulating landform until Ch 1200 where there would be a cutting through Castell y Dail Wood which lies to the north of the Iron Age fort and to the south of Castell y Dail House (Listed Structure).

The Scheme would continue to the south of Mochdre Industrial Estate eastwards over Dolfor brook. It would cross an area of high ground in cutting prior to crossing over the Middle Dolfor Road and under the Upper Dolfor Road on a three span bridge. The Scheme would tie into the existing A483 to the south of the Dolfor Road Roundabout adjacent to the entrance to Black Hall Farm.

There would be a new link road between the Dolfor Road Roundabout and the Lower Dolfor Roundabout from which connecting roads would tie in to the Mochdre Industrial Estate along Hoel Ashley and into Newtown along Dolfor Road.

From Upper Dolfor Overbridge the Scheme would pass in cutting through agriculture pasture then on embankment over Brimmon Farm Underbridge and Brimmon Lane Underbridge followed by a slight cutting to Kerry Road Junction. Kerry Road Roundabout would be at grade and adjacent to Lower Brimmon Farm.

The Scheme would be in cutting under Wern Ddu Overbridge and then on embankment as it goes over the railway and the over Pool Road Underbridge to A483 Pool Road Roundabout where it would tie in with the existing A483. From the Roundabout there would be a link back into Newtown under Pool Road Underbridge.

1.4. The Project Objectives and reason for the Project

1.4.1. Welsh Government Objective and Mission Statement

The Welsh Government's objective is to provide a bypass to the town of Newtown in accordance with the findings of the KS2 scheme, and to include the commitments made at the Public Consultation undertaken as part of this study. This is to be carried out through appointment of a design and build Contractor under an Early Contractor Involvement (ECI) contract to be managed following the principles of PRINCE2 project management system and to deliver the works to programme, budget, and with due regard to the Welsh Ministers policies.

The Welsh Government's mission is to:

> *"Promote the vision and transport strategy described in the Welsh Government's 'One Wales: Connecting the Nation', the Wales Transport Strategy, and the National and Regional Transport Plans".*

1.4.2. Scheme/Planning Objectives

Seven specific Transport Planning Objectives (TPOs) have been identified for the Scheme. These will be achieved by the successful ECI Contractor and several other stakeholders, namely Powys County Council/Trafnidiaeth Canolbarth Cymru (TraCC) (Objectives 1, 4 and 5) and Welsh Government (Objectives 2, 3, 6 and 7). The objectives are detailed below:

Objective 1 – Maintain economic base

- Maintain economic base of Newtown measured by levels of local employment by the date in the local development plan (2025).

Objective 2 – Meeting relevant environmental targets

- Within Newtown settlement boundary limit and within 200 m of the Scheme;
- Meet targets and comply with appropriate environmental legislation and policies by 2018;
- Reduce greenhouse gas emissions along Pool Road and New Road by 3% from 2008 levels, by 2018 (in accordance with Wales Transport Strategy).

Objective 3 – Removing through traffic from local roads

- Reduce through traffic on Heol Treowen, Plantation Lane and Milford Road by 50% over 2008 levels by 2018;
- Reduce HGVs on Heol Treowen, Plantation Lane by 90% from 2008 levels, by 2018.

Objective 4 – Increasing level of usage for non-car forms of transport

- For travel with origin and destination within Newtown, achieve modal shift of 10% from car to non-car forms of transport (cycling, walking and public transport), over 2008 levels, by 2018;
- For travel with origin or destination within Newtown, achieve modal shift of 2% from car to public transport, over 2008 levels, by 2018.

Objective 5 – Integration of public transport

- Within Newtown limit interchange penalty linking bus services and train services to 20 minutes, by 2018;
- Within Newtown, during morning and evening peak hours (0700–0900 and 1600–1800) limit interchange penalty between bus services to 10 minutes, by 2018.

Objective 6 – Improve journey time consistency (North–South, East–West)

- Reduce journey times during morning and evening peak hours (0800–0900 and 1615–1715) on A489/A483 between A470/A489 junction (Caersws) and A483/B4389 junction (Aberbechan junction) by 10% by 2018;
- Reduce journey times during morning and evening peak hours (0800–0900 and 1615–1715) on A489/A483 between A483/unnamed C class Road at 'The Dingle, and A483/B4389 junction (Aberbechan junction) by 10% by 2018;
- Reduce journey times during morning and evening peak hours (0800–0900 and 1615–1715) on A489/A483 between A483/unnamed C class Road at 'The Dingle', and A470/A489 junction (Caersws) by 10% by 2018.

Objective 7 – Reduction in accidents

- Within Newtown settlement boundary limit, reduce road traffic accidents on A483(T), A489(T), Heol Treowen, Plantation Lane and Milford Road by 25% by 2018.

2. Report introduction

2.1. Legislative background

The Water Framework Directive (WFD) 2001 requires all natural water bodies to achieve both Good Chemical Status (GCS) and Good Ecological Status (GES). The River Basin Management Plans (RBMPs) outline the actions required to enable natural water bodies to achieve GES. Artificial and Heavily Modified Water Bodies (A/HMWBs) may be prevented from reaching GES due to the modifications necessary to maintain their function. They are, however, required to achieve Good Ecological Potential (GEP), through the implementation of a series of mitigation measures outlined in the applicable RBMP.

New activities and schemes that affect the water environment may adversely impact biological, hydromorphological, physico-chemical and/or chemical quality elements (WFD quality elements), leading to a deterioration in water body status. They may also render proposed improvement measures ineffective, leading to the water body failing to meet its WFD objectives for GES/GEP. Under the WFD, activities must not cause deterioration in water body status or prevent a water body from meeting GES/GEP by invalidating improvement measures.

The overall ecological status of a water body is primarily based on consideration of its biological quality elements and determined by the lowest scoring of these elements. These biological elements are, however, in turn supported by the physico-chemical and hydromorphological quality elements. Assessment of hydromorphological quality is not explicitly required for a water body to achieve Moderate Ecological Status or lower. However, to achieve the overall WFD aim of GES or higher, hydromorphological quality must be considered within the classification assessment.

In addition, to achieve the overall WFD aim of GES, a water body must pass a separate chemical status assessment, relating to pass/fail checks on the concentrations of various identified priority/dangerous substances.

A summary of key WFD concepts is presented in Figure 2-1 and summary sheets in Appendix A. This includes a definition of what a water body is in relation to this assessment.

2.2. Purpose of the report and WFD compliance assessment approach

In liaison with Natural Resources Wales (NRW) and WG a WFD compliance assessment has been completed and forms part of the Environmental Statement (ES) for the Scheme. Further details of the project can be found in Section 3.1 on page 9. The 2009 Stage 2 Environmental Impact Assessment (EIA) Report (The AGC Team, December 2009 Ref: HHC 91371A/ 27a) identified numerous surface water features within 1 km of the Scheme. These include the River Severn (GB109054049310), the Mochdre Brook (GB109054044730) and the Montgomery Canal (GB70910253) water bodies (as designated under the Water Framework Directive (WFD, Directive 2000/60/EC). A number of smaller watercourses identified in the study area are all tributaries of the River Severn, and are in direct hydraulic connectivity with the river. They therefore contribute to

its overall quality and would subsequently adopt the same value/level of importance assigned to the River Severn water body. The groundwater body within the Scheme vicinity is the Severn Uplands – Secondary confined aquifer (GB40902G203400).

This document sets out the initial WFD screening assessment and comprises a summary overview, quality element assessment, results and recommendations. The assessment will take account of hydromorphology, aquatic ecology, water quality and groundwater. This assessment has been based on the general arrangement drawings for the proposed Scheme (See Appendix B) and detailed discussions with the project engineers. Documents and drawings have been listed in the reference list on page 18.

NRW do not currently have guidance for the WFD compliance assessment, however as agreed with NRW (26/09/13), this assessment will be based on Environment Agency (EA) draft guidance. The EA WFD guidance implies that temporary impacts, such as those resulting from construction works should be screened out of the WFD compliance assessment (with the assumption that they will be short in nature and the site will recover quickly).

2.3. Environmental objectives

The following environmental objectives (based on Articles 4.1, 4.8 and 4.9 of the WFD, and internal EA guidance) were used to make recommendations on WFD compliance:

- Objective 1: The Scheme will not cause deterioration in any element of water body classification.
- Objective 2: The Scheme will not prevent the WFD status objectives from being reached within the water body or other downstream water bodies.
- Objective 3: The Scheme will not negatively impact critical or sensitive habitats within the water body[1].
- Objective 4: The Scheme will contribute to the delivery of the Severn RBMP.

[1] Objective 3 is driven by the EA's wider responsibility for the protection of the UK's environmental assets rather than a specific requirement of the WFD legislation.

Figure 2-1 Background to the Water Framework Directive

WFD Objectives

The Water Framework Directive (WFD) is a European Directive which sets out a strategic planning process for the purposes of managing, protecting and improving the water environment. The main objectives of the WFD are to:

- Prevent deterioration in the status of aquatic ecosystems, protect them and improve the ecological condition of waters;
- Aim to achieve at least 'Good Status' for all waters by 2015 (2021 or 2027 where fully justified within an extended deadline under Article 4.4);
- Promote sustainable use of water;
- Conserve habitats and species that depend directly on water;
- Progressively reduce or phase out the release of individual pollutants or groups of pollutants that present a significant threat to the aquatic environment;
- Progressively reduce the pollution of groundwater and prevent or limit the entry of pollutants; and
- Help reduce the effects of floods and droughts.

Natural Resources Wales (NRW) are the lead authority for Wales for improving inland and coastal waters through better land management, regulating discharges, encouraging more sustainable use of water as a natural resource and processing environmental permits and licenses. NRW is also committed to creating better habitats for the wildlife that lives in and around water and a better quality of life for everyone.

WFD Classification

The WFD classification for a defined water body is produced by assessment of a wide variety of different 'elements' which includes:

- '*biological elements'* such as fish, invertebrates, phytobenthos (which includes plants, macro-algae and phytoplankton);
- '*supporting elements*' that include chemical measurements such as ammonia, dissolved oxygen, pH, phosphate, copper, zinc and temperature; and
- '*supporting conditions*' (sometimes referred to as hydromorphology) that assess the physical attributes of the water body such as 'quantity and dynamics of flow' and 'morphology'.

The assessment given for each element is also accompanied by a measure of certainty in the result. The status classification is published in the River Basin Management Plan (RBMP) and provides a baseline condition against which compliance and future improvements can be measured.

WFD Compliance

There are three key objectives against which the impacts of proposed works on a water body need to be assessed to determine compliance with the overarching objectives of the WFD:

- Objective 1: The Scheme will not cause a deterioration in any element of water body classification.
- Objective 2: The Scheme will not prevent the WFD status objectives from being reached within the water body or other downstream water bodies.
- Objective 3: The Scheme will contribute to the delivery of the relevant WFD objectives. In this case it will be what contribution the Scheme can make towards the water body reaching its objective Good Ecological Potential (GEP) through planned RBMP mitigation measures.

The first two obligations must be met to avoid infraction of the WFD. The delivery of the third objective is central to the implementation of the WFD, where it can be supported through its operational activities. If it is considered that the scheme is likely to cause deterioration in water body status or prevent a water body from meeting its ecological objectives then an assessment would be made against the conditions listed in Article 4.7 of the WFD. Article 4.7 can be invoked if; 'new modifications' are of overriding public interest and/or the environmental and social benefits of achieving the WFD objectives are outweighed by the benefits of the new modifications to human health, safety and sustainable development; there are no significantly better environmental options that are technically feasible or not disproportionately costly; and all practicable steps for mitigation have been taken.

Artificial or Heavily Modified Water Bodies

These water bodies cannot achieve Good Ecological Status (GES) due to substantial modification, e.g. for flood risk management. Instead, they are required to reach GEP. The presence or absence of a set list of mitigation measures is used as a proxy for biological indicators. If all mitigation measures have been taken, the water body is assigned a preliminary tag of 'GEP or better'. Good Chemical Status is a prerequisite for GEP. 'Moderate or worse' is used if some mitigation measures are yet to be implemented. HMWBs may therefore have an element rated 'Poor' but not be considered 'Poor' in overall status.

Hydromorphology

Hydromorphology is a term used in the WFD to describe the processes operating within, and the physical form of, a water body. The term encompasses both hydrological and geomorphological characteristics that, in combination, help support a healthy ecology. Hydromorphology is a supporting condition unless a water body is classified as being of 'High' ecological status. In these cases, hydromorphological elements contribute towards status classification. NRW provided Summary Guidance for the Water Framework Directive (WFD) Geomorphological Assessment as part of their response to the Environmental Scoping report (NRW, August 2013). This has been taken into account when defining the scope of the assessment.

What is a water body? (in relation to this assessment)

NRW do not currently have guidance for the WFD compliance assessment, however as agreed with NRW this assessment will be based on Environment Agency draft guidance. The Environment Agency's guidance note 'Water bodies for the Water Framework Directive'(Environment Agency July 2012) explains that the Directive defines a surface water body as a "discrete and significant element" of surface water such as a lake or reservoir or entire (or part) stream, river or canal, estuary or stretch of coastal water (out to 1 mile). They were identified in England and Wales as part of the characterisation process. The guidance further explains that 'the objectives for a river water body apply to every bit of the watercourse within the river body catchment' not just the reported network as shown on the Environment Agencies 'What's in Your Backyard' system.

The Environment Agency is in the process of developing guidance on the no deterioration requirements of the WFD and how to deal with local deterioration of reaches that have a perceived different status to that of the overall water body. For the purposes of this assessment we will use best judgement to make an appropriate assessment using available data.

3. WFD screening assessment

3.1. Summary overview

Please refer to section 1 for a description of the Scheme. An examination of the final general arrangement drawings and discussion with the engineering design team has identified the following elements to be considered by the final preliminary WFD Compliance Assessment (the 'S' – Structure, and 'C' – Culvert code names correspond to the names on Figure 3-1):

A. Junction at the west of the Scheme where it joins the A489 and potential impacts on the River Severn;

B. S2: New bridge over the Mochdre Brook;

C. S5: New bridge over the Dolfor watercourse (within the Dingle Valley) which would involve a short realignment of the watercourse, however it is not confirmed whether this would be a temporary or permanent diversion.

D. S4: New bridge over Green Brook (to the North of the roundabout at Dolfor) and local realignment;

E. Culvert extensions relating to minor watercourses that the Scheme crosses (C1, C2A, C12, C15);

F. New culverts relating to minor watercourses that the Scheme crosses (C3A and C3B, C4, C5, C6, C7, C8, C9, C10, C11, C13, C14); and

G. The route involves cuttings of up to 27 m depth at various locations along the route. The two largest cuttings are close to Dolfor and are approximately 27 m and 24 m deep. Other cuttings are approximately 8–10 m deep.

H. New flood relief culverts (C2B, C2C and C16)

It is currently understood that no other separate watercourse realignments will be required as part of the works. If additional realignments are needed they will be screened into the detailed assessment.

As described in Section 1.2 within the EIA scoping phase several surface and groundwater features have been identified. The water bodies relating to those features and WFD information relating to each water body are listed in Table 3-1. Their locations are shown on the map within Figure 3-1. Updated 2013 classifications were provided for three of the four water bodies by NRW (NRW 2013). Only the Montgomery Canal, southern section (GB70910253) information refers to that published in the 2009 Severn RBMP Annex B (Environment Agency 2009).

Table 3-1 Water body background data from 2013 classifications provided by NRW

Information	R Severn – conf Afon Dulas to conf R Camlad (GB109054049310)	Mochdre Bk – source to conf R Severn (GB109054044730)	Montgomery Canal, southern section (GB70910253)	Secondary Uplands – Secondary Combined (GB40902G203400)
Approximate water body reporting reach length (km)[2]	51.14	7.62	26[3]	NA
Approximate water body area (km^2)[4]	NA	NA	NA	2358
Hydromorphological designation	Heavily Modified (Drinking Water, Water Regulation and Water Storage)	Not designated	Artificial (Navigation)	NA
Current overall status/potential	Moderate	Moderate (Uncertain)	Moderate	Poor
Current ecological status/potential	Moderate (Quite Certain – WoE)	Moderate (Uncertain)	Moderate (Uncertain)	NA
Current chemical status/potential	Good	Does not require assessment	Not assessed	Fail
Status objective	Good by 2027	Good by 2015	Good by 2015	Good by 2027
Element causing a less than Good score	Phytobenthos – Moderate (uncertain)	Fish -Moderate (uncertain)	Copper - Moderate (uncertain)	Drinking Water Protected Area Impact On Surface Waters
Supporting conditions	Mitigation measures – Good (In Place)	Mitigation measures – NA Quantity and dynamics of flows – Supports Good Morphology – Supports Good Chemical - assessment not required	Mitigation measures – Good (In Place) Chemical - assessment not required	NA

[2] Length confirmed by NRW (May 2014) within SOC 25 document (unless stated). (It is assumed this length refers to reported water body lengths from the Severn RBMP)

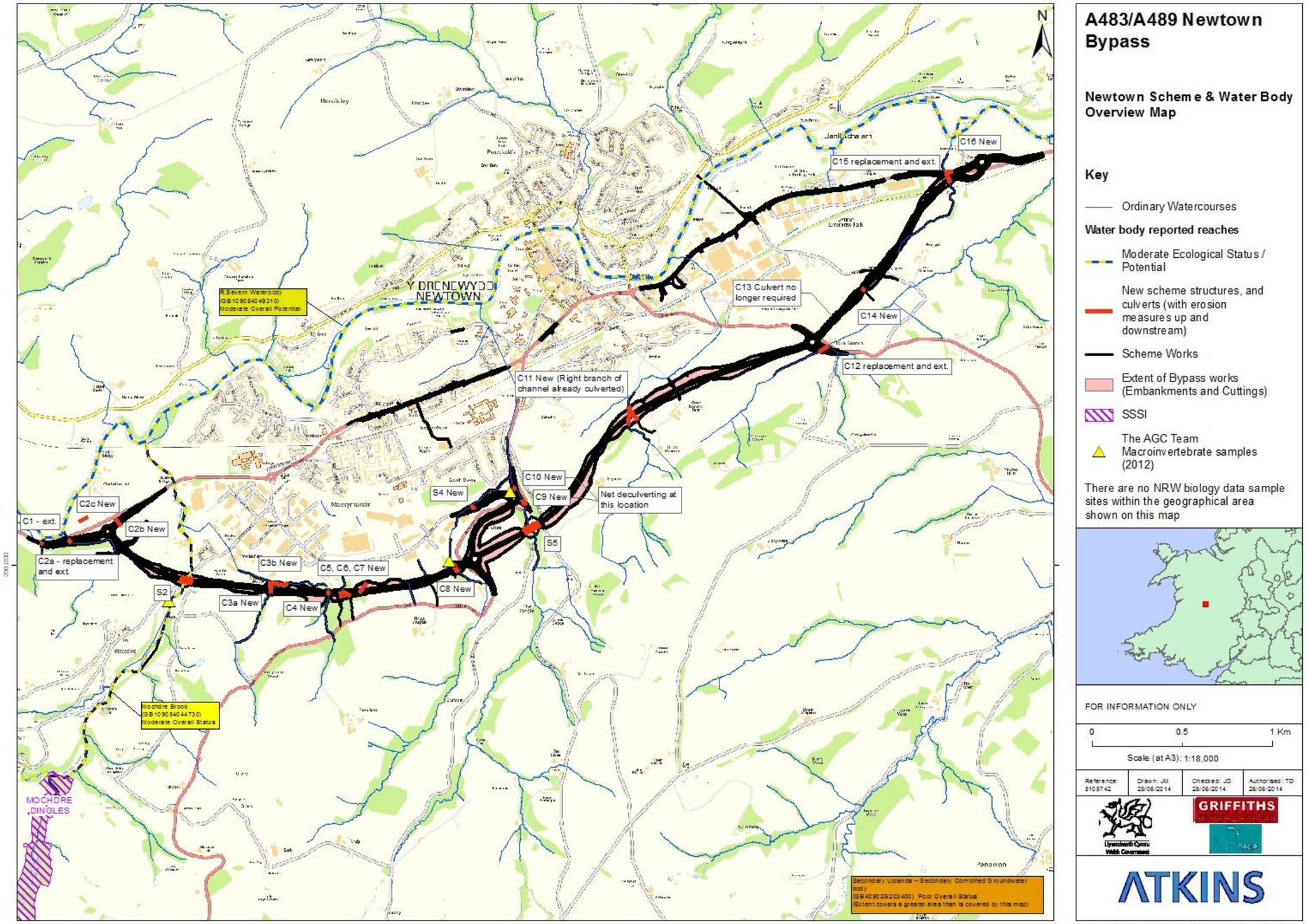
[3] http://maps.environment-agency.gov.uk/wiyby/wiybyController?x=357683.0&y=355134.0&scale=1&layerGroups=default&ep=map&textonly=off&lang=_e&topic=wfd_rivers

[4] http://maps.environment-agency.gov.uk/wiyby/wiybyController?x=357683.0&y=355134.0&scale=1&layerGroups=default&ep=map&textonly=off&lang=_e&topic=wfd_rivers

Information	R Severn – conf Afon Dulas to conf R Camlad (GB109054049310)	Mochdre Bk – source to conf R Severn (GB109054044730)	Montgomery Canal, southern section (GB70910253)	Secondary Uplands – Secondary Combined (GB40902G203400)
Supporting elements (causing a less than Good score)	Specific pollutants – Moderate (Very certain) Copper – Fail (Very certain) Zinc – Fail (Very certain) Diazinon (Uncertain) Dichlorvos (Very certain)	NA	Copper – Moderate (Uncertain)	NA
Protected area designation or Sites of Special Scientific Interest	Freshwater Fish Directive	Not Designated	Not Designated	Drinking Water Protected Area

Source: NRW (2013) and Environment Agency (December 2009), Annex B Severn River Basin District.

Figure 3-1 Scheme location map and WFD water bodies



3.2. Screening assessment of impacts on water body quality elements

The assessment within Table 3-2 considers impacts to all of the four water bodies listed within Table 3-1. The preferred Scheme option was selected through a WelTAG options appraisal process, which included public consultation and involves several elements (as listed see Section 3.1) that could have potential impact on the water bodies. The majority of elements impact on tributaries of the River Severn, which are in direct hydraulic connectivity with the River Severn water body. They therefore contribute to its overall quality and would subsequently adopt the same value/level of importance assigned to the River Severn water body.

Other key points to note include:

- The Montgomery Canal has been initially identified by the 2009 Stage 2 EIA Report as within 1 km of the Scheme. However, further examination of the preferred option indicates it is unlikely to be directly or indirectly impacted by the Scheme, this has been reflected in Table 3-2.
- Surface water and groundwater quality impacts will be fully considered within the ES Drainage and the Water Environment chapter assessment. It has therefore been assumed that water quality will be compliant with WFD objectives and will not require additional detailed assessment as part of the compliance assessment.
- Any indirect, additional and cumulative impacts to downstream water bodies should be included within the detailed assessment.
- Other general and water related impacts not applicable to the WFD water body objectives are assessed further in the ES, this includes temporary impacts such as those resulting from construction works which will not result in a deterioration of water body status.

Table 3-2 Screening assessment of impacts on water body quality elements

WFD Quality elements	Elements of the Scheme			
	R Severn – conf Afon Dulas to conf R Camlad (GB109054049310)	**Mochdre Bk – source to conf R Severn (GB109054044730)**	**Montgomery Canal, southern section (GB70910253)**	**Secondary Uplands – Secondary Combined (GB40902G203400)**
	Element A: Junction at the west of the Scheme where it joins the A489 and potential impacts on the River Severn. **Element C:** New clear span bridge over the Dolfor watercourse (potentially involves a stream realignment). **Element D:** New Bridge over Green Brook (design is yet to be confirmed). **Element E:** Four culvert extensions relating to minor watercourses that the Scheme crosses. **Element F:** 11 new culverts over minor watercourses that the scheme crosses. **Element H**. 3 new flood relief culverts (C2B C2C and C16)	**Element B:** New clear span bridge over the Mochdre Brook.	Current understanding is there will be no physical works that will impact on the water bodies.	**Element G:** Current understanding is that the route involves cuttings of up to 27 m depth at various locations along the route. The A483/A489 Newtown Study DMRB Stage 2 Environmental Impact Assessment Volume 1a Report (The AGC Team, December 2009 Ref: HHC 91371A/ 27a) indicates that the Scheme would pass over a 'non aquifer' which is overlain by till and alluvial silts that may contain a perched water table that could provide baseflow to local watercourses. No Source Protection Zones have been identified.
Hydromorphological elements				
Hydrological regime: ▪ Quantity and dynamics of water flow ▪ Connection to groundwater bodies **River continuity:** ▪ Migration of aquatic organisms, Sediment transport **Morphological conditions:** ▪ River depth and width variation ▪ Coastal/estuarine depth variation ▪ Structure and substrate of the river bed ▪ Quantity, structure and substrate of the coastal/estuary bed ▪ Structure of the riparian zone/intertidal zone **Tidal regime:** ▪ Freshwater flow, Wave exposure	✓ **Element A** (Works adjacent to River Severn) will not impact on the River Severn channel or bank. The zone of impact will be limited to the extent of the existing road. This element will be **screened out** of further detailed assessment. ✓ **Element C** (New bridge over a tributary of the River Severn: Dolfor watercourse) a clear span bridge is proposed. However, preliminary structure drawings indicate a river realignment to be required because a bridge abutment needs to be located close to the river. Further detailed assessment will be required if the watercourse is to be realigned. ✓ **Element D** (New bridge over Green Brook) could have a hydromorphological impact if it is not clear span and so should be further assessed. ✓ **Element E** (Culvert extensions) could further impact the biological connectivity of these River Severn tributaries especially for fish and invertebrates. A further detailed assessment is required. ✓ **Element F** (New culverts) could affect the sediment transport and flow dynamics and biological connectivity. The new culverts are situated on small watercourses which are tributaries to the main River Severn. A further detailed assessment is required. ✗ **Element H.** New culverts for mitigation of flood risk (C2B, C2C and C16) are required. There is no risk for hydromorphology. This element has been **screened out** of further detailed assessment. **A further detailed assessment is required.**	✗ ✗ **Element B** (New bridge over Mochdre Brook) a clear span bridge is proposed and therefore will have no impact on hydromorphology of the Mochdre Brook water body. This element will be **screened out** of further detailed assessment. **A further detailed assessment is not likely to be required. [Following discussion during the detailed assessment this element was subsequently screened back in.]**	✗ ✗ No adverse impacts to this water body are currently identified. **A further detailed assessment is not likely to be required.**	✓ ✓ There is the possibility of seepage (in-direct abstraction) and local drawdown due to cutting below the water table. The impact of the proposed cutting on the groundwater body, and flows within any linked surface water features, should be considered further, within the detailed assessment. **A further detailed assessment is required.**
Biological elements				
Phytoplankton: ▪ Taxanomic composition ▪ Average abundance ▪ Planktonic bloom frequency and intensity ▪ Biomass **Macrophytes and phytobenthos:** ▪ Taxanomic composition ▪ Average macrophytes and phytobenthic abundance **Other aquatic flora (e.g. macroalgae, angiosperms, sea grass, sea weed salt marsh):** ▪ Composition	✓ ✗ **Element A** (Works adjacent to River Severn) will have no impact to biological elements as discussed against the hydromorphology elements above. This element will be **screened out** of further detailed assessment. ✓ **Elements C** (New bridge over Dolfor watercourse) a clear span bridge with river realignment is proposed. Further detailed assessment is required. ✓ **Element D** (New bridge over Green Brook) could have a biological impact if it is not clear span and so should be further assessed.	✗ ✗ **Element B** (New bridge over Mochdre Brook) a clear span bridge is proposed and therefore will have no impact on biological elements on the Mochdre Brook water body. This element will be **screened out** of further detailed assessment. **A further detailed assessment is not likely to be required. [Following discussion during the detailed assessment this element was subsequently screened back in.]**	✗ No adverse impacts to this water body are currently identified. **A further detailed assessment is not likely to be required.**	✗ ✗ No adverse impacts identified. **A further detailed assessment is not likely to be required.**

	Elements of the Scheme			
	R Severn – conf Afon Dulas to conf R Camlad (GB109054049310)	**Mochdre Bk – source to conf R Severn (GB109054044730)**	**Montgomery Canal, southern section (GB70910253)**	**Secondary Uplands – Secondary Combined (GB40902G203400)**
WFD Quality elements	**Element A:** Junction at the west of the Scheme where it joins the A489 and potential impacts on the River Severn. **Element C:** New clear span bridge over the Dolfor watercourse (potentially involves a stream realignment). **Element D:** New Bridge over Green Brook (design is yet to be confirmed). **Element E:** Four culvert extensions relating to minor watercourses that the Scheme crosses. **Element F:** 11 new culverts over minor watercourses that the scheme crosses. **Element H**. 3 new flood relief culverts (C2B C2C and C16)	**Element B:** New clear span bridge over the Mochdre Brook.	Current understanding is there will be no physical works that will impact on the water bodies.	**Element G:** Current understanding is that the route involves cuttings of up to 27 m depth at various locations along the route. The A483/A489 Newtown Study DMRB Stage 2 Environmental Impact Assessment Volume 1a Report (The AGC Team, December 2009 Ref: HHC 91371A/ 27a) indicates that the Scheme would pass over a 'non aquifer' which is overlain by till and alluvial silts that may contain a perched water table that could provide baseflow to local watercourses. No Source Protection Zones have been identified.
Benthic invertebrate fauna: ▪ Composition, Abundance **Fish fauna:** ▪ Species composition and abundance ▪ Presence of type-specific disturbance sensitive species ▪ Age structure of fish communities	✓ **Element E** (Culvert extensions) could further impact the biological connectivity especially for fish and invertebrates. Guidance indicates that culvert extensions require further assessment. ✓ **Element F** (New culverts) could impact on the biological connectivity especially for fish and invertebrates. Guidance indicates that culvert extensions require further assessment. ✗ **Element H.** New culverts for mitigation (C2B, C2C and C16) are required for flood risk. There is no risk for biological elements. This element has been **screened out** of further detailed assessment. **A further detailed assessment is required.**			
Critical sensitive habitats/species				
Protected sites (SACs, SPAs, RAMSAR, SSSI, Priority habitats and species). ▪ The River Severn is designated under the Freshwater Fish Directive (FFD) which aims to improve river water quality and encourage healthy fish populations. ▪ The Mochdre Brook and Montgomery Canal are <u>not</u> designated under the FFD according to RBMP 2009 data. However, the Defra website lists the Mochdre Brook as designated for salmonids in two locations. (To be clarified as part of the detailed assessment) ▪ Otters are known to be active within the Newtown area, in particular they are vulnerable at road crossings, November 2013 a dead otter was reported at SO 11689 91350 to NRW	✓ ✓ The River Severn is designated under the FFD. The tributary watercourses are in direct hydraulic continuity and may possess the ability to provide supporting habitat and thus contribute to the River Severn water body objectives. **A further detailed assessment is required.**	✗ ✗ The Mochdre Brook is not designated under the FFD. However no adverse impacts to these water bodies have currently been identified. **A further detailed assessment is not likely to be required. [Following discussion during the detailed assessment this element was subsequently screened back in.]**	✗ ✗ No adverse impacts to this water body are currently identified. **A further detailed assessment is not likely to be required.**	✗ ✗ No adverse impacts to this water body are currently identified. **A further detailed assessment is not likely to be required.**
Physico-chemical elements				
▪ Salinity, Nutrient concentrations, pH, Oxygen balance, Acid neutralising capacity, Temperature, Transparency. ▪ Pollution by all priority substances identified as being discharged into the water body ▪ Pollution by other substances identified as being discharged in	✗ ✗ **Elements A–H** are considered unlikely to impact on the physico-chemical elements of the River Severn water body. The water quality of drainage from surface water and groundwater will be fully considered within the ES water chapter assessment. It has been assumed that water quality will be compliant with WFD objectives and will not require additional detailed	✗ ✗ No adverse impact the physico-chemical elements is currently identified on the Mochdre Brook. The water quality of drainage from surface water and groundwater will be fully considered within the ES water chapter assessment. It has been assumed that water quality will be compliant with WFD objectives and will not require additional detailed	✗ ✗ No adverse impacts to this water body are currently identified. **A further detailed assessment is not likely to be required.**	✗ ✗ There will be no impact on chemical status or pollution of the groundwater body as a result of this development. Groundwater chemical status can be scoped out of further assessment. The water quality of drainage from surface water and groundwater will be fully considered within the ES water chapter assessment. It has been assumed that water quality will be compliant with WFD objectives and will

	Elements of the Scheme			
	R Severn – conf Afon Dulas to conf R Camlad (GB109054049310)	**Mochdre Bk – source to conf R Severn (GB109054044730)**	**Montgomery Canal, southern section (GB70910253)**	**Secondary Uplands – Secondary Combined (GB40902G203400)**
WFD Quality elements	**Element A:** Junction at the west of the Scheme where it joins the A489 and potential impacts on the River Severn. **Element C:** New clear span bridge over the Dolfor watercourse (potentially involves a stream realignment). **Element D:** New Bridge over Green Brook (design is yet to be confirmed). **Element E:** Four culvert extensions relating to minor watercourses that the Scheme crosses. **Element F:** 11 new culverts over minor watercourses that the scheme crosses. **Element H**. 3 new flood relief culverts (C2B C2C and C16)	**Element B:** New clear span bridge over the Mochdre Brook.	Current understanding is there will be no physical works that will impact on the water bodies.	**Element G:** Current understanding is that the route involves cuttings of up to 27 m depth at various locations along the route. The A483/A489 Newtown Study DMRB Stage 2 Environmental Impact Assessment Volume 1a Report (The AGC Team, December 2009 Ref: HHC 91371A/ 27a) indicates that the Scheme would pass over a 'non aquifer' which is overlain by till and alluvial silts that may contain a perched water table that could provide baseflow to local watercourses. No Source Protection Zones have been identified.
significant quantities into the water body	assessment as part of the compliance assessment. **A further detailed assessment is not likely to be required.**	assessment as part of the compliance assessment. **A further detailed assessment is not likely to be required.**		not require additional detailed assessment as part of the compliance assessment. **A further detailed assessment is not likely to be required.**

3.3. Screening assessment results and recommendations

The screening assessment completed in Table 3-2 indicates that the following elements within Table 3-3 should be scoped into the WFD Compliance detailed assessment.

Table 3-3 Screening summary table - elements screened in for further assessment

Element Code	Element type	Description of element	Water body that could potentially be impacted on
C	New bridge with river realignment.	Bridge over the Lower Dolfor Road and adjacent watercourse.	R Severn – conf Afon Dulas to conf R Camlad (GB109054049310)
D	New bridge	Over the Green Brook (tributary of the River Severn).	
E	Culvert extensions	At 4 locations on tributaries to the River Severn.	
F	New culverts	At 11 locations on tributaries to the River Severn.	
G	Cutting into the ground	Up to a maximum of 27 m at various locations along the Scheme length.	Secondary Uplands – Secondary Combined (GB40902G203400)

It is concluded that a further more detailed WFD compliance assessment of the Scheme is required, and that the elements listed in Table 3-3 will be more fully considered. WFD mitigation measures delivery should also be considered as part of this assessment, so that they can be captured with the EIA.

Objective 3, while not a requirement of the WFD has been added to ensure that the report is comprehensive in its coverage of water related issues, on the advice of Environment Agency in England.

The information and analysis here uses information from the Environmental Statement (ES Volume 1, Section 14) and the Statement to Inform an Appropriate Assessment for the Montgomery Canal SAC (ES Volume 3, Appendix E2).

3.4. References

Environment Agency (December 2009), Annex B Severn River Basin District.

Environment Agency (July 2010) Internal Environmental Assessment and the Water Framework Directive: assessing new modifications, Issued 28/07/10, Internal EA Guidance

Environment Agency (July 2012) Water bodies for the Water Framework Directive, Guidance note (final), issued July 2012, Internal EA Guidance.

Environment Agency (November 2010) Assessing new modifications for compliance with WFD: detailed supplementary guidance, Issued 09/11/10, Internal EA Guidance

Natural Resources Wales (2013) Data request information (5105742//1/60/61/ 008)

Natural Resources Wales (August 2013) A483/A489 Newtown By-pass: Environmental Scoping Report, NRW, Issued 01/08/13.

NRW (May 2014) A483/A489 Newtown Bypass, Schedule of comments and Responses (SOC 025)

The AGC Team (07/10/13) S05 Preliminary Bridge Options Lower Dolfor Road Bridge Sheet 1, Drawing no [A483NB-ATK-ST17-BR05-SK-S-0050-P1.2]

The AGC Team (Date received 05/11/13) Draft drawing showing full scheme and longitudinal sections through it [P-5105742-FULL-SCHEME+SECTIONS-Opt 5-1-H]

The AGC Team (Date received 15/11/13) Draft drawing showing provisional bridge and culvert locations over water courses within the scheme vicinity [P-5105742-FULL-SCHEME-Opt 5-1-H]

The AGC Team (December 2009) A483/A489 Newtown Study DMRB Stage 2 Environmental Impact Assessment Volume 1a Report. December 2009. Report Number HHC 91371A/ 27a

Water Framework Directive (Directive 000/60/ec) (2001) implemented in England and Wales by the Water Environment (Water Framework Directive) Regulations (SI 3242/2003).

Appendices

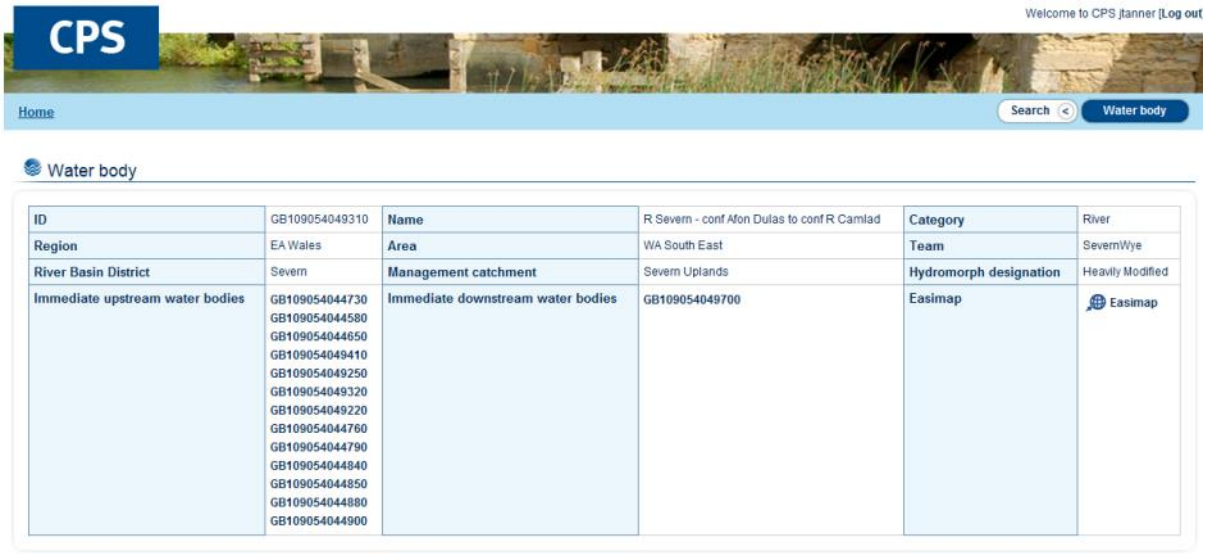
Appendix A. Water body summary sheets

NRW has provided the latest WFD 2013 water body for the following water bodies:

- R Severn - conf Afon Dulas to conf R Camlad water body (GB109054049310),
- the Mochdre Bk - source to conf R Severn water body (GB109054044730) and
- GB40902G203400 Severn Uplands Secondary Combined.

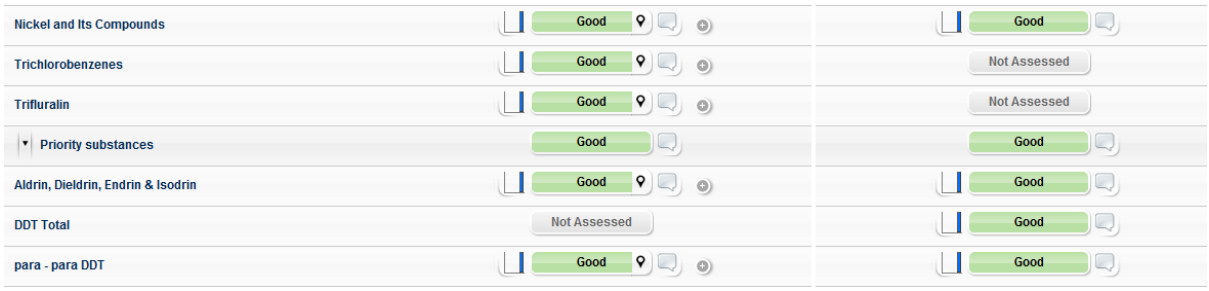
We do not have the updated 2013 classification for the Montgomery Canal, southern section (GB70910253) therefore the River Severn Annex B (2009) classification is recorded below instead.

R Severn - conf Afon Dulas to conf R Camlad water body (GB109054049310)



ID	GB109054049310	Name	R Severn - conf Afon Dulas to conf R Camlad	Category	River
Region	EA Wales	Area	WA South East	Team	SevernWye
River Basin District	Severn	Management catchment	Severn Uplands	Hydromorph designation	Heavily Modified
Immediate upstream water bodies	GB109054044730 GB109054044580 GB109054044650 GB109054049410 GB109054049250 GB109054049320 GB109054049220 GB109054044760 GB109054044790 GB109054044840 GB109054044850 GB109054044880 GB109054044900	Immediate downstream water bodies	GB109054049700	Easimap	Easimap

	2009 Classifications	2013 Classifications
Overall Water Body Potential	Poor	Moderate Quite Certain
Overall Ecological Potential	Poor Quite Certain	Moderate Quite Certain
Biological quality elements	Poor Very Certain	Moderate Uncertain
Fish	Poor Very Certain	Good
Invertebrates	High	High
Phytobenthos	Poor Very Certain	Moderate Uncertain
Supporting elements (Surface Water)	Good	Good
Mitigation Measures Assessment	Good	Good
Physico-chemical quality elements	High	Good
Ammonia (Phys-Chem)	High	High
BOD	Not Assessed	High
Dissolved oxygen	High	High
pH	High	High
Phosphate	High	Good
Temperature	High	Good
Specific pollutants	Moderate Very Certain	Moderate Very Certain
2,4-dichlorophenoxyacetic acid	Good	Not Assessed
Ammonia (Annex 8)	High	Not Assessed
Copper	Fail Very Certain	Fail Very Certain
Diazinon	Good	Not Assessed
Iron	Good	Good
Linuron	Good	Not Assessed
Mecoprop	Good	Not Assessed
Zinc	Fail Very Certain	Fail Very Certain
Hydromorphological quality elements	Not Assessed	Not Assessed
Overall Chemical Status	Fail Quite Certain	Good
Priority hazardous substances	Fail Very Certain	Good
Cadmium and Its Compounds	Fail Very Certain	Good
Chlorfenvinphos	Good	Not Assessed
Diuron	Good	Not Assessed
Hexachlorobenzene	Good	Not Assessed
Hexachlorobutadiene	Good	Not Assessed
Hexachlorocyclohexane	Good	Good
Isoproturon	Good	Not Assessed
Lead and Its Compounds	Good	Good



Metals failures driven by metal mines upstream.

MEASURE: There is an operating agreement in place to ensure flows are maintained to support environmental needs and to meet the needs of downstream abstractions

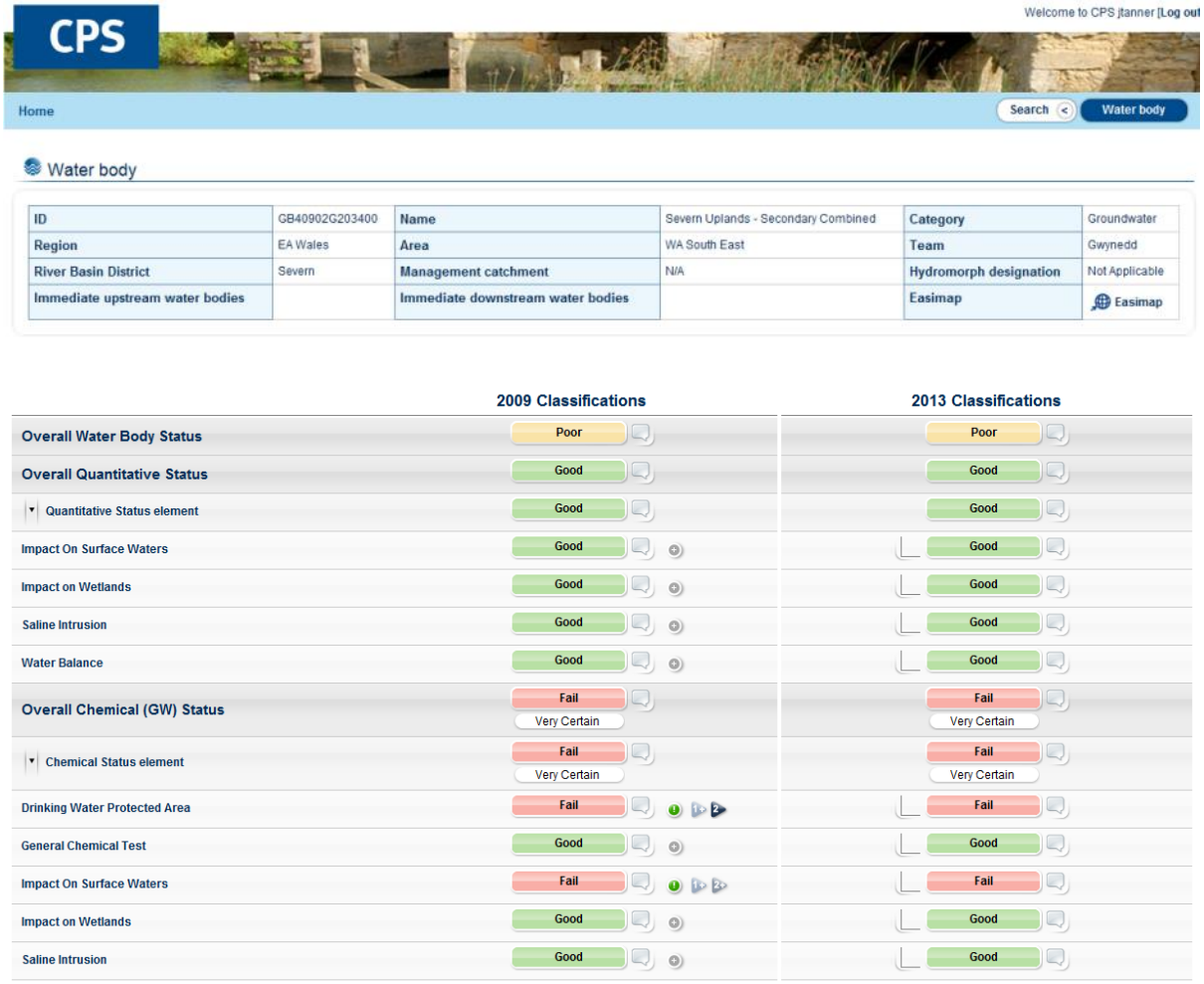
Mochdre Bk - source to conf R Severn water body (GB109054044730)

	2009 Classifications	2013 Classifications
Overall Water Body Status	Moderate	Moderate Uncertain
Overall Ecological Status	Moderate Quite Certain	Moderate Uncertain
Biological quality elements	Moderate Quite Certain	Moderate Uncertain
Fish	Moderate Quite Certain	Moderate Uncertain
Physico-chemical quality elements	High	Good
Ammonia (Phys-Chem)	High	High
BOD	Not Assessed	High
Dissolved oxygen	High	High
pH	High	High
Phosphate	High	Good
Temperature	High	Good
Specific pollutants	High	Not Assessed
Ammonia (Annex 8)	High	Not Assessed
Hydromorphological quality elements	Not High	Not High
Hydrology	High	High
Morphology	Good	Good
Overall Chemical Status	DNRA	DNRA
Priority hazardous substances	DNRA	DNRA
Priority substances	DNRA	DNRA

Fish failure driven by barriers and habitat

2 fish sites, Mochdre Brook site is at Good status, other site on headwaters of Cwm-y-Rhiwdre Brook is at Poor status based on 3 trout when expect 14. SRT Walkover report on file.

GB40902G203400 Severn Uplands Secondary Combined



The surface water chemical failures are primarily as a result of the impact of abandoned former metal mines in the area. GW Drinking water measures: Recommends: Continue with COGAP CSF; GW Protection Policy GP3; NVZ action plans; EPR 2010. To reduce N: Agronomist advice; winter cover crops; Alternative management of crops /fertilizer/ livestock / yards / slurry.

Catchment: All RBD: 9

Waterbody Category and Map Code.:	Canal - Ca29	**Surveillance site:**	No
Waterbody ID and Name:	GB70910253	Montgomery Canal, southern section	
National Grid Reference:	SJ 20503 03251		
Current Overall Potential	Moderate		
Status Objective (Overall):	Good by 2015		
Status Objective(s):	Good Ecological Potential by 2015		
Justification if overall objective is not good status by 2015:			
Protected Area Designation:	Not Designated		
SSSI (Non-N2K) related:	No		
Hydromorphological Designation:	Artificial		
Reason for Designation:	Navigation		
Downstream Waterbody ID:			

Ecological Potential

Current Status (and certainty that status is less than good)	Moderate (Uncertain)

Supporting elements

Element	Current status (and certainty of less than good)	Predicted Status by 2015	Justification for not achieving good status by 2015
Ammonia (Phys-Chem)	High	High	
pH	High	High	
Phosphate	High	High	
Temperature	High	High	
Copper	Moderate (Uncertain)	High	
Zinc	High	High	
Ammonia (Annex 8)	High	High	

Ecological Potential Assessment

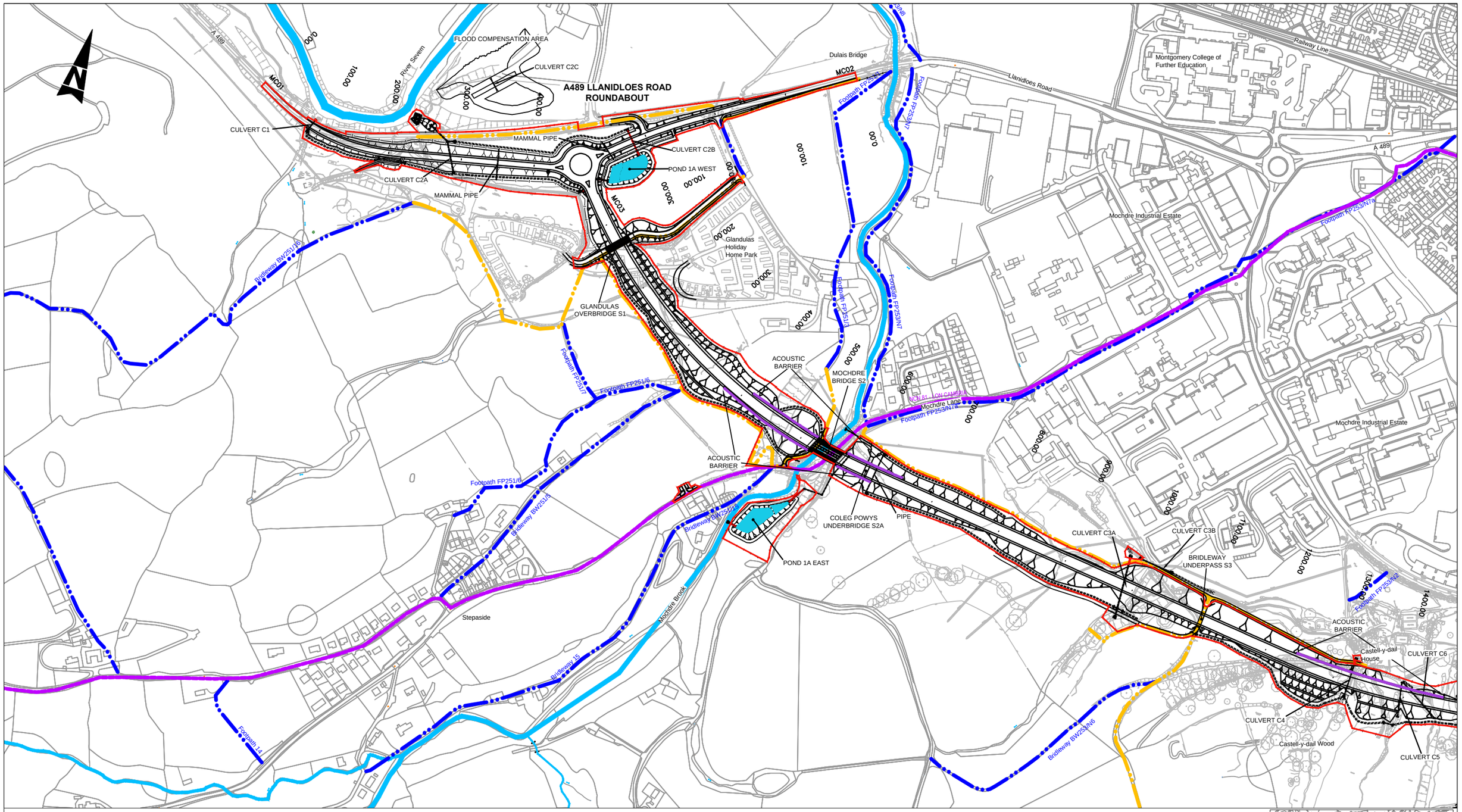
Element	Current status	Predicted Status by 2015	Justification for not achieving good status by 2015
Mitigation Measures Assessment	Good	Good	

GEMI0910BSSN-E-E

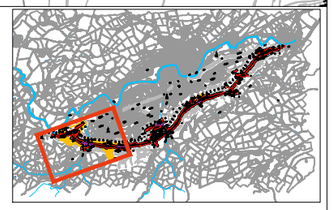
1413

Appendix B. Scheme data

Final scheme drawings



Highway Boundary
On Embankment
In Cutting
False cutting
Ditches
Boundary fencing
Attenuation Pond
Acoustic Barrier
Proposed Public Right of Way
Footpath FP253/N7a — Existing PROW
NCN 81 - LON CAMBRIA — Existing National Cycle Network



Client/Team: Llywodraeth Cymru Welsh Government

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Job Title: A483/A489 Newtown Bypass

Drawing Title: Appendix K.2 General Arrangement Sheet 1 of 4

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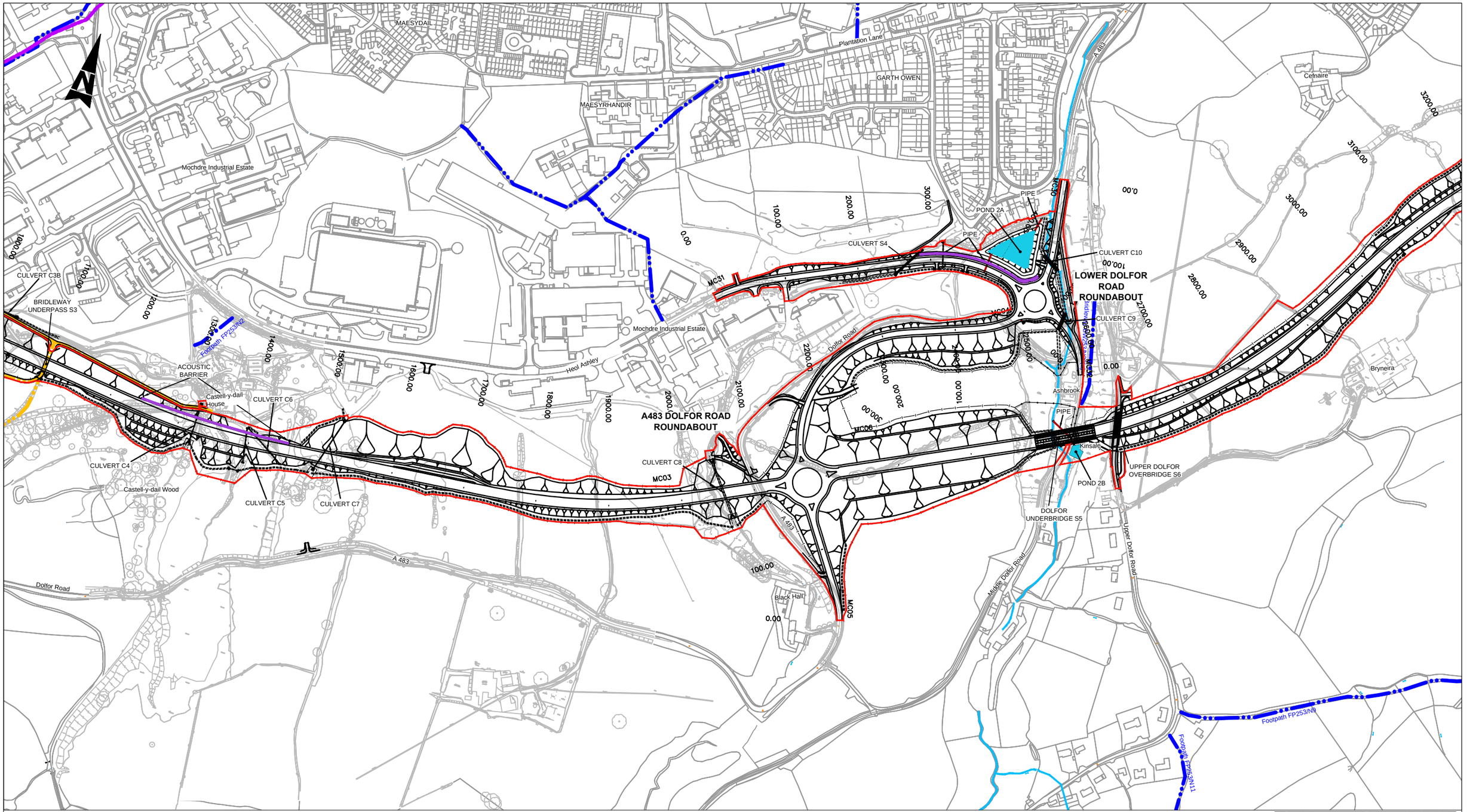
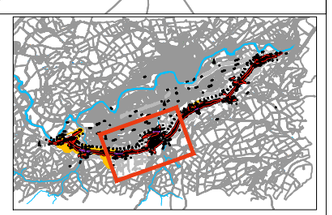
Job No: 60597	Figure No: 1.a	Issue: -	



Highway Boundary
False cutting
Attenuation Pond
Acoustic Barrier
Footpath FP253/N7a — Existing PROW
On Embankment
Ditches
Proposed Public Right of Way
NCN 81 - LON CAMBRIA — Existing National Cycle Network
In Cutting
Boundary fencing



Client/Team

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Newtown Bypass

Drawing Title

Appendix K.2
General Arrangement
Sheet 2 of 4

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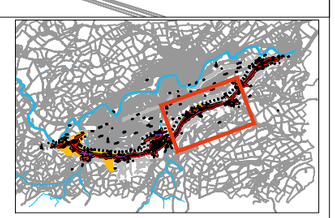
Drawing Status: FINAL		Approved: JW	
Job No: 60597	Figure No: 1.b	Issue: -	

A 489
Railway Line
TREOWEN
Heol Treowen
Vastre Enterprise Park/
Parc Menter Vastre
Wern Ddu Lane
A 489
Bridleway BW253/N15
POND 3
3700.00
3800.00
3900.00
4000.00
4100.00
4200.00
4300.00
4400.00
4500.00
4600.00
4700.00
4800.00
4900.00
BRIMMON LANE
UNDERPASS S8
MAMMAL PIPE
BRIMMON FARM
UNDERPASS S7
3400.00
3500.00
3600.00
3300.00
3200.00
3100.00
3000.00
2900.00
Cefnaire
CULVERT C11
PIPE
Brimmon House
Brimmon Farm
ACOUSTIC
BARRIER
A 489
MC07
KERRY ROAD
ROUNDABOUT
MC09
MC06
PIPE
PIPE
POND 4
PIPE
200.00
100.00
100.00
0.00
0.00
Footpath FP253/N22
CULVERT C14
REPLACEMENT
PONDS
Lower Brimmon Farm
CULVERT C12
MAMMAL PIPE
MC08
A 489
Bryneira
Brimmon Wood
Footpath FP253/N10
Footpath FP253/N9
Footpath 9
Footpath FP253/N16

Highway Boundary
On Embankment
In Cutting
False cutting
Ditches
Boundary fencing
Attenuation Pond
Acoustic Barrier
Proposed Public Right of Way
Footpath FP253/N7a
Existing PROW
NCN 81 - LON CAMBRIA
Existing National Cycle Network



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Newtown Bypass

Drawing Title
Appendix K.2
General Arrangement
Sheet 3 of 4

Date: OCT 2014		Drawn by: FS	
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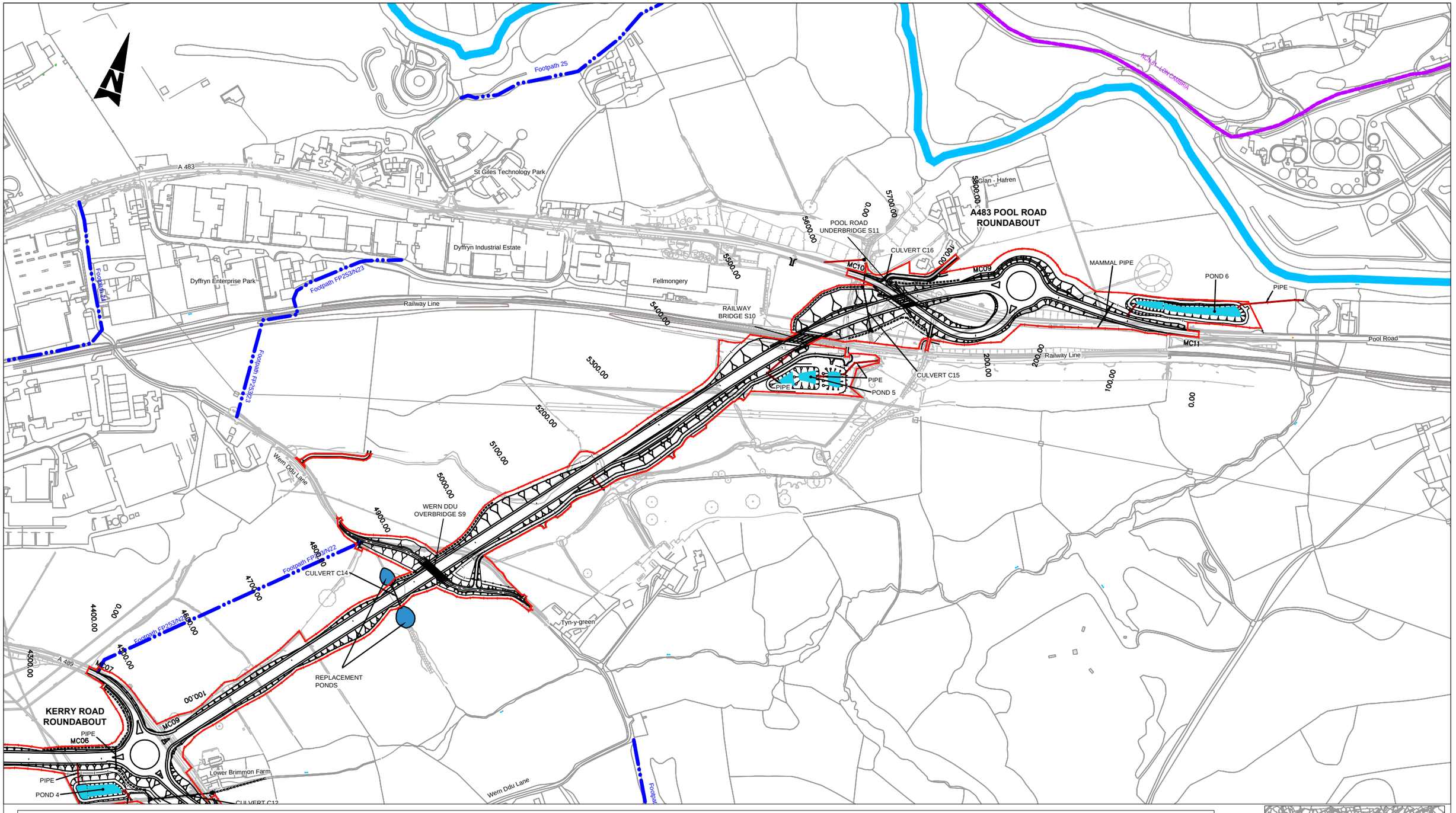
Job No: 60597	Figure No: 1.c	Issue: -	



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On Embankment
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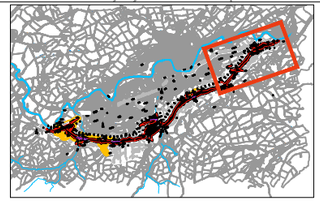
Footpath FP253/N7a — Existing PROW
NCN 81 - LON CAMBRIA — Existing National Cycle Network



Client/Team: Llywodraeth Cymru Welsh Government

GRIFFITHS civil engineering and construction · ATKINS · TACP · CORDEROY · CAPITA

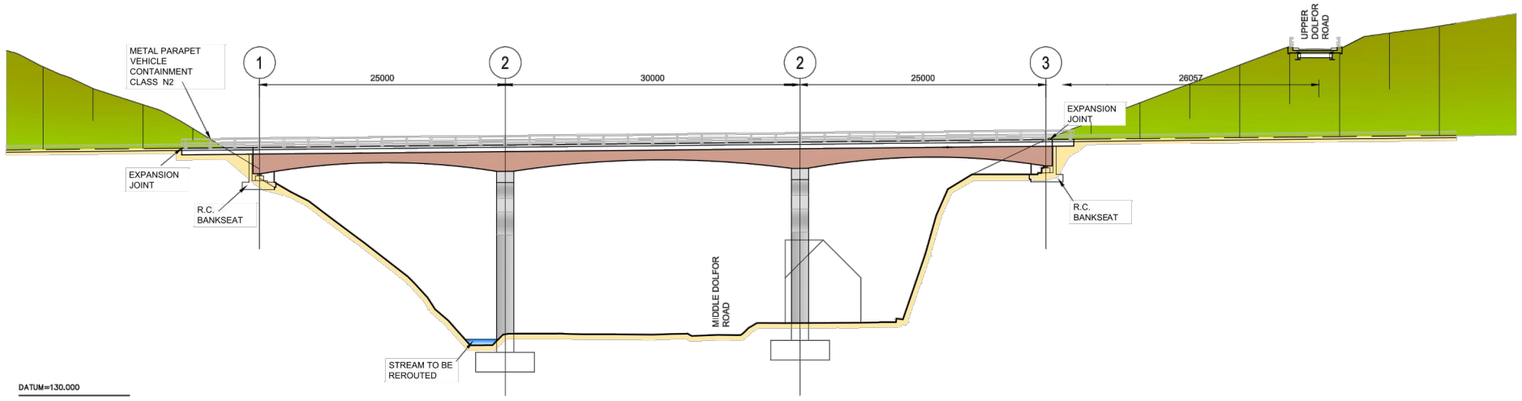
Job Title: A483/A489 Newtown Bypass

Drawing Title: Appendix K.2 General Arrangement Sheet 4 of 4

Date: OCT 2014		Drawn by: FS	
Scale at A3 1:5,000	Scale at A1 1:2,500	Checked: MB	
Drawing Status: FINAL		Approved: JW	
Job No: 60597	Figure No: 1.d	Issue: -	

Figure showing S05 Bridge options Dolfor Under- bridge

DO NOT SCALE



PROPOSED ELEVATION

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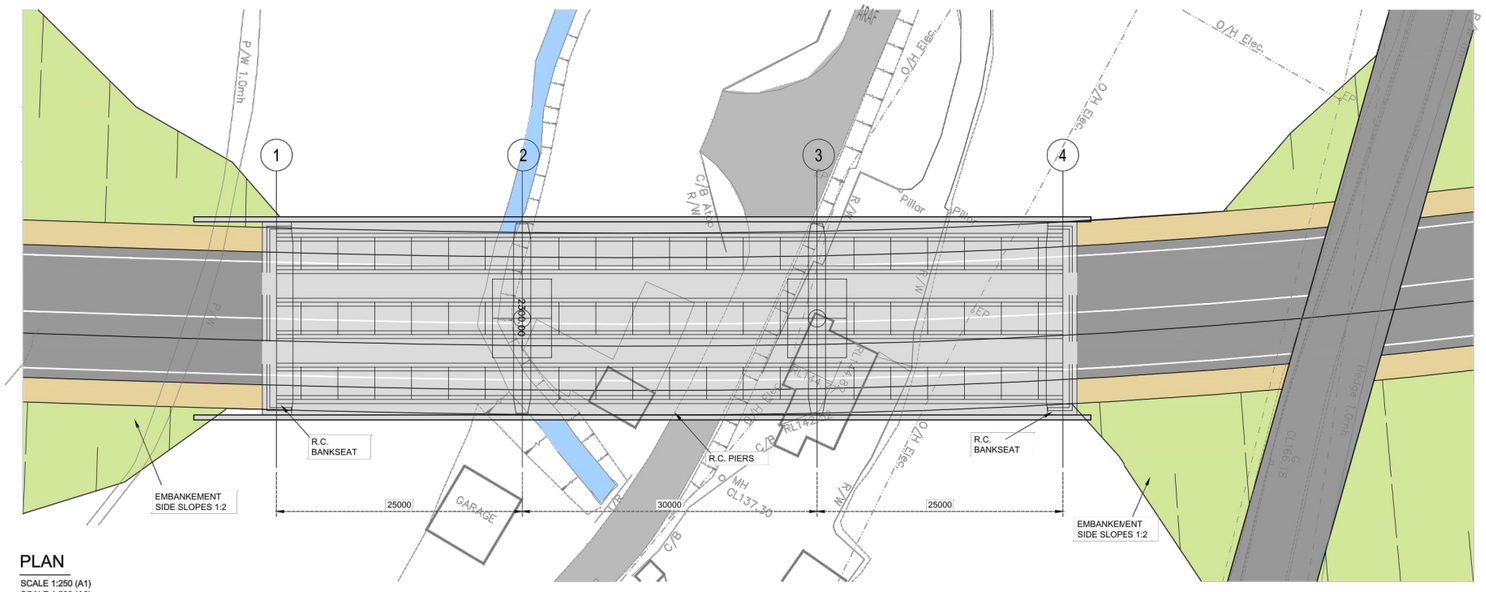

PLAN

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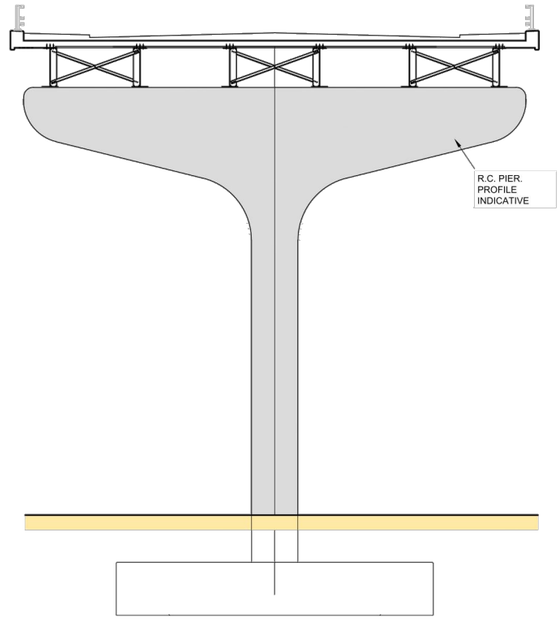

TYPICAL CROSS SECTION

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Client/Team

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TACP
CORDEROY
CAPITA

Job Title

A483/A489
Newtown Bypass

Drawing Title

APPENDIX K.2
S05 - Dolfor Under-bridge
Preliminary Bridge Option - Type 4
Sheet 1 of 1

Date: OCT 2014		Drawn by: DAS	
Scale at A3: Not to Scale		Checked: AT	
Drawing Status: FINAL		Approved: JW	
Job No: 60597	Figure No: 2.0	Issue: -	

Llywodraeth Cymru
Welsh Government



A483/A489 NEWTOWN BYPASS

Drainage Strategy

September 2014

GRIFFITHS civil engineering and construction
ATKINS
TACP
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Llywodraeth Cymru
Welsh Government

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DOCUMENT REFERENCE:
5105742/FD/DRS/RT505/F

CLIENT: The Welsh Government

Transport

PROJECT: **A483/A489 Newtown Bypass**

Report Title: Drainage Strategy/ Design Approach

Issue: 1

Status: To accompany Environmental Statement

F	02-09-14	Finalised version	DMH	HR	TAD
Issue	Date	Status	Written	Reviewed by	Authorised by Project Manager

CONTENT

Executive summary

This document provides a summary of the key elements of the drainage outline design principles to be used on the Newtown Bypass.

The report is intended for the use of Welsh Government, NMWTRA, NRW, LLFA, operating agencies and the contractor.

The new highway would be designed to incorporate a positive drainage system with SUDS elements as appropriate.

Carriageway drainage would be provided by a kerb and gulley system along sections of embankment and filter drains in cuttings. The latter would capture carriageway runoff and a portion of the cutting drainage.

Carriageway drainage capacities would be designed to achieve no surcharge during a 100% (1 in 1) annual average chance event and no flooding during 20% (1 in 5) annual chance event, with no flooding during a 33% (1 in 30) annual chance event in critical areas.

Attenuation facilities in the form of hybrid ponds with flow controls would restrict the discharge rates to no more than the pre-development Greenfield run-off. These would be designed to contain the volume of runoff from a 1% (1 in 100) annual chance event inclusive of a climate change allowance.

The ponds would incorporate settlement fore bays and vegetative treatment areas, and would serve the dual purpose of pollution control and flow control. The ponds would be equipped with skim plates and flow controls which would operate on the same principles as oil separators. Shut-off valves would be provided at pond outlets to contain accidental spillages.

Further pollution control measures would be offered by filter drains where provided.

Access for future maintenance would be provided to all attenuation, pollution control and outfall facilities as appropriate.

Fence line drains would predominantly be ditches lined with PC slabs, concrete canvas or geotextile. These would be designed to a 1.33% (1 in 75) annual chance event capacity

1. The Project

1.1. Context

The Welsh Government proposes to provide a bypass to the south of the town of Newtown in Powys, which would link the A489 and A483 Trunk Roads.

Newtown is a pinch point on the network and the junction of the A483 and A489 regularly suffers from traffic congestion. The A483/A489 at Newtown forms part of the north-south and east-west transport corridors linking areas such as Mid Wales and the West Midlands in England. Further industrial development of Newtown is believed to be hampered by transport/congestion issues.

Historically, extensive work has been undertaken to identify traffic problems in Newtown, Powys, dating back to 1969 when a study to investigate possible bypass routes was commissioned because of the proposed expansion of the town. The result of this study led to a Preferred Route being announced and protected in 1973.

The protection of the route was relaxed in 1989 and certain developments have encroached onto the protected route at the south western end and on Upper Dolfor Road. Over the years the area has seen industrial development along the trunk road corridor together with housing within the town and more recently the development of a number of retail stores having direct access onto the trunk road.

1.2. Background

The Welsh Government commissioned an independent study to examine the transport problems associated with the A483 (T) and A489 (T) through Newtown. The Newtown Planning Objectives and Pre-Appraisal Report (February 2006) concluded it was unlikely that further traffic management measures, improvements in public transport or a combination of such measures, would have a significant impact on alleviating the problems. A road improvement or bypass option, which removes the low headroom restrictions and reduces congestion within the town, was likely to be the only acceptable solution.

In December 2007 the Welsh Government commissioned a Key Stage 2 (KS2) Study to investigate options to resolve the transport problems in Newtown. The study was conducted and options appraised in accordance with the Welsh Transport Planning and Appraisal Guidance (WelTAG), taking into account the numerous policies, plans and strategies including undertaking a Health Impact Assessment. The study placed specific emphasis on the social, economic and environmental impacts.

A Public Consultation Exhibition was held between 8th and 10th September 2009 in Newtown and in October 2010 the Deputy First Minister announced a preferred route which has been protected for planning purposes.

1.3. The Scheme

The A483/A489 Newtown Bypass preferred route is a 5.8km route to the south of Newtown. It links into the A489 Llanidloes Road to the west of Newtown by way of a

roundabout. It crosses over Mochdre Brook then runs south of Mochdre Industrial Estate and interfaces with the A483 at Dolfor Road by way of a roundabout. (The northern section of the A483 would incorporate a new direct link into the Mochdre Industrial Estate from a second roundabout which would also connect with Middle Dolfor Road).

From the A483 roundabout the bypass route runs in a north easterly direction and crosses over Middle Dolfor Road and under Upper Dolfor Road. The alignment then generally follows the line of the original TR111 route and lies south of the Vastre and Dyffryn Industrial Estates. There would be an at-grade roundabout to link into the A489 Kerry Road.

The route then crosses over the main Cambrian railway line east of Dyffryn Industrial Estate before tying into the existing A483 Pool Road to the east of Newtown which would be by way of a roundabout located north of the existing Pool Road.

In addition to the bypass the Scheme would include some online footway widening improvements along Pool Road and New Road through Newtown.

1.4. The Project Objectives and reason for the Project

1.4.1. Welsh Government Objective and Mission Statement

The Welsh Government's objective is to provide a bypass to the town of Newtown in accordance with the findings of the KS2 Scheme, and to include the commitments made at the Public Consultation undertaken as part of this study. This is to be carried out through appointment of a design and build Contractor under an Early Contractor Involvement (ECI) contract to be managed following the principles of PRINCE2 project management system and to deliver the works to programme, budget, and with due regard to the Welsh Ministers policies.

The Welsh Government's mission is to:

''Promote the vision and transport strategy described in the Welsh Government's 'One Wales: Connecting the Nation', the Wales Transport Strategy, and the National and Regional Transport Plans''.

1.4.2. Scheme / Planning Objectives

Seven specific Transport Planning Objectives (TPOs) have been identified for the Scheme. These would be achieved by the successful ECI Contractor and several other stakeholders, namely Powys County Council/TraCC (Objectives 1, 4 and 5) and Welsh Government (Objectives 2, 3, 6 and 7). The objectives are detailed below:

Objective 1 – Maintain economic base

Maintain economic base of Newtown measured by levels of local employment by the date in the local development plan (2025).

Objective 2 – Meeting relevant environmental targets

Within Newtown settlement boundary limit and within 200m of the Scheme;
Meet targets and comply with appropriate environmental legislation and policies by 2018;

Reduce greenhouse gas emissions along Pool Road and New Road by 3% from 2008 levels, by 2018 (in accordance with Wales Transport Strategy).

Objective 3 – Removing through traffic from local roads

Reduce through traffic on Heol Treowen, Plantation Lane and Milford Road by 50% over 2008 levels by 2018;

Reduce HGVs on Heol Treowen, Plantation Lane by 90% from 2008 levels, by 2018.

Objective 4 – Increasing level of usage for non-car forms of transport

For travel with origin and destination within Newtown, achieve modal shift of 10% from car to non-car forms of transport (cycling, walking and public transport), over 2008 levels, by 2018;

For travel with origin or destination within Newtown, achieve modal shift of 2% from car to public transport, over 2008 levels, by 2018.

Objective 5 – Integration of public transport

Within Newtown limit interchange penalty linking bus services and train services to 20 minutes, by 2018;

Within Newtown, during morning and evening peak hours (0700-0900 and 1600-1800) limit interchange penalty between bus services to 10 minutes, by 2018.

Objective 6 – Improve journey time consistency (North-South, East-West)

Reduce journey times during morning and evening peak hours (0800-0900 and 1615-1715) on A489/A483 between A470/A489 junction (Caersws) and A483/B4389 junction (Aberbechan junction) by 10% by 2018;

Reduce journey times during morning and evening peak hours (0800-0900 and 1615-1715) on A489/A483 between A483/unnamed C class Road at 'The Dingle, and A483/B4389 junction (Aberbechan junction) by 10% by 2018;

Reduce journey times during morning and evening peak hours (0800-0900 and 1615-1715) on A489/A483 between A483/unnamed C class Road at 'The Dingle', and A470/A489 junction (Caersws) by 10% by 2018.

Objective 7 – Reduction in accidents

Within Newtown settlement boundary limit, reduce road traffic accidents on A483 (T), A489 (T), Heol Treowen, Plantation Lane and Milford Road by 25% by 2018.

2. Purpose of Report

The purpose of this report is to describe the proposed design strategy for key elements of the new road drainage system. It covers the design standards to be adopted, as well as levels of service and methods of analysis as appropriate.

The report is intended for the use of;

- the Welsh Government and North and Mid Wales Trunk Rd Agency in determination of acceptability of the chosen design
- Natural Resources Wales for the purpose of agreement on design principles in relation to flood defence applications
- Powys County Council (PCC) as Lead Local Flood Authority (LLFA)
- The Contractor for assistance in construction strategy and development of target costs.

3. Existing & Proposed Drainage Works

3.1. Proposed Highway Works

The works are as described in detail in Section 1.3 above. Please refer to Appendix B for a list of drainage drawings to be read in conjunction with this report.

In brief,

- The bypass would be constructed to 3 lane standard with maximum 60 mph speed limit
- Overall length is 5800m main carriageway, with 5 roundabouts and 10 points of connection to existing roads
- The predominant form of new construction would be across green field site, with a mixture of cutting, embankment and sidelong ground.
- Main line gradients range from1:16 to1:225
- There would be a total of 7 bridges, which are proposed to be of steel/concrete composite construction.
- There would be a total of 17 pipe culverts. Of these, one would be a mammal (otters and badgers) crossing and the remainder watercourse crossings. Watercourses of significance are the Dolfor and Mochdre Brooks, both being tributaries of the River Severn which passes nearby.

3.2. Existing drainage

No details of the drainage of the existing trunk or side roads have been made available to date.

The existing road catchments, drainage capacities and outfall locations have not been confirmed.

The extent of pollution control measures on the existing system is unknown, but oil interceptors are not thought to be present.

As the design capacities and service levels of the existing systems are unclear at this stage, any connections of new drainage into the existing systems would be limited to short sections of road where the existing carriageway would be replaced, i.e. at ties ins to existing roads. All new carriageway flows would be attenuated separately.

However, it is recommended that a full drainage survey be carried out prior to detailed design in order to determine whether any cross connections may be viable.

3.3. Proposed Carriageway Drainage

3.3.1. Surface water system

On embankments, the surface water drainage system would comprise kerb and gullies routed to carrier drains. Filter drains would be utilised within cuttings.

Kerbed side roads would be drained by gullies or combined kerb and gully systems where applicable.

It is also proposed to use combined kerb and gully systems where possible in the centres of the roundabouts, but only gullies on the outside of roundabouts for reasons of practicality.

Likewise combined kerb and gully systems would also be used over bridges where the depth of construction is limited.

All of the carrier pipes would run to attenuation ponds (see 3.4 below), the outflows from which would be restricted as agreed with NRW on behalf of the LLFA prior to discharge to watercourse. At this stage, it is not anticipated that any discharge to ground would be possible, unless otherwise proven by permeability tests.

It is likely that a portion of the cutting drainage along the route would be combined in the same pipe system as the highway runoff. The cutting drainage would be captured using filter drains feeding into the highway drain carrier pipes. The filter drains would therefore serve the purpose of cutting drainage, carriageway drainage and formation drainage. However this would be subject to detailed design as practical requirements may require separation where pipe diameters become excessive or where cutting drainage is required to be discharged upstream of the carriageway, to avoid overloading attenuation ponds and flow controls.

Design Standards

The surface water and other elements would be designed in accordance with the following DMRB sections:

HD 33/06	Surface and Sub Surface Drainage for Highways
HA 39/98	Edge of Pavement Details
HD 45/09	Road Drainage and the Water Environment
HA 102/00	Spacing of Road Gullies
HA 103/06	Vegetative Treatment Systems for Highway Runoff

Levels of Service

Typically, the design levels of service for the drains would be to carry a 100% (1 in 1) average annual chance event with no surcharging, and 20% (1 in 5) chance event with surcharging permitted but no surface flooding (HA39 DMRB 4.2). Critical sections

such as changes in cross fall and sags would be designed to higher level of service up to no flooding during a 33% (1 in 30) annual chance event, to be determined during detail design stage.

Carrier drains would be designed to the same criteria, i.e. 100% (1 in 1) annual chance with no surcharge and 20% (1 in 5) annual chance event with surcharge, or a higher level of service at critical sections.

The capacity of drains would be designed in accordance with DMRB HD33/06 and would incorporate a 20% increase in rainfall intensities for the design storm as an allowance for climate change.

Minimum pipe size would be 225mm for carrier drains.

3.3.2. Sub-surface system

Sub-surface water would be drained using filter and narrow filter drains connected into carrier drains. These would be designed in accordance with DMRB HD33/06. Fin drains have been considered but are not preferred for practical reasons.

Minimum pipe size would be;

- 225mm for filter drains, and
- 150mm for narrow filters.

3.4. Ponds and Detention Basins

3.4.1. Attenuation Requirements

It is proposed to restrict the peak discharge from the pavement drainage to no greater than the pre-development run-off rates. As this is predominantly a green field site, the predevelopment run off rates would be Greenfield rates (see below).

Discharge flows to watercourses would be restricted using controls, such as orifice plates or Hydrobrakes; the choice of control would be determined by the flow in each case.

Ponds and Detention Basins would be designed to contain the surface water runoff from the 1% (1 in 100) annual chance event including an allowance for climate change. To allow for potential future climate change, rainfall intensities would be increased by 20% (in accordance with Adapting to Climate Change: Guidance for Flood and Coastal Erosion and Risk Management Authorities in Wales; Welsh Government, 2011). Simulations for a range of storm durations would be undertaken to determine the largest detention volume required for the design event.

Checks would also be undertaken to ensure that the highway run-off for the more frequent events would not exceed the existing Greenfield runoff. The range of flows to be tested is given in Table 3.1.

Storage facilities would be designed generally in accordance with the guidance provided by CIRIA C697 SUDS Manual, and HA103/06.

3.4.2. Greenfield runoff

Unit area runoff rates

In determining the appropriate Greenfield runoff the following approach has been adopted.

The DMRB indicates that runoff from catchments of less than 50ha should be assessed using the ADAS 124 method. However, Environment Agency Guidance (June 2012), recommends that FEH methods should now be used in preference for runoff from small catchments.

Therefore, unit area runoff rates for the watercourses along the Scheme have been derived using FEH methodology (FEH calculation records are appended to the Flood Consequences Assessment for the Scheme).

Catchment average runoff rates have been derived for the following catchments.

- River Severn at Newtown
- Mochdre Brook
- Dolfor Brook at the confluence with Green Brook

The unit area runoff rates for these catchments are presented in Table3.1, below.

Table 3-1 Catchment Unit area runoff rates (l/sec/ha)

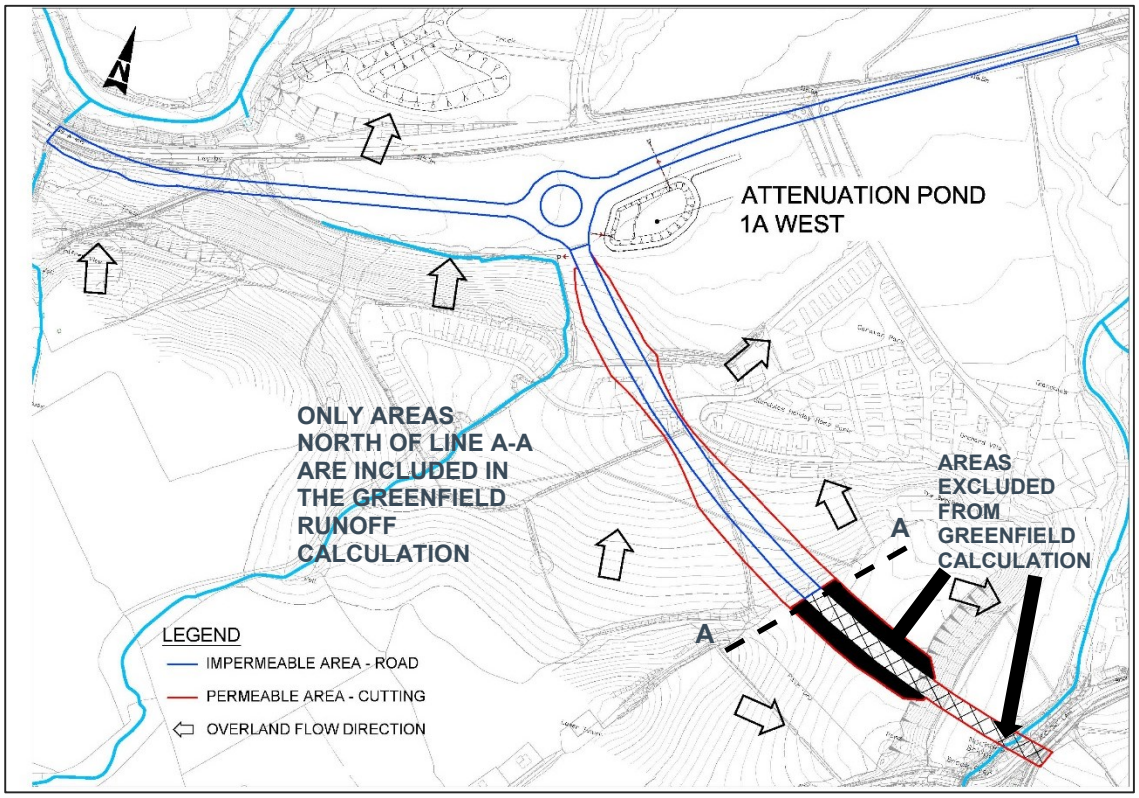
Unit area runoff rates (litres/second/hectare) by annual average chance event					
Catchment	**100% (1 in 1)**	**50% (QMED)**	**20% (1 in 5)**	**1% (1 in 100)**	**1% (1 in 100)+cc**
River Severn (Sev_14)	3.55	3.8	4.7	7.57	9.08
Mochdre Brook	3.45	3.7	5.9	8.94	10.73
Dolfor Brook	4.47	4.8	6.7	14.4	17.28

Areas used in Greenfield runoff calculation

The proposed vertical alignment of the new road would result in drainage runs from some parts of the highway crossing natural watersheds. Where this is the case, that part of the road catchment which currently does not drain to the point of discharge of the highway drain has been omitted from the calculation of the allowable Greenfield runoff.

For example, the catchment contributing to Attenuation Pond 1A West is indicated on Figure 3.1. Due to the proposed vertical alignment of the road it is necessary for the drainage of the hatched (carriageway) and solid (earthworks) areas to be routed to Attenuation Pond 1A West. However, only those areas north of the dashed line (A-A) are included in the Greenfield Runoff calculation, since only these areas currently drain to the watercourse to which Pond 1A West would discharge.

Figure 3-1 Catchment to Attenuation Pond 1A West as an example of areas excluded from Greenfield runoff calculation.



The road catchments to each of the attenuation ponds are presented in Figures B1 to B4 in Appendix B1.

3.4.3. Pollution control Requirements

The main sources of pollution in carriageway runoff are hydrocarbons, suspended particulate matter (with associated heavy metals), and dissolved solids (containing zinc and copper).

The Environment Agency's Pollution Prevention Guidance note 3 (PPG3, 2006) require that consideration would need to be given to protecting the environment from pollution by oils and hydrocarbons. This can be achieved by either oil interceptors or the use of sustainable drainage systems (SUDS). SUDS systems include ponds, wetlands or swales.

The Water Quality chapter of the Environmental Statement (ES) covers pollution control requirements more fully. An assessment was carried out under the terms of HD 45/09 (Road Drainage and the Water Environment) and other related documentation. Section 14.4.2 of the ES determined the respective treatment requirements for water quality for each proposed outfall location. Section 14.5.2 of the ES indicates that the mitigation requirements would be satisfied by the provision of wet ponds or detention basins (dry lagoons) at outfall locations. However, in order to intercept hydrocarbons, storage facilities which feature permanently wet areas would be required.

The outfalls from the storage facilities would be equipped with systems to retain hydrocarbons within the permanently wet areas, (similar to the mechanisms shown on Figure 2.5, HA 103/06). These systems operate on the same principles as full retention oil separators. This approach is subject to agreement with NRW.

Transported sediments would be removed by sedimentation within the ponds.

Dissolved solids can be removed through plant metabolism in vegetative treatment systems, which would be provided by dedicated planted areas. Hydrocarbons would be removed partially in wet ponds and partially by natural breakdown in the planted areas. They would also be partially removed upstream in filter drains, and swales where provided.

Emergency shut-off valves and bypasses would be provided upstream of critical discharge locations to isolate the ponds from receiving watercourses in the event of an accidental spillage.

Suitable access provision would be provided to all pollution control facilities to allow for future maintenance.

If any attenuation solutions other than wet ponds need to be utilised, consideration would need to be given to how the required pollution control requirements could be achieved.

3.4.4. Storage options

Hybrid Ponds

The use of carefully designed open ponds using a combination of wet area and normally dry detention basin would satisfy both the pollution control requirements and the attenuation requirements discussed above. These have the advantages over enclosed storage in that they provide easier access for construction and maintenance

purposes and eliminate confined spaces. It is envisaged that hybrid ponds would be provided at eight locations throughout the scheme.

These would typically comprise an inlet structure, fore bay, vegetative treatment area for pollution control, detention storage, lined wet area, and outlet control structure. The inlet structure would contain a high level bypass with piped connection to the outlet structure. The outlet structure would be equipped with gabion baffles to prevent detritus from entering the flow controls, baffles/ skim boards to contain floating hydrocarbons, flow controls and isolation penstocks. The flow controls would be orifice plates where possible (minimum diameter 75mm), or hydrobrakes for smaller flows. A typical pond is illustrated in drawing number A483NB-ATK-HDG-0500-DR-D-0006 P1. Isolation penstocks have been proposed only at the outlet structures (rather than both inlet and outlet) as this would prevent the contents from discharging to watercourse in the event of a spillage when the detention storage is in operation (Isolation penstocks on the upstream side would only isolate flows into but not away from the tank).

It should be noted that gabion or other retaining walls may be required to provide access or where space is limited

Current proposals are that only wet areas would be lined. The remainder of the storage area would be unlined to allow infiltration into the underlying sub soils. Further assessment would be undertaken as part of the detailed design to ensure that such infiltration would not contribute to areas of instability or areas at risk from landslip.

Based on ground investigations reported in the Geotechnical Report (Volume 3 Appendix F of the Environmental Statement), full infiltration drainage is not considered a viable option for the Scheme for the following reasons:

- Generally along the route of the Scheme, impermeable rock lies approximately 1m below ground level, and
- Where more permeable gravels or made ground underlies the Scheme, these correspond with areas of instability and areas at risk of land slip.

Swales and oversized pipes

For some smaller localised areas, consideration could be given to utilising Swales or open channels if required.

Oversized pipes would be also considered for storage in specific situations, in particular where insufficient open area is available beside the road to accommodate ponds. This would apply to small areas which may not easily accommodate storage ponds.

Geocellular storage

As with oversized pipes, geocellular storage tanks would also be considered in areas where gravity drainage to the detention ponds is not possible.

Underground storage tanks

Underground tanks would only be considered as a last resort, where topography precludes any of the other options, typically on steep ground where insufficient area is available, and deeper construction depths are required

3.4.5. Preferred Solution

Hybrid ponds are the preferred solution as they achieve all the project objectives, i.e. pollution control and attenuation.

Table 3.2 below shows a list of the storage facilities and approximate volumes of storage required. The volumes would be confirmed at detailed design stage.

The location of the proposed storage facilities are indicated on Figures B1 to B4 which are appended to this Strategy.

Table 3.2 Storage Ponds

Road Catchment Reference	Catchment Name	Receiving Watercourse	Chainage	Total Impermeable Area (ha)	Solution Required for water quality in Envtl Statement	Planted Area (m^2)	Approximate Volume (m^3)
1A West	Mochdre West	WC2	0 - 600	1.58	Wet Pond	10	1,000
1A East	Mochdre East	Mochdre Brook	600 - 1670	1.47	Detention Basin	0	1,100
2A	Dolfor	Green Brook or Dolfor Brook at their confluence	1670 - 2600	2.71	Wet Pond	18	1700
2B	Dolfor	Dolfor Brook	2600 - 2770	0.29	Detention Basin	0	200
3	Vastre	Tributary 6 (WC14)	2770 - 4100	1.68	Wet Pond	22	1,100
4	Kerry Road	Tributary 4 (WC14)	4100 - 4500	0.93	Detention Basin	0	700
5	Railway	Tributary 6 (WC16)	4500 - 5500	1.39	Wet Pond	9	1,300
6	Glan Hafren	Tributary 7 (WC19)	5500 - 5800	1.23	Detention Basin	0	700

3.5. Proposed Off Site Drainage

In this context the term off site drainage covers all drainage at fence lines, cuttings, embankments, toe drains and cut off ditches. The watercourses and culverts crossing the line of the highway are outside the scope of this report, and are covered by the Flood Consequences Assessment Report.

3.5.1. Fence line and cutting drainage

Fence line drainage would be provided to intercept overland flow from reaching the highway and to prevent flows from the highway cuttings and embankments from reaching adjacent property.

Standards

It would be designed in accordance with the requirements of:

HA 106/04	Drainage of Runoff from Natural Catchments
HA 119/06	Grassed Surface Water Channels for Highway Runoff

Levels of Service

The fence line and cutting drainage would be designed to accommodate the 1.33% (1 in 75) annual chance flood event (although land drainage culverts are designed to the 1% (1 in 100) annual chance event including climate change allowance). It should be noted that assessments based on ADAS for smaller catchments <0.4km2, or IH124 for larger catchments as described in the DMRB is not now in line with NRW current industry best practice for assessment of runoff from small catchments.

This drainage would generally take the form of lined V ditch cut off drains at the top of earthworks cuttings. Some of these would be directed to the nearest watercourse, either directly or via carrier drains.

Flow down the faces of cuttings would be captured by a system of berms. Runoff below the level of the lowest berm in each cutting would be intercepted by filter drains, which would also serve as subsurface drains in some areas. These would be combined with highway runoff in some locations.

Flow down earthworks embankments would be intercepted by V ditch toe drains connecting with the nearest watercourse. If possible these would be designed as swales in flatter areas, providing an element of SUDS, although the extent of these would generally be limited.

Because of the nature of the topography, it is likely that some areas of cut, particularly at Dolfor Road Roundabout area would intercept groundwater flow. These have not yet been assessed. Additional groundwater flow day lighting at cuttings would also need to be conveyed by the drainage. These cannot be determined at this stage, and would need to be identified by site investigation and hydrogeological assessment.

It should be noted that the carriageway drainage and a portion of the cutting drainage have been kept separate at this stage. The cutting drainage below bottom berm level

(which approximates to the lower 10m by elevation) would be combined with the carriageway drainage within the constraints discussed in section 3.3 above.

The carriageway drainage is designed for short term storms and is attenuated prior to discharge.

The fence line drainage is designed for longer duration storms, and flows directly to outfall / watercourse without the need for attenuation.

In some areas, notably at Dolfor Road, catchment No. 2, there may be opportunities to separate a greater proportion of the cutting drainage from the carriageway flow. This would reduce load on the flow controls.

4. Consultation

4.1. Natural Resources Wales

Regular Environmental Liaison Group (ELG) meetings have been held through the design of the Scheme. A specific water related ELG was held with Natural Resources Wales and Powys Land Drainage representative on 8th January 2014 which included a discussion of drainage requirements. The proposed road drainage design approach as described in Chapter 3 was discussed and no objections were raised.

The Water Quality issues relating to the Scheme were discussed with NRW at this same meeting.

Comments received from NRW in May 2014 (Scheme Schedule of Comments 025) in relation to a draft of this Strategy have been addressed in revisions incorporated in this Strategy document.

4.2. Powys County Council - Lead Local Flood Authority

The drainage authorities for the area are as above, and they are being consulted on an ongoing basis. All outfalls to the Mochdre and Dolfor Brooks and other unnamed streams along the route of the Scheme would be subject to ordinary watercourse consents to be issued by PCC. (There are no outfalls to the River Severn, which would fall under the remit of NRW).

5. Summary

5.1. Summary

A kerb and gulley system is proposed to drain the highway along sections of embankment.

Filter drains are proposed in cuttings. These would capture carriageway runoff and a portion of the cutting drainage.

Attenuation, using storage pond systems and flow controls, is proposed to restrict the proposed discharge to no more than the pre-development Greenfield run-off.

Pollution control measures would be provided by catchpits and settlement areas in the fore bays of the attenuation ponds. There would also be a degree of vegetative treatment in the ponds. Shut-off valves would be provided at pond outlets

Access for future maintenance would be provided to all attenuation, pollution control and outfall facilities as appropriate.

Micro drainage models have been produced for the carriageway drainage catchments.

Fence line drains would predominantly be ditches lined with PC slabs, concrete canvas or geotextiles

Appendix A. Extract from Works Information

Drainage

The Contractor shall provide Sustainable drainage systems (SUDS) where appropriate. The proposed system shall be agreed with the Environment Agency. Pipes discharging to watercourses shall be provided with head walls to a design approved by the authority responsible for the receiving watercourse. Suitable provision to prevent scour of the watercourses shall be included.

All inspection chambers and manholes should be located so that their access covers are outside the area of the main carriageway, hard strip and lay-bys. Access covers shall not be obstructed by safety fences or other roadside features.

The Contractor shall be responsible for obtaining all necessary discharge consents, licences etc required from the Environment Agency and any other body.

The minimum size for culverts beneath the Trunk road shall be 1000mm. Minimum sizes of other culverts shall be agreed with the authority responsible for the watercourse.

Facilities for accessing and maintaining attenuation ponds, interceptors, control valves and the like shall be agreed with the maintaining authority. Access tracks and hard standings shall be designed to permit all-weather usage whilst not being attractive for unauthorised users.

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Appendix B. Figures and Drawings

B.1. Figures B1 to B4 – Catchments for Greenfield Runoff calculations to each attenuation pond

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Figure B-1 (Figure 1 of 4) - Catchments to Attenuation Ponds – areas excluded from Greenfield runoff calculations are highlighted by hatched areas.

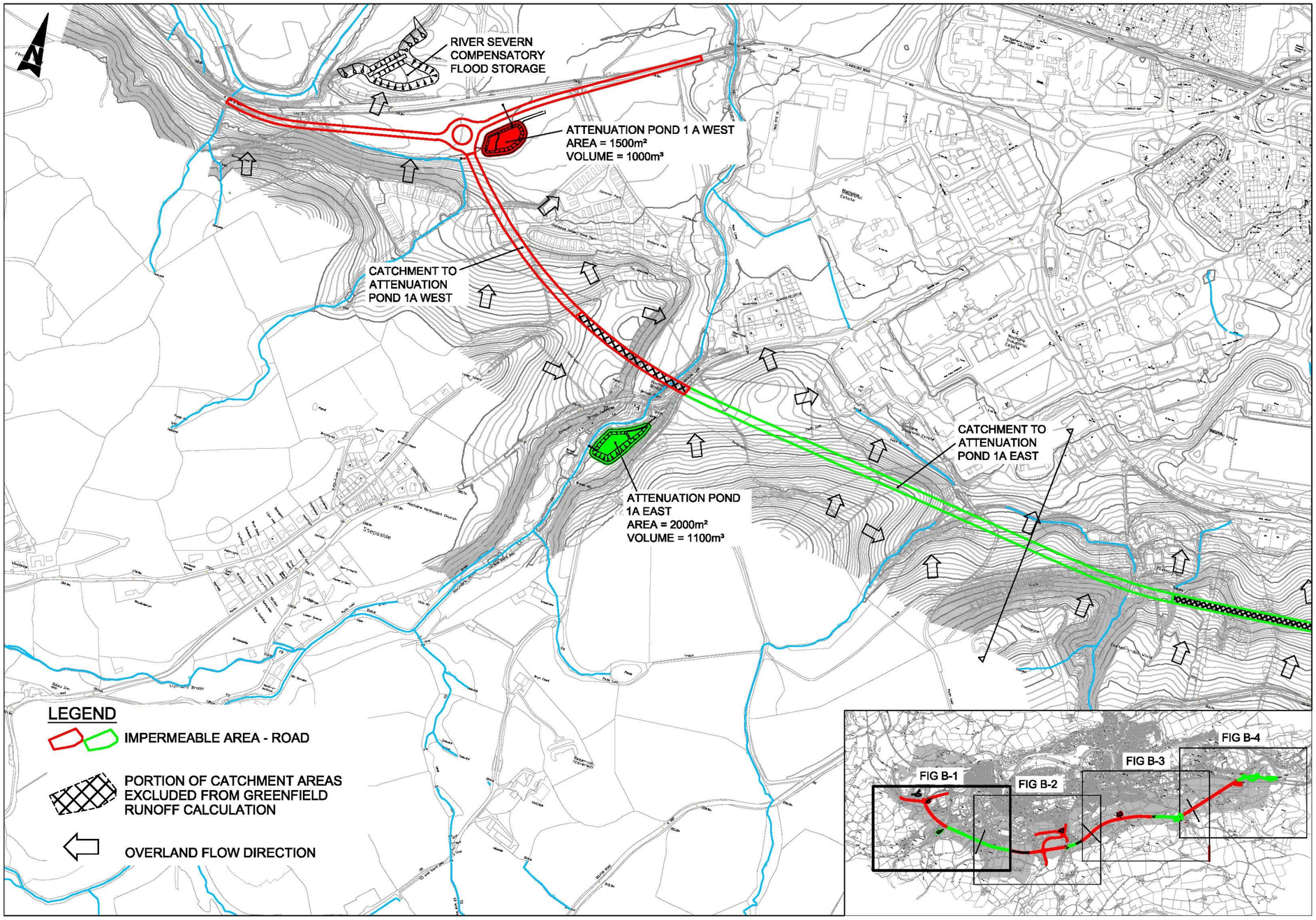


Figure B-2 (Figure 2 of 4) - Catchments to Attenuation Ponds – areas excluded from Greenfield runoff calculations are highlighted by hatched areas.

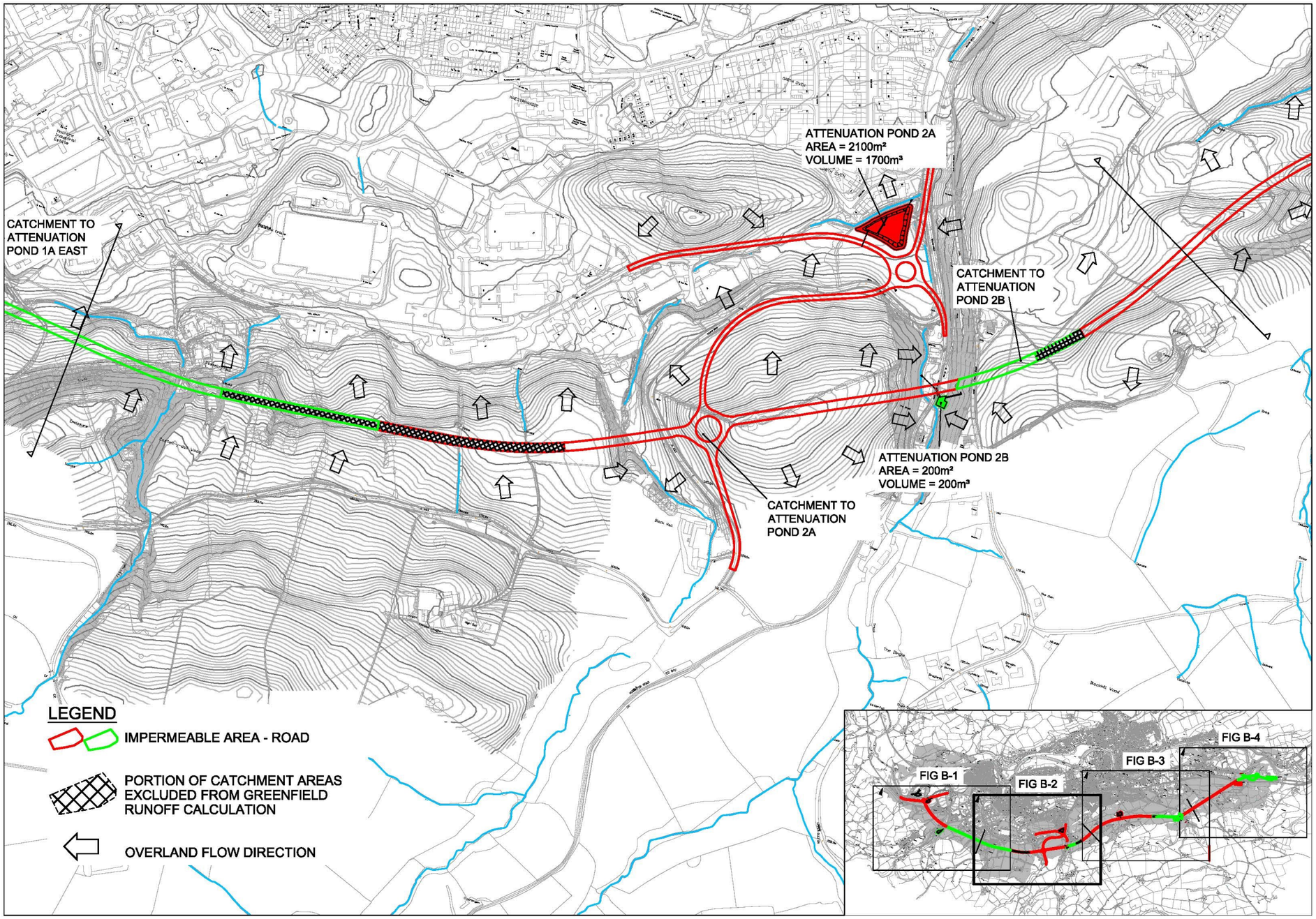


Figure B-3 (Figure 3 of 4) - Catchments to Attenuation Ponds – areas excluded from Greenfield runoff calculations are highlighted by hatched areas.

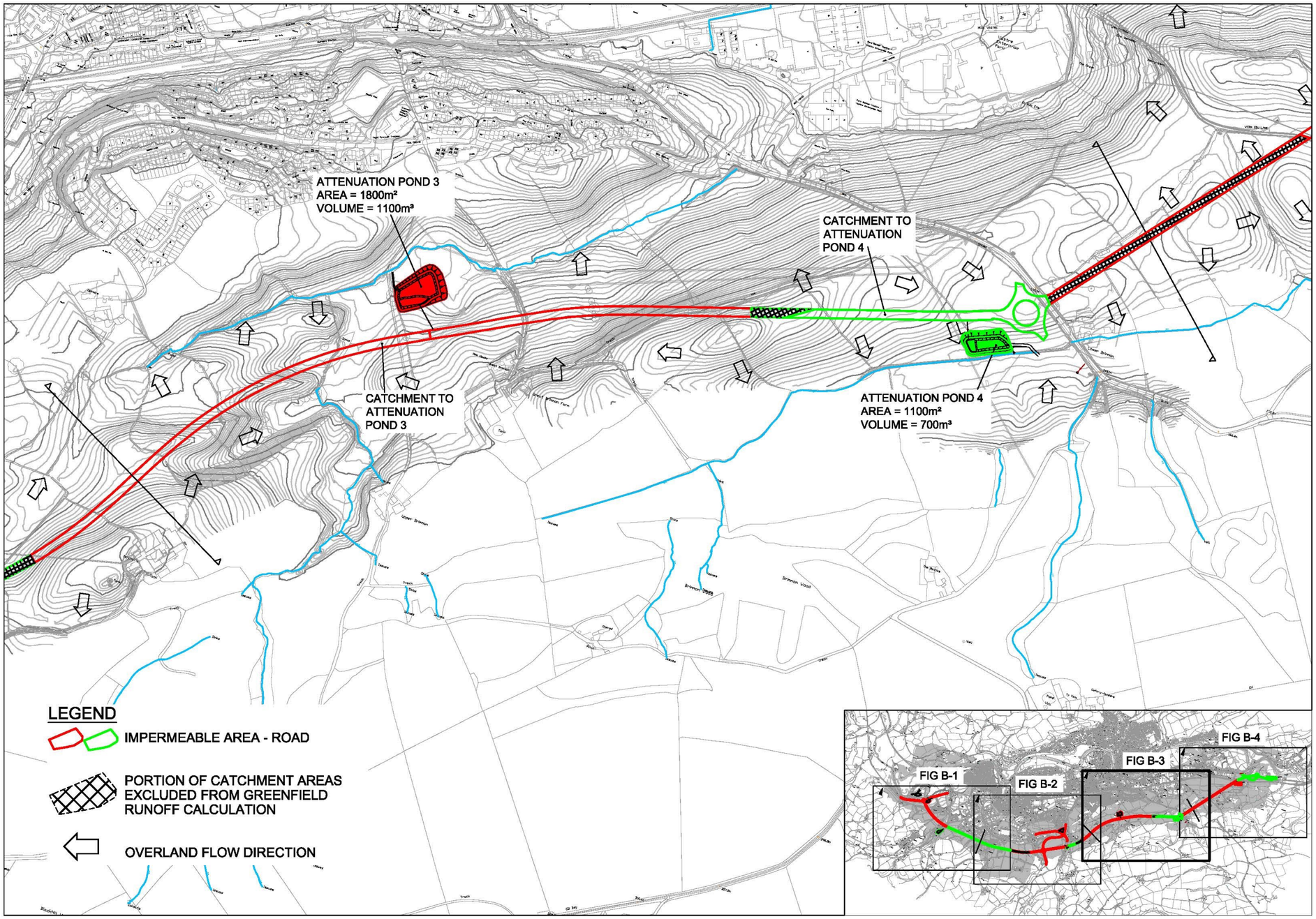
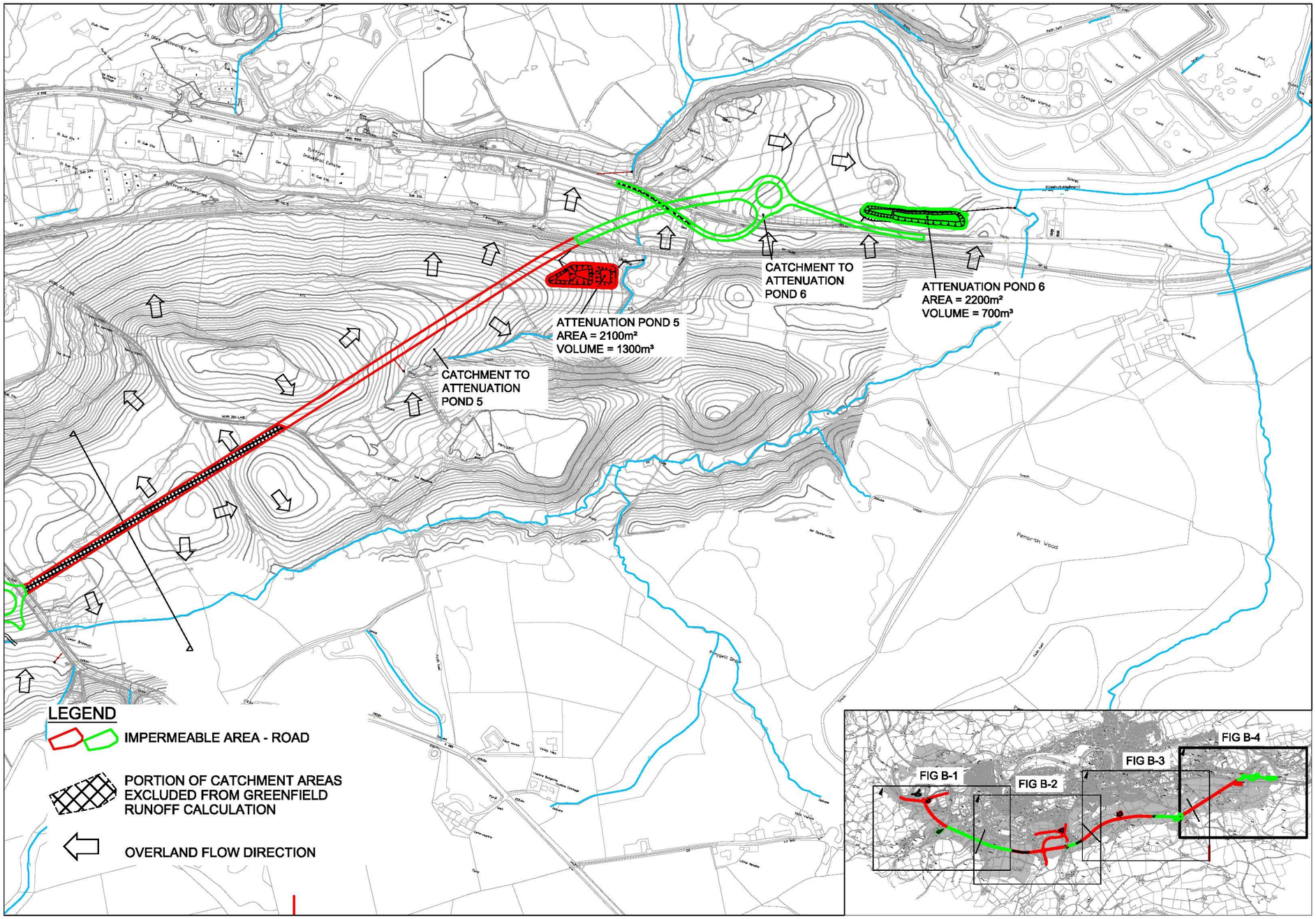


Figure B-4 (Figure 4 of 4) - Catchments to Attenuation Ponds – areas excluded from Greenfield runoff calculations are highlighted by hatched areas.



B.2. Drawings List

Drawing	Drawing Number
Schematic Drainage Proposals Sheet 1 of 4	A483NB-ATK-HDG-0500-DR-D-0001
Schematic Drainage Proposals Sheet 2 of 4	A483NB-ATK-HDG-0500-DR-D-0002
Schematic Drainage Proposals Sheet 3 of 4	A483NB-ATK-HDG-0500-DR-D-0003
Schematic Drainage Proposals Sheet 4 of 4	A483NB-ATK-HDG-0500-DR-D-0004
Typical Sections	A483NB-ATK-HDG-0500-DR-D-0005
Typical Drainage Details	A483NB-ATK-HDG-0500-DR-D-0006

DO NOT SCALE

Millimetres 0 10 100

A489 LLANIDLOES ROAD ROUNDABOUT

TIE-IN TO EXISTING DRAINAGE

MC01

C1

C2

CULVERT C2C

RIVER SEVERN COMPENSATORY FLOOD STORAGE

River Severn (Afon Hafren)

MAMMAL PIPE

CULVERT C2B

ATTENUATION POND 1 WEST
AREA = 1500m²
VOLUME = 1000m³

MAMMAL PIPE

MC03

GLANDULAS OVERBRIDGE S1

Glandulas Holiday Home Park

MOCHDRE BRIDGE S2

TEMPORARY SILT MANAGEMENT POND

COLEG POWYS UNDERPASS S2A

ATTENUATION POND 1 EAST
AREA = 2000m²
VOLUME = 1100m³

Dulais Bridge

MC02

TIE-IN TO EXISTING DRAINAGE

Llanidloes Road

Railway Line

Montgomery College of Further Education

Mochdre Industrial Estate

Mochdre Lane

CULVERT C3B

BRIDLEWAY UNDERPASS S3

A489NB-ATK-HDG-0500-DR-D-0001

CUTLINE

CUTLINE

C3

C4

C5

C6

Castell-y-dail Wood

Dolfor Road

Stepaside

Mochdre Methodist Church

Mochdre Brook

Llyfnant Brook

Dolfor Inn

Mochdre Mill

Mochdre Industrial Estate

LEGEND

- CARRIER DRAIN WITH CATCHPIT AND FLOW DIRECTION ARROW
- FILTER DRAIN WITH CATCHPIT AND FLOW DIRECTION ARROW
- COMBINED DRAINAGE KERB
- HEADWALL
- PROPOSED CULVERT (C1)
- WATERCOURSE
- CASCADE
- OVERLAND FLOW DIRECTION

SAFETY, HEALTH AND ENVIRONMENTAL INFORMATION

In addition to the hazards/risks normally associated with the types of work detailed on this drawing, note the following:

CONSTRUCTION

MAINTENANCE/CLEANING

DECOMMISSIONING/DEMOLITION

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Rev.	Date	Description	By	Chk'd	App'd
P1	11/08/14	FIRST ISSUE	DJW	SE/HR	TAD

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GRIFFITHS civil engineering and construction

TACP

Project Title: A483/A489 NEWTOWN BYPASS

Drawing Title: SCHEMATIC DRAINAGE PROPOSALS (Sheet 1 of 4)

Scale	Designed	Drawn	Checked	Authorised
1:2500	DW	DJW	SE/HR	TAD
Original Size	Date	Date	Date	Date
A1	17.07.14	17.07.14	17.07.14	17.07.14

Drawing Number: A483NB-ATK-HDG-0500-DR-D-0001

Revision: P1

DO NOT SCALE

LEGEND

- CARRIER DRAIN WITH CATCHPIT AND FLOW DIRECTION ARROW
- FILTER DRAIN WITH CATCHPIT AND FLOW DIRECTION ARROW
- COMBINED DRAINAGE KERB
- HEADWALL
- PROPOSED CULVERT
- C1
- WATERCOURSE
- CASCADE
- OVERLAND FLOW DIRECTION

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Project Title: A483/A489 NEWTOWN BYPASS

Drawing Title: SCHEMATIC DRAINAGE PROPOSALS (Sheet 2 of 4)

Scale	Designed	Drawn	Checked	Authorised
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Original Size	Date	Date	Date	Date
A1	17.07.14	17.07.14	17.07.14	17.07.14

Drawing Number	Revision
A483NB-ATK-HDG-0500-DR-D-0002	P1

DO NOT SCALE

Millimetres 0 10 100

ATTENUATION POND 3
AREA = 1800m²
VOLUME = 1100m³

BRIMMON FARM
UNDERBRIDGE S7

BRIMMON LANE
UNDERBRIDGE S8

MAMMAL PIPE

KERRY ROAD
ROUNDABOUT

ATTENUATION POND 4
AREA = 1100m²
VOLUME = 700m³

MAMMAL PIPE

TIE-IN TO EXISTING
DRAINAGE

CUTLINE

A483NB-ATK-HDG-0500-DR-D-0003

Vastre Enterprise Park/
Parc Menter Vastre

Brimmon Wood

Railway Line

A 489

LEGEND

- CARRIER DRAIN WITH CATCHPIT AND FLOW DIRECTION ARROW
- FILTER DRAIN WITH CATCHPIT AND FLOW DIRECTION ARROW
- COMBINED DRAINAGE KERB
- HEADWALL
- PROPOSED CULVERT (C1)
- WATERCOURSE
- CASCADE
- OVERLAND FLOW DIRECTION

SAFETY, HEALTH AND ENVIRONMENTAL INFORMATION

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P1	11/08/14	FIRST ISSUE	DJW	SE/HR	TAD

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Project Title: A483/A489 NEWTOWN BYPASS

Drawing Title: SCHEMATIC DRAINAGE PROPOSALS (Sheet 3 of 4)

Scale	Designed	Drawn	Checked	Authorised
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Drawing Number: A483NB-ATK-HDG-0500-DR-D-0003
Revision: P1

DO NOT SCALE

Millimetres 0 10 100

A 483

St Giles Technology Park

Dyffryn Industrial Estate

Dyffryn Enterprise Park

Railway Line

Fellmongery

POOL ROAD UNDERBRIDGE S11

CULVERT C16

A483 POOL ROAD ROUNDABOUT

MAMMAL PIPE

RAILWAY BRIDGE S10

Pool Road

ATTENUATION POND 6
AREA = 2200m²
VOLUME = 700m³

ATTENUATION POND 5
AREA = 2100m²
VOLUME = 1300m³

TIE-IN TO EXISTING DRAINAGE

WERN DDU OVERBRIDGE S9

Wern Ddu Lane

CUTLINE

A483NB-ATK-HDG-0500-DR-D-0003

KERRY ROAD ROUNDABOUT

ATTENUATION POND 4
AREA = 1100m²
VOLUME = 700m³

MAMMAL PIPE

Penarth Wood

Penygelli Bridge

LEGEND

- CARRIER DRAIN WITH CATCHPIT AND FLOW DIRECTION ARROW
- FILTER DRAIN WITH CATCHPIT AND FLOW DIRECTION ARROW
- COMBINED DRAINAGE KERB
- HEADWALL
- PROPOSED CULVERT (C1)
- WATERCOURSE
- CASCADE
- OVERLAND FLOW DIRECTION

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Drawing Title: SCHEMATIC DRAINAGE PROPOSALS (Sheet 4 of 4)

Scale	Designed	Drawn	Checked	Authorised
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Revision: P1

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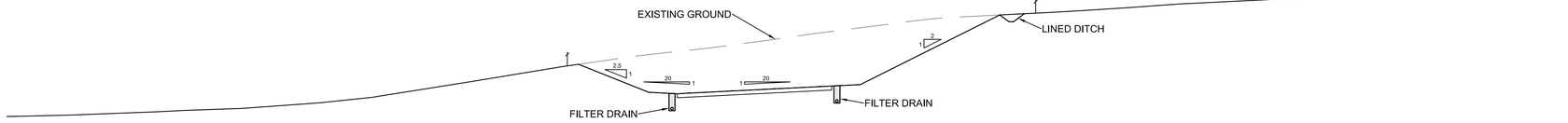

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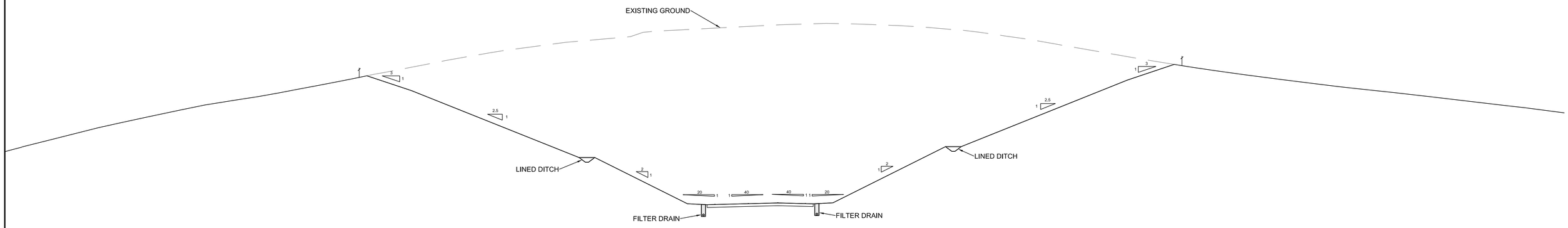

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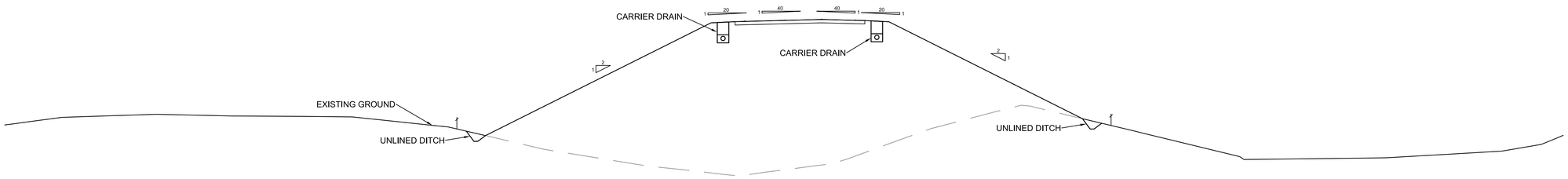

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SCALE 1: 250

SAFETY, HEALTH AND ENVIRONMENTAL INFORMATION

In addition to the hazards/risks normally associated with the types of work detailed on this drawing, note the following:

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Drawing Title: TYPICAL SECTIONS

Scale	Designed	Drawn	Checked	Authorised
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Original Size	Date	Date	Date	Date
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Drawing Number: A483NB-ATK-HDG-0500-DR-D-0005
Revision: P1

DO NOT SCALE

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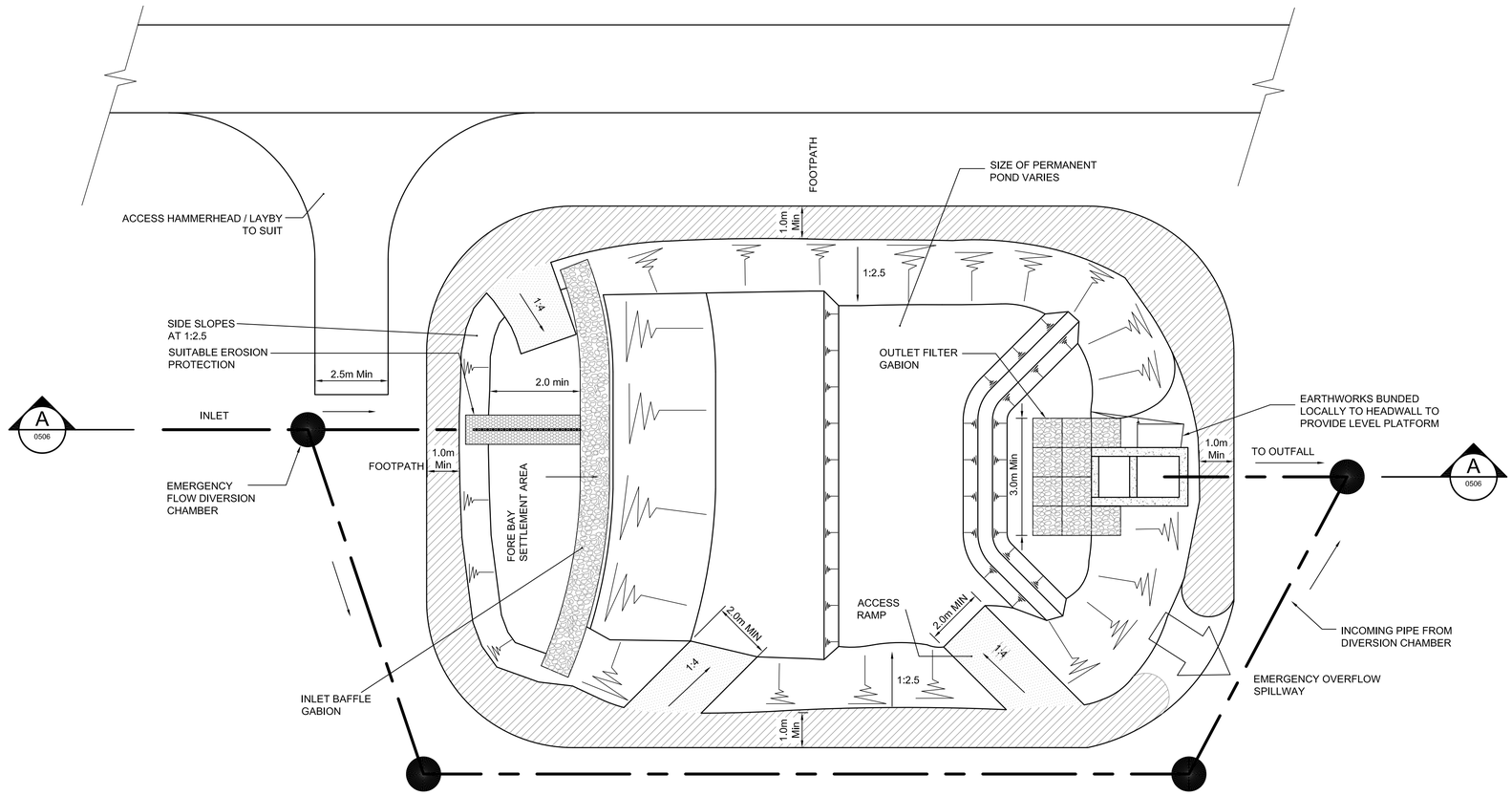

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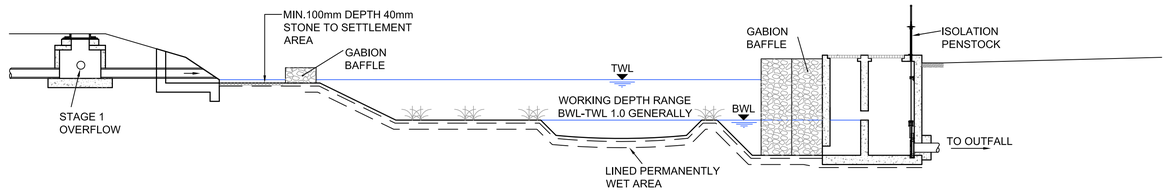

A 0506 **SECTION A-A**
SCALE 1: 100

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In addition to the hazards/risks normally associated with the types of work detailed on this drawing, note the following:

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Project Title: A483/A489 NEWTOWN BYPASS

Drawing Title: HYBRID POND TYPICAL DETAILS

Scale	Designed	Drawn	Checked	Authorised
1:100	DW	DJW	SE/HR	TAD
Original Size	Date	Date	Date	Date
A1	27.02.14	27.02.14	17.07.14	17.07.14

Drawing Number: A483NB-ATK-HDG-0500-DR-D-0006
Revision: P1