Appendix 11.4

Hydromorphology Assessment Part 4



Annex 11.4.4-Hydromorphological Catchment Assessment-159

Catchment No.	159		
Catchment Name	-		
	Nature of water course	Na	tural
Channel Nature	Size of water course		inor
	Catchment Area (km²)	C	1.3
Quantitative Spatial Elements	Average slope in catchment (°)		5
Liements	% Catchment over 750m (for snow melt risk)		0
	Water, flows and levels		bod
WFD classification	Physical condition	G	bod
	Overall ecological status	G	bod
		LOCH Laggan Psammite formation-	
Geology	Majority Bedrock (see Drawing 11.4.4.1 a and b Catchment 159)	Psammite, Micaeous	resistant to weathering, impermeable
	Is an alluvial fan present at or near the crossing?	No	
	Ramsar	No	
Environmental designations (see	SAC	No	
Drawing 11.4.4.1 c,	SPA	No	
Catchment 159)	SSI	No	
			· · · · · · · · · · · · · · · · · · ·
	Changes in slope and channel confinement	See Drawing 11.4.	4.2, Catchment 159
	Is peat present in the catchment?	Yes	In former glacial metlwater channel
	Is there a bog burst risk?	Yes	
	Current valley side or terrace erosion	No	
	Potential valley side or terrace erosion	No	
	Hill slope failures (including peat slides and debris flows and slides)	No	
	Hill slope failures coupled to channel Vertical incision present in catchment	No	
			Channel seems to wander across
			midcatchment slope in Google and
Sediment source and	Bank erosion/lateral migration	Yes	ArcGIS imagery
supply - Catchment Scale			
	Unvegetated bars	No	
	Unvegetated bars	No	Some scrub woodland and deciduous
	Wooded/forested areas in catchment	Yes	woodaland
			Ruins of Upper Raitts settlement. No
	Infrastructure type (see Drawing 11.4.4.1 d, Catchment 159)	Yes	impact on channel
	Comment on sediment source potential in catchment	Limited. Potential for bog bur	st but unlikely to reach crossing
	Comment on sediment supply potential to crossing	Limited. Potential for bog bur	st but unlikely to reach crossing
	Channel morphology		Not visible
	Predominant sediment size		Not visible
	Unvegetated bars Vertical incision		Not visible Not visible
	Deposition		Not visible
Morphology and Process- Reach upstream of	Lateral migration/bank erosion		Not visible
crossing	Presence and nature of infrastructure (see Drawing 11.4.4.1 d, Catchment		
	159		Not visible Not visible
	Impact of infrastructure		Small body of standing water shown
			c.80m u/s of crossing in 1903 mapping
	Channel realignment	Yes	no longer exists
	Channel morphology	Engineered	
	Predominant sediment size	-	None visible
Morphology and Process-	Unvegetated bars Vertical incision	No None	
At crossing	Deposition	None	
	Lateral migration/bank erosion	None	
	Damaged/unstable drains or armouring	No	
r			
			Appears to re-enter culvert immediately under farmyard and track
			until emerging into meandering
			channel c.180m d/s of crossing on d/s
	Channel morphology	Engineered	side of B9152
	Predominant sediment size	No	Not visible
	Unvegetated bars Vertical incision	NO	Assumed not, not visible though
Morphology and Process-	Deposition		Assumed not, not visible though
Reach downstream of	Lateral migration/bank erosion		Assumed not, not visible though
crossing	Presence and nature of infrastructure (see Drawing 11.4.4.1 d, Catchment		Channel culverted under farmyard and
	159	Yes	minor road for c.180m Channel confined in culvert for
			substantial distance. Significant
			disruption required for any
	Impact of infrastructure	Yes	improvement d/s of crossing
			See comments on enclosure in culvert
	Channel realignment	Yes	above.
	Limited activity in this catchment. Limited realignment u/s of crossing. So	eems stable and vegetated. D/s of cross	ing realigned, probably during railwav
Summary behaviour	construction to take flow from this and other channel		



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Nature of water course Drain Channel Nature Size of water course Minor 0.7 Catchment Area (km²) **Quantitative Spatial** Average slope in catchment (°) 6.3 Elements % Catchment over 750m (for snow melt risk) 0 Water, flows and levels Good WFD classification Physical condition Good Overall ecological status Good imite formatio och Laggan Psa Geology Majority Bedrock (see Drawing 11.4.4.1 a and b Catchment 161) Psammite, Micaeous resistant to weathering, impermeable Is an alluvial fan present at or near the crossing? No Environmental Ramsar No designations (see Drawing SAC No 11.4.4.1 c, Catchment SPA No 161) SSSI No Changes in slope and channel confinement See Drawing 11.4.4.2, Catchment 161 Is peat present in the catchment? Yes Lower catchment only Is there a bog burst risk? No Current valley side or terrace erosion No Potential valley side or terrace erosion No Hill slope failures (including peat slides and debris flows and slides) No Hill slope failures coupled to channel No Vertical incision present in catchment No Sediment source and Bank erosion/lateral migration No upply - Catchment Scale Unvegetated bars No Scrubwoodland and planations in mid Wooded/forested areas in catchment Yes and lower catchment Infrastructure type (see Drawing 11.4.4.1 d, Catchment 161) No Comment on sediment source potential in catchment Very limited Very limited, little channelisation. Channels of intermittent continuity as upper Comment on sediment supply potential to crossing channel disappears into sink, probaly to become subsurface flow (note the flush) Drain Channel morphology Engineered Predominant sediment size Unvegetated bars No Vertical incision None Morphology and Process Deposition None Reach upstream of Lateral migration/bank erosion None crossing Presence and nature of infrastructure (see Drawing 11.4.4.1 d, Catchment 161 None Impact of infrastructure None Channel realignment Yes Road parallel drain Channel morphology Engineered Pipe culvert in concrete structure Predominant sediment size Unvegetated bars No Morphology and Process Vertical incision None At crossing Deposition Low Lateral migration/bank erosion None Damaged/unstable drains or armouring No Channel morphology No photos Predominant sediment size No photos Unvegetated bars No photos Vertical incision No photos Deposition No photos No photos Lateral migration/bank erosion Presence and nature of infrastructure (see Drawing 11.4.4.1 d, Catchment Aorphology and Process-Farm buildings and minor road 161 Yes Reach downstream of Channel likely culverted for significant crossing Impact of infrastructure Yes distances Significant realignment likely to have occurred d/s of road to take channel in culvert. Not confirmed by any photos or the map but suspect this channel has a confluence with 159 somewhere under the road. Channel realignment Yes Limited activity in this catchment. Limited realignment u/s of crossing. Seems stable and vegetated. D/s of crossing realigned, probably during railway Summary behaviour construction to take flow from this and other channels through just one point along the railway embankment.

Annex 11.4.4-Hydromorphological Catchment Assessment-161

161

Catchment No.

Catchment Name



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Catchment No. Catchment Name		hment Assessment-162	
	162 Raitts Burn		
Channel Nature	Nature of water course		atural
	Size of water course	b	fajor
Quantitative Spatial Elements	Catchment Area (km ²) Average slope in catchment (*)		12 7.8
	% Catchment over 750m (for snow melt risk)		2.6
WFD classification	Water, flows and levels Physical condition		High Sood
	Overall ecological status		derate
Geology	Majority Bedrock (see Drawing 11.4.4.1 a and b Catchment 162)	Loch Laggan Psammite formation- Psammite, Micaeous	resistant to weathering, impermeable
000069	Is an alluvial fan present at or near the crossing?	Yes	Risk of avulsion
			River Spey - Insh Marshes Breeding birds, wetlands, freshwater
	Ramsar	Yes	habitats, trophic range river/stream,Whooper Swan
			Insh Marshes Alder woodland on floodplains, clear-
			water lakes or lochs with aquatic vegetation and poor to moderate
			nutrient levels, Otter, very we mires often identified by an unstable quakir
Environmental designations (see Drawing			surface River Spey
11.4.4.1 c, Catchment 162)	SAC	Yes	Atlantic salmon, freshwater pearl mussel, otter, sea lamprey
			River Spey - Insh Marshes Hen Harrier, Osprey breeding, Spotted
	SPA	Yes	Crake breeding, Whooper swan, Wige breeding, Wood Sandpiper
			River Spey - Insh Marshes Arctic charr, breeding bird assemblage
			flood plain fen, invertebrate assemblage, mesotrophic loch, Osprey
	SSSI	Yes	breeding, Otter, vascular plant assemblage, Whooper swan
			4.2. Catchment 162
	Changes in slope and channel confinement	See Drawing 11.4	Visible in GoogleEarth in upper catchment and in BGS 1:50k superficia
	Is peat present in the catchment?	Yes	mapping
			Some valley and watershed mire deposits which look potentially deep.
			Evidence of peat hagging. Extensive blanket bog deposits which may fail as
			peat slides, but scars small and limited to upper catchment. Possibly slope
	Is there a bog burst risk? Current valley side or terrace erosion	Yes Yes	angles limit likelihood of failures >7km
	Potential valley side or terrace erosion Hill slope failures (including peat slides and debris flows and slides)	Yes Yes	c.7km of unconfined channel Limited scars in upper
	Hill slope failures coupled to channel	No	Not visible other than terrace/valleysi erosion
			Presumably but difficult to see on GoogleEarth and no photos sufficient
	Vertical incision present in catchment	Yes	far upstream
			Lengthy sections of unconfined chann
			where floodplain has developed in valley bottom and wandering channel
	Bank erosion/lateral migration	Yes	has developed
Sediment source and supply - Catchment Scale			
supply - catchinent scale			
	Unvegetated bars	Yes	Principally in the flatter mid-section of the catchment
	Wooded/forested areas in catchment	Yes	Lower catchment wooded, including immediately adjacent to river.
	Infrastructure type (see Drawing 11.4.4.1 d, Catchment 162)	Yes	Access track to upper catchment
		sides/terrace bluffs in mid catchment	Y HIGH. Very obvious eroding valley mobile bars and channel is likely incisin
		extensive deposits of loose rock fragm	cording to BGS 1:50k mapping, there are ents (scree) moved downslope from free
	Comment on sediment source potential in catchment	thaw	processes.
		supplied to the crossing. This is uns	hat large volumes of coarse sediment an urprising given the sources of sediment
			nent will travel all the way from the upp in all but the most extreme events, but
	Comment on sediment supply potential to crossing	and scree deposits in the mid to lowe	
	Channel morphology	and scree deposits in the mid to lowe	r catchment would probably to reach th
		and scree deposits in the mid to lowe crossing in mod Plane bed	r catchment would probably to reach th
Morphology and Process- Reach upstream of	Channel morphology Predominant sediment size Univegetated bars Vertical inclision Deposition	and scree deposits in the mid to low crossing in mod Plane bed Gravel and Cobbles No Low Low	r catchment would probably to reach th
Morphology and Process- Reach upstream of crossing	Channel morphology Predominant sediment size Unwegstated bas Vertical incision Deposition Literal migration/bank ension Presence and nature of infrastructure (see Drawing 11.4.1.1.d, Catchment Presence and nature of infrastructure (see Drawing 11.4.1.1.d, Catchment	and scree deposits in the mit to lowe crossing in mod Plane bed Gravel and Cobbles No Low Low Medium	r catchment would probably to reach the reately large events.
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Photograph 11.4.4.54- Downstream

Railway Roa bridge

Deposition in channel occurring as high flow is impounded on railway bridge Road bridge

Deposition in channel



Photograph 11.4.4.55- Upstream



Photograph 11.4.4.56- Upstream

Floodplain

Deposition in channel and over banks occurring as high flows impound on road bridge

> Embankment on right hand channel bank



Photograph 11.4.4.57



Photograph 11.4.4.58

Overbank fines

Road bridge

Little clearance



Photograph 11.4.4.59- Downstream



Large woody debris deposited during flood event

and arising put on bank top, reducing channelfloodplain connection

Overbank fines

Channel dredged



Photograph 11.4.4.61

Photograph 11.4.4.60



Photograph 11.4.4.62- Upstream

Photograph 11.4.4.64

Crossing exit

Plane bed morphology Woody debris at crossing exit



Photograph 11.4.4.63



Photograph 11.4.4.65- Downstream



Crossing exit

Woody debris at crossing exit



Photograph 11.4.4.66

Photograph 11.4.4.67

Annex 11.4.4-Hydromorphological Catchment Assessment-165

Catchment No.	165		
Catchment Name			
Channel Nature	Nature of water course	D	rain
enamier Hatare	Size of water course	M	linor
Quantitative Spatial	Catchment Area (km ²)		0.2
Elements	Average slope in catchment (°)	7.5	
Elements	% Catchment over 750m (for snow melt risk)		
	Water, flows and levels	G	ood
WFD classification	Physical condition	Good Good	
	Overall ecological status		
		Loch Laggan Psammite formation-	
Geology	Majority Bedrock (see Drawing 11.4.4.1 a and b Catchment 165)	Psammite, Micaeous	resistant to weathering, impermeable
	Is an alluvial fan present at or near the crossing?	No	

			River Spey - Insh Marshes
1			
			Breeding birds, wetlands, freshwater
			habitats, trophic range river/stream,
	Ramsar	Yes	Whooper Swan
			Insh Marshes
			Alder woodland on floodplains, clear-
			water lakes or lochs with aquatic
			vegetation and poor to moderate
Environmental			nutrient levels, Otter, very we mires
designations (see			often identified by an unstable quaking
Drawing 11.4.4.1 c,			surface
Catchment 165)			River Spey
catchinent 105)			Atlantic salmon, freshwater pearl
	SAC	Yes	mussel, otter, sea lamprey
	SPA	Yes	Hen Harrier, Osprey breeding, Spotted
			River Spey - Insh Marshes
			Arctic charr, breeding bird assemblage,
1			flood plain fen, invertebrate
			assemblage, mesotrophic loch, Osprey
			breeding, Otter, vascular plant
	SSSI	Yes	assemblage, Whooper swan

	Changes in slave and shored configurate	Cae Drawing 11.4	4.2, Catchment 165
	Changes in slope and channel confinement	See Drawing 11.4.	
			Floodplain mire deposits d/s/ of road
	Is peat present in the catchment?	Yes	on spey floodplain.
	Is there a bog burst risk?	No	D/s of road on flat ground.
	Current valley side or terrace erosion	No	
	Potential valley side or terrace erosion	No	
	Hill slope failures (including peat slides and debris flows and slides)	No	
	Hill slope failures coupled to channel	No	
	Vertical incision present in catchment	No	
		NO	
Sediment source and	Bank erosion/lateral migration	No	
upply - Catchment Scale	· •		
apply cateninent seale			
	Unvegetated bars	No	
			Extensive woodland in upper
	Wooded/forested areas in catchment	Yes	catchment
	Infrastructure type (see Drawing 11.4.4.1 d, Catchment 165)	Yes	B9152 and Railway d/s of A9
	8,		
		Limited. Talus deposits present as are g	placio fluvial sands and gravels, but the
			nel in upper catchment is very limited
	Commont on codimont course notantial in catchmont		
	Comment on sediment source potential in catchment	therefore transport of set	diment to crossing unlikely
	Comment on sediment supply potential to crossing	See	above
	second to crossing	See	00010
			1
	Channel morphology	Plane bed	
			difficult to see as channel completely
	Predominant sediment size	Fines	vegetated
	Unvegetated bars	No	
	Vertical incision	None	
Aorphology and Process-		None	probably deposition of fines in
Reach upstream of crossing	Deposition	Low	vegetated channel
	Lateral migration/bank erosion	None	
	Presence and nature of infrastructure (see Drawing 11.4.4.1 d, Catchment		OS Mapping shows track u/s of road,
	165	Yes	probably crosses channel at a ford.
	Impact of infrastructure	None evident	
	impact of initial details	Hone eracite	Channel not shown u/s of road on 18
	Channel realizement	No	map
	Channel realignment	NU	шар
	Channel morphology	Engineered	Pipe culvert
	Predominant sediment size	Fines	
	Predominant sediment size	Fines	
Morphology and Process-	Unvegetated bars	No	
Morphology and Process- At crossing	Unvegetated bars Vertical incision	No None	
	Unvegetated bars Vertical incision Deposition	No None Low	
	Unvegetated bars Vertical incision	No None	
	Unvegetated bars Vertical incision Deposition	No None Low	
	Unvegetated bars Vertical incision Deposition Lateral migration/bank erosion	No None Low None	
	Unvegetated bars Vertical incision Deposition Lateral migration/bank erosion	No None Low None	Not known, photos only show culver
	Unvegetated bars Vertical incision Deposition Lateral migration/bank erosion Damaged/unstable drains or armouring	No None Low None	
	Unvegetated bars Vertical incision Deposition Lateral migration/bank erosion	No None Low None	exit
	Unvegetated bars Vertical incision Deposition Lateral migration/bank erosion Damaged/unstable drains or armouring Channel morphology	No None Low None	exit Not known, photos only show culver
	Unvegetated bars Vertical incision Deposition Lateral migration/bank erosion Damaged/unstable drains or armouring	No None Low None	exit Not known, photos only show culver exit
	Unvegetated bars Vertical incision Deposition Lateral migration/bank erosion Damaged/unstable drains or armouring Channel morphology	No None Low None	exit Not known, photos only show culver exit
	Unvegetated bars Vertical incision Deposition Lateral migration/bank erosion Damaged/unstable drains or armouring Channel morphology Predominant sediment size	No None Low None	exit Not known, photos only show culver exit
	Unvegetated bars Vertical incision Deposition Lateral migration/bank erosion Damaged/unstable drains or armouring Channel morphology	No None Low None	exit Not known, photos only show culver exit Not known, photos only show culver exit
At crossing	Unvegetated bars Vertical incision Deposition Lateral migration/bank erosion Damaged/unstable drains or armouring Channel morphology Predominant sediment size Unvegetated bars	No None Low None	exit Not known, photos only show culver exit Not known, photos only show culver exit Not known, photos only show culver
At crossing	Unvegetated bars Vertical incision Deposition Lateral migration/bank erosion Damaged/unstable drains or armouring Channel morphology Predominant sediment size	No None Low None	exit Not known, photos only show culver exit Not known, photos only show culver exit Not known, photos only show culver exit
At crossing	Unvegetated bars Vertical incision Demogratical bars Vertical incision Channel morphology Predominant sediment size Unvegetated bars Vertical incision	No None Low None	exit Not known, photos only show culver exit Not known, photos only show culver exit Not known, photos only show culver exit Not known, photos only show culver
At crossing Morphology and Process- Reach downstream of	Unvegetated bars Vertical incision Deposition Lateral migration/bank erosion Damaged/unstable drains or armouring Channel morphology Predominant sediment size Unvegetated bars	No None Low None	exit Not known, photos only show culver exit Not known, photos only show culver exit Not known, photos only show culver exit Not known, photos only show culver exit
At crossing	Unvegetated bars Vertical incision Deposition Lateral migration/bank erosion Damaged/unstable drains or armouring Channel morphology Predominant sediment size Unvegetated bars Vertical incision Deposition	No None Low None	exit Not known, photos only show culver exit Not known, photos only show culver exit Not known, photos only show culver exit Not known, photos only show culver exit
At crossing Aorphology and Process- Reach downstream of	Unvegetated bars Vertical incision Demogratical bars Vertical incision Channel morphology Predominant sediment size Unvegetated bars Vertical incision	No None Low None	exit Not known, photos only show culver exit Not known, photos only show culver exit Not known, photos only show culver exit Not known, photos only show culver exit
At crossing Aorphology and Process- Reach downstream of	Unvegetated bars Vertical incision Deposition Channel morphology Predominant sediment size Unvegetated bars Vertical incision Deposition Lateral migration/bank erosion	No None Low None	exit Not known, photos only show culver exit Not known, photos only show culver exit
At crossing Morphology and Process- Reach downstream of	Unvegetated bars Vertical incision Deposition Lateral migration/bank erosion Channel morphology Predominant sediment size Unvegetated bars Vertical incision Deposition Lateral migration/bank erosion Presence and nature of infrastructure (see Drawing 11.4.4.1 d, Catchment	No None Low None	exit Not known, photos only show culver exit Not known, photos only show culver
At crossing Morphology and Process- Reach downstream of	Unvegetated bars Vertical incision Deposition Channel morphology Predominant sediment size Unvegetated bars Vertical incision Deposition Lateral migration/bank erosion	No None Low None	exit Not known, photos only show culver exit Not known, photos only show culver exit
At crossing Morphology and Process- Reach downstream of	Unvegetated bars Vertical incision Deposition Lateral migration/bank erosion Channel morphology Predominant sediment size Unvegetated bars Vertical incision Deposition Lateral migration/bank erosion Presence and nature of infrastructure (see Drawing 11.4.4.1 d, Catchment 165	No None Low None	exit Not known, photos only show culver exit Not known, photos only show culver
At crossing Morphology and Process- Reach downstream of	Unvegetated bars Vertical incision Deposition Lateral migration/bank erosion Channel morphology Predominant sediment size Unvegetated bars Vertical incision Deposition Lateral migration/bank erosion Presence and nature of infrastructure (see Drawing 11.4.4.1 d, Catchment	No None Low None	exit Not known, photos only show culver exit Not known, photos only show culver exit exit Not known, photos only show culver exit
At crossing Morphology and Process- Reach downstream of	Unvegetated bars Vertical incision Deposition Channel morphology Predominant sediment size Unvegetated bars Vertical incision Deposition Lateral migration/bank erosion Presence and nature of infrastructure (see Drawing 11.4.4.1 d, Catchment 165 Impact of infrastructure	No None Low None	Not known, photos only show culver exit Not known, photos only show culver
At crossing Morphology and Process- Reach downstream of	Unvegetated bars Vertical incision Deposition Lateral migration/bank erosion Channel morphology Predominant sediment size Unvegetated bars Vertical incision Deposition Lateral migration/bank erosion Presence and nature of infrastructure (see Drawing 11.4.4.1 d, Catchment 165	No None Low None	exit Not known, photos only show culver exit Not known, photos only show culver exit exit Not known, photos only show culver exit
At crossing Morphology and Process- Reach downstream of	Unvegetated bars Vertical incision Deposition Channel morphology Predominant sediment size Unvegetated bars Vertical incision Deposition Lateral migration/bank erosion Presence and nature of infrastructure (see Drawing 11.4.4.1 d, Catchment 165 Impact of infrastructure	No None Low None	exit Not known, photos only show culver exit Not known, photos only show culver
At crossing Morphology and Process- Reach downstream of	Unvegetated bars Vertical incision Deposition Channel morphology Predominant sediment size Unvegetated bars Vertical incision Deposition Lateral migration/bank erosion Presence and nature of infrastructure (see Drawing 11.4.4.1 d, Catchment 165 Impact of infrastructure	No None Low None	exit Not known, photos only show culver exit Not known, photos only show culver
At crossing Aorphology and Process- Reach downstream of	Unvegetated bars Vertical incision Deposition Channel morphology Predominant sediment size Unvegetated bars Vertical incision Deposition Lateral migration/bank erosion Presence and nature of infrastructure (see Drawing 11.4.4.1 d, Catchment 165 Impact of infrastructure	No None Low None	exit Not known, photos only show culver exit Not known, photos only show culver exit
At crossing Morphology and Process- Reach downstream of	Unvegetated bars Vertical incision Deposition Lateral migration/bank erosion Channel morphology Predominant sediment size Unvegetated bars Vertical incision Deposition Lateral migration/bank erosion Presence and nature of infrastructure (see Drawing 11.4.4.1 d, Catchment 165 Impact of infrastructure Channel realignment	No None Low None No	exit Not known, photos only show culver exit Not known, photos only show culver exit
At crossing Morphology and Process- Reach downstream of crossing	Unvegetated bars Vertical incision Deposition Lateral migration/bank erosion Channel morphology Predominant sediment size Unvegetated bars Vertical incision Deposition Lateral migration/bank erosion Presence and nature of infrastructure (see Drawing 11.4.4.1 d, Catchment 165 Impact of infrastructure Channel realignment Limited activity in this catchment. Limited realignment u/s of crossing. S	No None Low None No	exit Not known, photos only show culver exit Not known, photos only show culver exit
At crossing Aorphology and Process- Reach downstream of	Unvegetated bars Vertical incision Deposition Lateral migration/bank erosion Channel morphology Predominant sediment size Unvegetated bars Vertical incision Deposition Lateral migration/bank erosion Presence and nature of infrastructure (see Drawing 11.4.4.1 d, Catchment 165 Impact of infrastructure Channel realignment	No None Low None No	exit Not known, photos only show culver exit Not known, photos only show culver exit



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C01



Annex 11.4.4-Hydromorphological Catchment Assessment-166

Catchment Name			
	-	-	Drain
Channel Nature	Nature of water course Size of water course		Drain Minor
0	Catchment Area (km ²)		0.4
Quantitative Spatial Elements	Average slope in catchment (*)		7
	% Catchment over 750m (for snow melt risk)	I	0
	Water, flows and levels	(Good
WFD classification			
	Physical condition		Sood
	Overall ecological status		Good
Geology	Majority Bedrock (see Drawing 11.4.4.1 a and b Catchment 166)	Loch Laggan Psammite formation- Psammite, Micaeous	resistant to weathering, impermeab
	Is an alluvial fan present at or near the crossing?	No	
			River Spey - Insh Marshes
			Breeding birds, wetlands, freshwate habitats, trophic range
	Ramsar	Yes	river/stream,Whooper Swan Insh Marshes
			Alder woodland on floodplains, clear
			water lakes or lochs with aquatic vegetation and poor to moderate
			nutrient levels, Otter, very we mires often identified by an unstable quak
Environmental			surface
designations (see Drawing 11.4.4.1 c,			River Spey Atlantic salmon, freshwater pearl
Catchment 166)	SAC	Yes	mussel, otter, sea lamprey River Spey - Insh Marshes
			Hen Harrier, Osprey breeding, Spott
	SPA	Yes	Crake breeding, Whooper swan, Wig breeding, Wood Sandpiper
			River Spey - Insh Marshes Arctic charr, breeding bird assembla
			flood plain fen, invertebrate
			assemblage, mesotrophic loch, Ospr breeding, Otter, vascular plant
	SSSI	Yes	assemblage, Whooper swan
	Changes in slope and channel confinement	See Drawing 11.4	1.4.2, Catchment 166
	Is peat present in the catchment?	Yes	Floodplain mire in very lowest exten catchment
			Floodplain mire in very lowest exten
	Is there a bog burst risk? Current valley side or terrace erosion	No No	catchment - d/s of road
	Potential valley side or terrace erosion Hill slope failures (including peat slides and debris flows and slides)	No	
	Hill slope failures coupled to channel	No	
	Vertical incision present in catchment	No	
Sediment source and	Bank and in Astronomy in the		
upply - Catchment Scale	Bank erosion/lateral migration	No	
	Unvegetated bars	No	
	Wooded/forested areas in catchment	No	Croftcarnoch farm - distant from
	Infrastructure type (see Drawing 11.4.4.1 d, Catchment 166)	Yes	watercourse
	Infrastructure type (see Drawing 11.4.4.1 d, Catchment 166) Comment on sediment source potential in catchment		watercourse getated catchment.
	Comment on sediment source potential in catchment	Limited. Well ve Low gradient area between steep u	getated catchment.
		Limited. Well ve	getated catchment. upper catchment and crossing, and little pportunity for sediment supply to cross
	Comment on sediment source potential in catchment	Limited. Well ve Low gradient area between steep u	getated catchment.
	Comment on sediment source potential in catchment	Limited. Well ve Low gradient area between steep u channel development means limited o	getated catchment. pper catchment and crossing, and littly pportunity for sediment supply to cross: No Photos (notes say photos are u// flow of water is out of culvert cul- camera) but OS indicates channel u/
	Comment on sediment source potential in catchment	Limited. Well ve Low gradient area between steep u	getated catchment. pper catchment and crossing, and littl pportunity for sediment supply to cros No Photos (notes say photos are u/s flow of water is out of culvert towar camera) but O Sindcates channel u slope is a cut drain. No Photos (notes say photos are u/s
	Comment on sediment source potential in catchment Comment on sediment supply potential to crossing Channel morphology	Limited. Well ve Low gradient area between steep u channel development means limited o	getated catchment. pper catchment and crossing, and littl pportunity for sediment supply to cross No Photos (notes say photos are u/ flow of water is out of culvert towas camera) but O Sindicates channel u, slope is a cut drain. No Photos (notes say photos are u//
	Comment on sediment source potential in catchment	Limited. Well ve Low gradient area between steep u channel development means limited op Engineered	getated catchment. ppper catchment and crossing, and littl pportunity for sediment supply to cros No Photos (notes say photos are u/; flow of water is out of culvert towar camera) but OS indicates channel u/ slope is a cut drain. No Photos (notes say photos are u/; flow of water is out of culvert towar camera) UN oPhotos notes say photos are u/; No Photos (notes say photos are u/;
	Comment on sediment source potential in catchment Comment on sediment supply potential to crossing Channel morphology	Limited. Well ve Low gradient area between steep u channel development means limited op Engineered	getated catchment. poper catchment and crossing, and littl portunity for sediment supply to cross No Photos (notes say photos are u/; flow of water is out of culvert towar camera) but OS indicates channel u, slope is a cut drain. No Photos (notes say photos are u/; flow of water is out of culvert towar camera) No Photos (notes say photos are u/; flow of water is out of culvert towar camera)
Marabalan	Comment on sediment source potential in catchment Comment on sediment supply potential to crossing Channel morphology Predominant sediment size	Limited. Well ve Low gradient area between steep u channel development means limited o Engineered No data	getated catchment. upper catchment and crossing, and littl pportunity for sediment supply to cross No Photos (notes say photos are u/, flow of water is out of culvert towan camera) but OS indicates channel u, slope is a cut drain. No Photos (notes say photos are u/, flow of water is out of culvert towan camera) No Photos (notes say photos are u/, flow of water is out of culvert towan camera) No Photos (notes say photos are u/, No Photos (notes say photos are u/, No Photos (notes are u/, No Photos (notes are u/, No Photos (notes are u/,
Morphology and Process- Reach upstream of	Comment on sediment source potential in catchment Comment on sediment supply potential to crossing Channel morphology Predominant sediment size	Limited. Well ve Low gradient area between steep u channel development means limited o Engineered No data	getated catchment. pper catchment and crossing, and littl pportunity for sediment supply to cross INO Photos (notes say photos are u/ flow of water is out of culvert towan camera) but OS indicates channel u, slope is a cut drain. No Photos (notes say photos are u/ flow of water is out of culvert towan camera) No Photos (notes say photos are u/ flow of water is out of culvert towan camera) No Photos (notes say photos are u/ flow of water is out of culvert towan camera)
	Comment on sediment source potential in catchment Comment on sediment supply potential to crossing Channel morphology Predominant sediment size Unvegetated bars Vertical incision	Limited. Well ve Low gradient area between steep u channel development means limited op Engineered No data No data No data	getated catchment. pper catchment and crossing, and littl pportunity for sediment supply to cross No Photos (notes say photos are u/ flow of water is out of culvert towas camera) but OS indicates channel u, slope is a cut drain. No Photos (notes say photos are u/ flow of water is out of culvert towas camera) No Photos (notes say photos are u/ flow of water is out of culvert towas camera) No Photos (notes say photos are u/ flow of water is out of culvert towas camera) No Photos (notes say photos are u/ flow of water is out of culvert towas camera) No Photos (notes say photos are u/ flow of water is out of culvert towas camera)
Reach upstream of	Comment on sediment source potential in catchment Comment on sediment supply potential to crossing Channel morphology Predominant sediment size Unvegetated bars	Limited. Well ve Low gradient area between steep u channel development means limited o Engineered No data No data	getated catchment. pper catchment and crossing, and littl pportunity for sediment supply to cross No Photos (notes say photos are u/; flow of water is out of culvert towal camera) but OS indicates channel u, slope is a cut drain. No Photos (notes say photos are u/; flow of water is out of culvert towal camera) No Photos (notes say photos are u/; flow of water is out of culvert towal camera) No Photos (notes say photos are u/; flow of water is out of culvert towal camera) No Photos (notes say photos are u/; flow of water is out of culvert towal camera) No Photos (notes say photos are u/; flow of water is out of culvert towal camera)
Reach upstream of	Comment on sediment source potential in catchment Comment on sediment supply potential to crossing Channel morphology Predominant sediment size Unvegetated bars Vertical incision Deposition	Limited. Well ve Low gradient area between steep u channel development means limited o Engineered No data No data No data	getated catchment. pper catchment and crossing, and littl pportunity for sediment supply to cross No Photos (notes say photos are u/ flow of water is out of culvert towal camera) but OS indicates channel u, slope is a cut drain. No Photos (notes say photos are u/ flow of water is out of culvert towal camera) No Photos (notes say photos are u/ flow of water is out of culvert towal camera) No Photos (notes say photos are u/ flow of water is out of culvert towal camera) No Photos (notes say photos are u/ flow of water is out of culvert towal camera) No Photos (notes say photos are u/ flow of water is out of culvert towal camera) No Photos (notes say photos are u/ flow of water is out of culvert towal camera)
Reach upstream of	Comment on sediment source potential in catchment Comment on sediment supply potential to crossing Channel morphology Predominant sediment size Unvegetated bars Vertical incision Deposition Lateral migration/bank erosion	Limited. Well ve Low gradient area between steep u channel development means limited op Engineered No data No data No data	getated catchment. pper catchment and crossing, and littl pportunity for sediment supply to cross No Photos (notes say photos are u/ flow of water is out of culvert towal camera) but OS indicates channel u, slope is a cut drain. No Photos (notes say photos are u/ flow of water is out of culvert towal camera) No Photos (notes say photos are u/ flow of water is out of culvert towal camera) No Photos (notes say photos are u/ flow of water is out of culvert towal camera) No Photos (notes say photos are u/ flow of water is out of culvert towal camera) No Photos (notes say photos are u/ flow of water is out of culvert towal camera) No Photos (notes say photos are u/ flow of water is out of culvert towal camera) No Photos (notes say photos are u/ No Photos (notes say photos are u/
Reach upstream of	Comment on sediment source potential in catchment Comment on sediment supply potential to crossing Channel morphology Predominant sediment size Unvegetated bars Vertical incision Deposition	Limited. Well ve Low gradient area between steep u channel development means limited o Engineered No data No data No data	getated catchment. pper catchment and crossing, and littl pportunity for sediment supply to cros No Photos (notes say photos are u/; flow of water is out of culvert towar camera) but OS indicates channel u/ slope is a cut drain. No Photos (notes say photos are u/; flow of water is out of culvert towar camera) No Photos (notes say photos are u/; flow of water is out of culvert towar camera) No Photos (notes say photos are u/; flow of water is out of culvert towar camera) No Photos (notes say photos are u/; flow of water is out of culvert towar camera) No Photos (notes say photos are u/; flow of water is out of culvert towar camera) No Photos (notes say photos are u/; flow of water is out of culvert towar camera) No Photos (notes say photos are u/; No Photos (notes say photos are u/;
Reach upstream of	Comment on sediment source potential in catchment Comment on sediment supply potential to crossing Channel morphology Predominant sediment size Unvegetated bars Vertical incision Deposition Lateral migration/bank erosion Presence and nature of infrastructure (see Drawing 11.4.4.1 d, Catchment	Limited. Well ve Low gradient area between steep u channel development means limited o Engineered No data No data No data No data	getated catchment. pper catchment and crossing, and littl pportunity for sediment supply to cross No Photos (notes say photos are u/; flow of water is out of culvert towarca camera) but O Sindicates channel u, slope is a cut drain. No Photos (notes say photos are u/; flow of water is out of culvert towarca camera) No Photos (notes say photos are u/; flow of water is out of culvert towarca camera) No Photos (notes say photos are u/; flow of water is out of culvert towarca camera) No Photos (notes say photos are u/; flow of water is out of culvert towarca camera) No Photos (notes say photos are u/; flow of water is out of culvert towarca camera) No Photos (notes say photos are u/; flow of water is out of culvert towarca camera) No Photos (notes say photos are u/; flow of water is out of culvert towarca camera) No Photos (notes say photos are u/; flow of water is out of culvert towarca camera) No Photos (notes say photos are u/; flow of water is out of culvert towarca camera) flow of water is out of culvert towarca camera)
Reach upstream of	Comment on sediment source potential in catchment Comment on sediment supply potential to crossing Channel morphology Predominant sediment size Unvegetated bars Vertical incision Deposition Lateral migration/bank erosion Presence and nature of infrastructure (see Drawing 11.4.4.1 d, Catchment 166 Impact of infrastructure	Limited. Well ve Low gradient area between steep u channel development means limited o Engineered No data No data No data No data No data No data	getated catchment. pper catchment and crossing, and littl pportunity for sediment supply to cross No Photos (notes say photos are u/; flow of water is out of culvert towarca camera) but O Sindicates channel u, slope is a cut drain. No Photos (notes say photos are u/; flow of water is out of culvert towarca camera) No Photos (notes say photos are u/; flow of water is out of culvert towarca camera) No Photos (notes say photos are u/; flow of water is out of culvert towarca camera) No Photos (notes say photos are u/; flow of water is out of culvert towarca camera) No Photos (notes say photos are u/; flow of water is out of culvert towarca camera) No Photos (notes say photos are u/; flow of water is out of culvert towarca camera) No Photos (notes say photos are u/; flow of water is out of culvert towarca camera) No Photos (notes say photos are u/; flow of water is out of culvert towarca camera) No Photos (notes say photos are u/; flow of water is out of culvert towarca camera) No Photos (notes say photos are u/; flow of water is out of culvert towarca camera) No Photos (notes say photos are u/; flow of water is out of culvert towarca camera) No Photos (notes say photos are u/; flow of water is out of culvert towarca camera)
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Reach upstream of crossing Morphology and Process- At crossing Morphology and Process- Reach downstream of	Comment on sediment supply potential to crossing Comment on sediment supply potential to crossing Channel morphology Predominant sediment size Unvegetated bars Vertical incision Deposition Lateral migration/bank erosion Presence and nature of infrastructure (see Drawing 11.4.4.1 d, Catchment 166 Channel realignment Channel morphology Predominant sediment size Unvegetated bars Vertical incision Deposition Lateral migration/bank erosion Demanged/unstable drains or amouring Channel morphology Predominant sediment size Unvegetated bars Vertical incision Deposition Lateral migration/bank erosion Demanged/unstable drains or amouring Channel morphology Predominant sediment size Unvegetated bars Vertical incision Deposition Lateral migration/bank erosion Presence and nature of infrastructure (see Drawing 11.4.4.1 d, Catchment 166 Impact of infrastructure Channel realignment	Limited. Well ve Low gradient area between steep u channel development means limited op Engineered No data No data No data No data No data No data No data No data Engineered N/a No data Cascade No data No data	getated catchment. pper catchment and crossing, and littl pportunity for sediment supply to cross No Photos (notes say photos are u/; flow of water is out of culvert towar camera) No Photos (notes say photos are u/; flow of vater is out of culvert towar camera) No Photos (notes say photos are u/; flow of vater is out of culvert towar camera) No Photos (notes say photos are u/; flow of vater is out of culvert towar camera) No Photos (notes say photos are u/; flow of vater is out of culvert towar camera) No Photos (notes say photos are u/; flow of vater is out of culvert towar camera) No Photos (notes say photos are u/; flow of vater is out of culvert towar camera) No Photos (notes say photos are u/; flow of vater is out of culvert towar camera) No Photos (notes say photos are u/; flow of vater is out of culvert towar camera) No Photos (notes say photos are u/; flow of vater is out of culvert towar camera) No Photos (notes say photos are u/; flow of vater is out of culvert towar camera) No Photos (notes say photos are u/; flow of vater is out of culvert towar camera) Pipe culvert Fence will restrict flow and passage sediment Channel straightening u/; of road pr dates road construction (visible on 1 OS Map)
Reach upstream of crossing Morphology and Process- At crossing Morphology and Process- Reach downstream of	Comment on sediment source potential in catchment Comment on sediment supply potential to crossing Channel morphology Predominant sediment size Unvegetated bars Vertical incision Deposition Lateral migration/bank erosion Presence and nature of infrastructure (see Drawing 11.4.4.1 d, Catchment 166 Channel realignment Channel morphology Predominant sediment size Unvegetated bars Vertical incision Damaged/unstable darias or armouring Channel morphology Predominant sediment size Unvegetated bars Un	Limited. Well ve Low gradient area between steep u channel development means limited o Engineered No data No data	getated catchment. pper catchment and crossing, and littl pportunity for sediment supply to cros No Photos (notes say photos are u/, flow of water is out of culvert towar camera) but O5 indicates chamel u slope is a cut drain. No Photos (notes say photos are u/, flow of water is out of culvert towar camera) No Photos (notes say photos are u/, flow of water is out of culvert towar camera) No Photos (notes say photos are u/, flow of water is out of culvert towar camera) No Photos (notes say photos are u/, flow of water is out of culvert towar camera) No Photos (notes say photos are u/, flow of water is out of culvert towar camera) No Photos (notes say photos are u/, flow of water is out of culvert towar camera) No Photos (notes say photos are u/, flow of water is out of culvert towar camera) No Photos (notes say photos are u/, flow of water is out of culvert towar camera) No Photos (notes say photos are u/, flow of water is out of culvert towar camera) No Photos (notes say photos are u/, flow of water is out of culvert towar camera) Pipe culvert pipe culvert pipe culvert famed across channel, B9152, Railwa Fence across channel



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Annex 11.4.4-Hydromorphological Catchment Assessment-168

Catchment No.	168			
Catchment Name	-			
Channel Nature	Nature of water course	Natural		
channerNature	Size of water course	N	linor	
	2			
Quantitative Spatial	Catchment Area (km ²)		0.9	
Elements	Average slope in catchment (°)	8.2		
	% Catchment over 750m (for snow melt risk)			
	Water, flows and levels	0	Good	
WFD classification				
	Physical condition	Good		
	Overall ecological status	6	Good	
		Loch Laggan Psammite formation-		
Geology	Majority Bedrock (see Drawing 11.4.4.1 a and b Catchment 168)	Psammite, Micaeous	resistant to weathering, impermeabl	
	Is an alluvial fan present at or near the crossing?			

			River Spey - Insh Marshes
			Breeding birds, wetlands, freshwater
			habitats, trophic range
	Ramsar	Yes	river/stream,Whooper Swan
			Insh Marshes
			Alder woodland on floodplains, clear-
			water lakes or lochs with aquatic
			vegetation and poor to moderate
			nutrient levels, Otter, very we mires
			often identified by an unstable quaking
Environmental			surface
designations (see			River Spey
Drawing 11.4.4.1 c,			Atlantic salmon, freshwater pearl
Catchment 168)	SAC	Yes	mussel, otter, sea lamprey
			River Spey - Insh Marshes
			Hen Harrier, Osprey breeding, Spotted
			Crake breeding, Whooper swan,
	SPA	Yes	Wigeon breeding, Wood Sandpiper
			River Spey - Insh Marshes
			Arctic charr, breeding bird assemblage,
			flood plain fen, invertebrate
			assemblage, mesotrophic loch, Osprey
			breeding, Otter, vascular plant
	SSSI	Yes	assemblage, Whooper swan

	Changes in slope and channel confinement	See Drawing 11.4	.4.2, Catchment 168
	Is peat present in the catchment?	No	
	Is there a bog burst risk?	No	
	Current valley side or terrace erosion	No	
	Potential valley side or terrace erosion	No	
	Hill slope failures (including peat slides and debris flows and slides)	No	
	Hill slope failures coupled to channel	No	
	Vertical incision present in catchment	No	
Sediment source and	Bank erosion/lateral migration	No	
supply - Catchment Scale	· · · · · · · · · · · · · · · · · · ·		
supply - catchinent scale			
	Unvegetated bars	No	
	* · · · · · · · · · · · · · · · · · · ·		Some foresty in middle catchment so
	Wooded/forested areas in catchment	Yes	somall risk of blockage of culvert
	Infrastructure type (see Drawing 11.4.4.1 d, Catchment 168)	Railway downstream of crossing	
	Comment on sediment source potential in catchment	Little sediment vi	isiable from imagery
	Comment on sediment supply potential to crossing	Little sediment vi	siable from imagery

	Channel morphology	Engineered	
	Predominant sediment size	Not visiable in data	
	Unvegetated bars	Not visiable in data	
	Vertical incision	Not visiable in data	
Morphology and Process-	Deposition	Not visiable in data	
Reach upstream of	Lateral migration/bank erosion	Not visiable in data	
crossing	Presence and nature of infrastructure (see Drawing 11.4.4.1 d, Catchment	Drop chamber upstream end of	
	168	crossing	
	Impact of infrastructure	Not visiable in data	
	Channel realignment	Not visiable in data	

Summary behaviour	Catchment appears relatively stable, but a landslide on the embankment h with granular fill, an	as occurred and the crossing and section d a boulder lined channel.	directly downstream has been replaced
	Channel realignment	Yes	
	Impact of infrastructure	Will reduce downstream flood flows	
	168	Railway bridge downstream	
crossing	Presence and nature of infrastructure (see Drawing 11.4.4.1 d, Catchment	Broad crossing (2 pipe culverts) and	
crossing	Lateral migration/bank erosion	None	
Morphology and Process- Reach downstream of	Deposition	None	
	Vertical incision	None	
	Unvegetated bars	None	
	Predominant sediment size	Gravel	
	Channel morphology	Plane bed	
		P	L
	Damaged/unstable drains or armouring	photographs)	
		fill and large boulders (see	
		and has been remediated with granular	
		Landslide has occured on embankment	
At crossing	Lateral migration/bank erosion	Yes	Now remediated
Morphology and Process-	Deposition	None	
	Vertical incision	None	
	Unvegetated bars	None	
	Predominant sediment size	Not visiable in data	
	Channel morphology	Engineered	



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Drif	t Geolo	ogy				
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Legend General

Crossing location





Photograph 11.4.4.68



Photograph 11.4.4.70



Photograph 11.4.4.69

Catchment No. 170 Catchment Nam Nature of water course Natural Channel Nature Size of water course Minor Catchment Area (km²) 1.4 Quantitative Spatial Average slope in catchment (°) 6.5 Elements % Catchment over 750m (for snow melt risk) Water, flows and levels Good WFD classification Physical condition Good Overall ecological status Good Loch Laggan Psammite formati Majority Bedrock (see Drawing 11.4.4.1 a and b Catchment 170) Is an alluvial fan present at or near the crossing? Psammite, Micaeous resistant to weathering, impermeable Geology No River Spey - Insh Marshe Breeding birds, wetlands, freshwater habitats, trophic range river/stream,Whooper Swan Ramsar Yes Insh Marshes Alder woodland on floodplains, clear water lakes or lochs with aquatic vegetation and poor to moderate nutrient levels, Otter, very we mires often identified by an unstable quaking Environmental surface esignations (see Drawir **River Spey** 11.4.4.1 c. Catchment Atlantic salmon, freshwater pearl 170) mussel, otter, sea lamprey SAC Yes River Spey - Insh Marshes Hen Harrier, Osprey breeding, Spotted Crake breeding, Whooper swan Wigeon breeding, Wood Sandpipe River Spey - Insh Marshes SPA Yes Arctic charr, breeding bird assemblage flood plain fen, invertebrate assemblage, mesotrophic loch, Osprey breeding, Otter, vascular plant assemblage, Whooper swan Yes Changes in slope and channel confinement See Drawing 11.4.4.2, Catchment 170 Is peat present in the catchment? Yes Is there a bog burst risk? No Current valley side or terrace erosion No Potential valley side or terrace erosion Hill slope failures (including peat slides and debris flows and slides) No No Hill slope failures coupled to channel No Vertical incision present in catchment No Sediment source and upply - Catchment Scale Bank erosion/lateral migration No Unvegetated bars No Wooded/forested areas in catchment No Infrastructure type (see Drawing 11.4.4.1 d, Catchment 170) No Comment on sediment source potential in catchment Limited. Well vegetated catchment. Low gradient area between upper catchment and crossing, limited opportunity Comment on sediment supply potential to crossing for sediment supply to crossing. Channel morphology Engineered Predominant sediment size No data Unvegetated bars No data No data Vertical incision Morphology and Process Deposition No data Reach upstream of Lateral migration/bank erosion Presence and nature of infrastructure (see Drawing 11.4.4.1 d, Catchment No data crossing 170 No data Impact of infrastructure No data Channel realignment No data Channel morphology Engineered Pipe culvert Predominant sediment size N/a Unvegetated bars No Morphology and Proces Vertical incision Low At crossing Deposition Low Lateral migration/bank erosion Low Damaged/unstable drains or armouring No Channel morphology No data Predominant sediment size No data Unvegetated bars No data Vertical incision No data Aorphology and Process Deposition No data Reach downstream of Lateral migration/bank erosion Presence and nature of infrastructure (see Drawing 11.4.4.1 d, Catchment No data crossing 170 Yes Impact of infrastructure Yes Channel realignment No Limited activity in this catchment. Limited realignment u/s of crossing. Seems stable and vegetated. Summary behaviour

Annex 11.4.4-Hydromorphological Catchment Assessment-170



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Legend								
General								
Crossing location								
Solid Geology Gaick Psammite Formation - Psammite								
Loch Laggan Psammite Formation - Psammite								
Psammite, Micaceous								
North Britain Siluro-Devonian Calc- Alkaline Dyke Suite - Microdiorite								
Pitmain Semipelite Member - Semipelite And Calcsilicate-Rock								
Pitmain Semipelite Member - Semipelite, Gneissose								
Scottish Highland Ordovician Minor Intrusion Suite - Leucogranite								
Scottish Highland Siluro-Devonian Calc- Alkaline Minor Intrusion Suite- (Other Than Dykes) - Microdiorite								
Drift Geology								
Peat								
Glaciofluvial Ice Contact Deposits								
Gaick Plateau Moraine Formation								
Hummocky Glacial Deposits								
Ardverikie Till Formation - Diamicton								
Glaciofluvial Sheet Deposits								
Alluvium								
River Terrace Deposits								
Alluvial Fan Deposits								
Head								
Talus - Rock Fragments								
Talus Cone								
Environmental Designations								
Ramsar								
Special Site of Scientific Interest								
Special Area of Conservation								
Special Protection Area								
National Nature Reserve								
Morphological Pressures								
Culvert								
Cascade								
 Step in Bed 								
 Catchpit 								
Discharge Location								
Drainage Ditch								
- Flood Embankment								
REV SUIT DATE DESCRIPTION BY APP								
CH2MHILL Fairhurst JV								
C/O: City Park 368 Alexandra Parade Glasgow G31 3AU Tel + 44 (0) 141 552 2000 Fax +44 (0) 141 552 2525								
TRANSPORT SCOTLAND ALAA CONSUMA ALAA Crubemmer to Kincraje								
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Drawing 11.4.4.1 Catchment 170 Catchment Overview								
DESIGN: DRAWN: CHK: APP: EL EV EL EL								
DATE: 20/12/2017								

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REVISION: C01

SUITABILITY:



Annex 11.4.5

EIA Hydromorphological Assessment Tables



1 1	Additional editgetions After additional editions after additionadditional editionadditionad editionad editionad editionad	Additional miligation	Sgnificance	Magnitude of Impact	Duration of Impact	Scale of Impact	Design Spatial extent of impact	Worst case degree of change in WFD Status	Positive impacts of scheme	Negative impacts of scheme	n Single Activity Limit Embedded mitigation	the Change in crossing discharge s	Upstream Downstream Propos atercourse watercourse Total length d	Proposed Works	Existing WFD Status	eline Baseline Works Sensitivity h (m) (m/m) location of Receptor	Hydro Baseline
N N	signal signa							Good to Moderate (new change down			(herear	n) discharge (Type b	Overall- Moderate	h (m) (m/m) location of Receptor	ID type Small
1 1 <	k noophology witable for the channel gradient and type U.S-2.5. Very small Long (More than 6 years) Mettor NeUtrail	Add varied bed and bank morphology suitable for the channel gradient and type Ensure suitable size and grade of substrate for channel conditions						status)	Naturalised flow, due to increased discharge through crossin improved continuity of sediment transfer due to usailed cube	small change in flow patterns and sediment supply		0 -		realignment		US Low	
N N								status)	and natural bed in crossing	Loss of natural banks	Bed Material added to culvert				Physical condition- Good		
N N N <	proportieg flow production the stand constrained of the stand constr	Avoid projecting the cottail into the channel Avoid insulation of outful is it boots on shown hindraid channel impaction Avoid positioning in flow convegence zones or where three is evidence of active bank erosion/instability Direct outful way from the tarket. Minimizing the size/extent of the outful advaul	Neutral	Negligisle	Long (More than 6 years)	Negligible	-0.5	Good to Moderate (one change down status)	Norw	Very small change in flow Very small loss of natural bed and bank due to headwall	No None	-		Drain outfall	Overall- Moderate Water, flows and levels-Good Physical condition- Good	Low	134 small 134 natural channel
1 1 1 <	prove planform of two flows channel Amsphaling withhile for the shared planform of two flows channel main of pask of shared models for channel and official main of pask of shared models for channel and official main of pask of shared models and the shared models of the shared planform of the s	Insprove planform of low flow channel Add varied bed hack morphology valuable for the channel gradient and type Ensure suitable is are and grade of substrates for channel conditions	Neutral	Minor	Long (More than 6 years)	Very Small (length of channel realignment)	>0.5	Good to Moderate (one change down status)	Norse	Loss of natural bed and bank - more uniform form and small change in flow patterns and sediment supply	No 12 year low flow channel	7 .	81.61 0.017	High Impact realignment		- US Low	Small 136 natural channel
1 1 1 2	prove planform of low flow channel	Improve planform of low flow channel Add varied bed and bank morphology suitable for the channel gradient and type	Neutral	Minor	Long (More than 6 years)	Very Small	<0.5	Good to Moderate (one change down status)	None	Loss of natural bed and bank - more uniform form and change in flow patterns and sediment supply	No 1.2 year low flow channel	1 .	55.78 0.011	High Impact realignment	Overall- Moderate Water, flows and levels-Good Physical condition- Good	- US VERGE -	136 -
1 1	nnel (designed for a 12 year flow) through the crossing pool downstream of culvert to dissipate energy 40.5 Neelinble Long (More than 5 years) Neelinble Neutral	Ensure a low flow channel (designed for a 1-2 year flow) through the crossing Ensure Scour pool downstream of culvert to dissipate ensery	Neutral	Negligble	Long (More than 6 years)	Negligible	42.5	g Good to Moderate (one change down ert status)	More natural flow width Improved continuity of sediment transfer due to upsized culv	e Fixed channel position	No Reduced length of culvert compared to baselin Pipe to Box culvert	Upsize		Box culvert	Water, flows and levels-Good	09 0.06 Mainline Low	135 Pipe
N N	projecting the solidil line bit dution in the solidil line bit of the solidil	Avoid projecting the cutful into the channel Avoid instaliation of outlinks at locations of known historical channel nigration Avoid positioning in flow convergence zones or where there is evidence of active bank erosion/instability Direct cutful laway from the banks	Neutral	Negligble	Long (More than 6 years)	Nargligtble	-0.5	Good to Moderate (one charge down status)	None	Very small charge in flow Very small loss of natural bed and bank due to headwalk	No None			3 Drain outfails	Water, flows and levels-Good		140 -
N N	k morphology suitable for the channel gradient and type 40.5 Negligible Long (More than 6 years) Negligible Neutral	Add varied bed and bank morphology suitable for the channel gradient and type	Slight adverse	Minor	Long (More than 6 years)	Very Small	0.5-1.5	Good to Moderate (one change down status)	None	Loss of natural bed and bank - more uniform form and change in flow patterns and sediment supply	No 12 year low flow channel	o -	7.40 0.010	High Impact realignment	Water, flows and levels-Good	DS Medium	140 Natural channel
1 1 1 <	prove planform of two flows channel A morphological watch for the shared pradient and type as or digited of shared resolutions. Integrigible Long (More than 6 years) Regligible Neutral	Insprove planform of low flow channel Add varied back hosphology suitable for the channel gradient and type Ensure suitable is the and grade of substrates for channel conditions	Slight adverse	Minor	Long (More than 6 years)	Very Small	0.5-1.5	status)		Loss of natural bed and bank - more uniform form and change in flow patterns and sediment supply.	No 12 year low flow channel	s -	5.23 0.198	High Impact realignment	Water firms and Invels-Cond	US Medium	140 Natural channel
v v	nnel (designed for a 12 year flow) through the crossing posi downstream of culvert to dissipate energy 0.5-1.5 Very Small Long (More than 6 years) Minor change in culvert type and additi	sulvert, Ensure a low flow channel (designed for a 1.2 year flow) through the crossing ion of Ensure Scour pool downstream of culvert to dissipate energy	Slight beneficial due to upsized culvert, change in culvert type and addition of sediment to culvert	Minor	Long (More than 6 years)	Very Small	05-1.5	6 Good to Moderate (one change down ert status)	More natural flow width Improved continuity of sediment transfer due to upsized culv	Increased length of fixed channel position Loss of natural banks	Upsized culvert to take 1:200 year flow No Pipe to Box culvert Bed Material added to culvert	0 Upsize	254.029 253.287 74.11 0.010	Box culvert	Water, flows and levels-Good	0 0.01 Mainline Medium	140 Pipe
1 1 2 <	sk morphology suitable for the channel gradient and type 0.3-2.5 Very small Long (More than 6 years) Menor Neutral	Add varied bed and bank morphology suitable for the channel gradient and type	Neutral	Minor	Long (More than 6 years)	Very Small	0.5-1.5	Good to Moderate (one change down status)		Loss of natural bed and bank - more uniform form and change in flow patterns and sediment supply		4 -	· · 11.24 0.124	High Impact realignment	Water, flows and levels-Good	DS Low	142 Natural channel
1 1 2 3 3 5	nma nlarform of live than channel	Interview relations of Irus Reachannel	Neutral	Minor	Long (More than 6 years)	Very Small	0.5-1.5	Good to Moderate (one change down status)	None		No 12 year low flow channel	s .	· · 22.11 0.455	High Impact realignment	Overall-Good Water, flows and levels-Good Physical condition- Good	US Low	142 Natural channel
N N	nnel (designed for a 1.2 year flow) through the crossing post downstream of culvert to dissipate energy 0.5-1.5 Very Small Long (More than 6 years) Minor Neutral	Ensure a low flow channel (designed for a 1.2 year flow) through the crossing Ensure Scour pool downstream of culvert to dissipate energy	Neutral	Minor	Long (More than 6 years)	Very Small	0.5-1.5	6 ert Good to Moderate (one change down status)	Improved continuity of sediment transfer due to upsized culv	Increased length of fixed channel position Loss of natural banks and erodible natural bed	No Bed Material added to culvert	0 Upsize	258.938 258.442 51.97 0.010	Pipe	Water, flows and levels-Good	5 0.38 Mainline Low	142 Arch
I I	A descention of the main large in the second s	Plant auto withil development to wintering the setting of the setting of	Neutral	Negligble	Long [More than 6 years]	Negligible	425	Good to Moderate (one charge down status)		Very small change in flow Very small loss of natural bed and bank due to headwal	No Number of outfalls has been reduced	-		2 Drain outfails	Overall- Good Water, flows and levels-Good		142 -
1 1	sk morphology suitable for the channel gradient and type	Add varied bed and bank morphology suitable for the channel gradient and type	Neutral	Minor	Long (More than 6 years)	Very small	05-1.5	status)	None	Loss of natural bed and bank - more uniform form and change in flow patterns and sediment supply		• -	41.05 0.030	High Impact realignment	Water, flows and levels-Good Physical condition- Good	DS Low	143 Natural channel
1 1	sk mosphology uzitable for the channel gradient and type 0.5-3.5 Very small Long (More than 6 years) Misor Neutral use and ende of substrate for channel conditions.	Add varied bed and bank morphology suitable for the channel gradient and type Ensure suitable size and grade of substrate for channel conditions	Neutral	Minor	Long (More than 6 years)	Very small	0.5-1.5	status)			No compared to the previously straightened baseline channel 1.2 year low flow channel	9 -	10.07 0.049	High Impact realignment	Water, flows and levels-Good Physical condition- Good	• • U5_2 Low	143 Straightene d channel
1 1 1 2 2 3 3 4 5	pool downtream of culvert to dissipate energy 0.5-1.5 Very small Long (More than 6 years) Minor Neutral uitable grade of bed material to culvert	Ensure Scour pool downstream of culvert to dissipate energy Add witable grade of bed material to culvert	Neutral	Minor	Long (More than 6 years)	Very small	0.5-1.5	g Good to Moderate (one change down ert status)	Naturalised flow, due to increased discharge through crossin Improved continuity of sediment transfer due to upsized culv	Increased length of fixed channel position Loss of natural bed and banks	No Upsized culvert to take 1:200 year flow Bed material added to culvert	3 Upsize	262.250 260.422 42.03 0.043	Pipe Culvert	Water, flows and levels-Good	i.5 0.03 Mainline Low	143 Pipe
N N	projecting the southill into the channel thinks a locations of shorth advance in engration or come or where there is evidence of active bank erestory(instability cor come or where there is evidence of active bank erestory(instability cor come or where there is evidence of active bank erestory(instability core control and active bank erestory(instability core control active bank erestory(instability core control active bank erestory) erestory (core control active bactive bactive bactive bank erestory)	Avoid projecting the outfall into the channel Avoid installation of outfalls at locations of shown historical channel migration Avoid positioning in flow convegence zones or where there is exidence of active bank erosion/instability Direct outfall avoid from the banks	Neutral	Negligible	Long (More than 6 years)	Negligible	-0.5	Good to Moderate (one change down status)	None	Very small change in flow Very small loss of natural bed and bank due to headwall				3 Drain outfalls	Water, flows and levels-Good Physical condition- Good	Low	143 .
N N	size and anale of substrate for channel conditions	Ensure suitable size and erade of substrate for channel conditions	Neutral	Minor	Long (More than 6 years)	Very small	05-1.5	Good to Moderate (one change down status)	Small improvement likely in flow conditions	Loss of adjusted channel	No compared to the previously straightened baseline channel	2 .	18.10 0.102	High Impact realignment	Overall- Good Water, flows and levels-Good Physical condition- Good	US_1 Low	143 Straightene d channel
I I	projecting the southill into the channel thinks a locations of shorth advance in engration or come or where there is evidence of active bank erestory(instability cor come or where there is evidence of active bank erestory(instability cor come or where there is evidence of active bank erestory(instability core control and active bank erestory(instability core control active bank erestory(instability core control active bank erestory) erestory (core control active bactive bactive bactive bank erestory)	Avoid projecting the outfall into the channel Avoid installation of outfalls at locations of shown historical channel migration Avoid positioning in flow convegence zones or where there is exidence of active bank erosion/instability Direct outfall avoid from the banks	Neutrai	Negligible	Long (More than 6 years)	Negligible	<0.5	Good to Moderate (one change down status)	None	Very small change in flow Very small loss of natural bed and bank due to headwal	No None	-		2 SUDS outfall	Overall- Good Water, Rows and Jevels-Good Physical condition- Good		148 -
1 1	proze glanform of low flow chunnel A morphologie unicha for the shared gradient and type as org days of unichan for chunnel conditions. The shared of the sh	Insprove planform of low flow channel Add warried back hask morphology utiliable for the channel gradient and type Ensure utilable is are and grade of utiliabries for channel conditions	Neutral	Negligible	Long (More than 6 years)	Negligible	40.5	Good to Moderate (one change down status)	Norse	Loss of natural bed and bank - more uniform form and change in flow patterns and sediment supply	No 12 year low flow channel	o -	· · 32.29 0.120	High Impact realignment	Overall- Good Water, flows and levels-Good Physical condition- Good	- DS Low	148 Natural channel
1 N </td <td>prove glandimu di kon favor dhumod An mograding unikali for the shared gradient and type un organ glandi unikati mo thanan an anditati and type</td> <td>Improve planform of low flow channel Add varied bed and back norphology utiliable for the channel gradient and type Ensure utilable size and grade of utilization for channel conditions</td> <td>Neutral</td> <td>Negligible</td> <td>Long (More than 6 years)</td> <td>Negligible</td> <td><0.5</td> <td>Good to Moderate (one change down status)</td> <td>None</td> <td>Loss of natural bed and bank - more uniform form and change in flow patterns and sedment supply</td> <td>-</td> <td>o -</td> <td> 14.61 0.160</td> <td>High Impact realignment</td> <td>Water, flows and levels-Good</td> <td>- US Low</td> <td>148 Natural channel</td>	prove glandimu di kon favor dhumod An mograding unikali for the shared gradient and type un organ glandi unikati mo thanan an anditati and type	Improve planform of low flow channel Add varied bed and back norphology utiliable for the channel gradient and type Ensure utilable size and grade of utilization for channel conditions	Neutral	Negligible	Long (More than 6 years)	Negligible	<0.5	Good to Moderate (one change down status)	None	Loss of natural bed and bank - more uniform form and change in flow patterns and sedment supply	-	o -	14.61 0.160	High Impact realignment	Water, flows and levels-Good	- US Low	148 Natural channel
1 1	w How channel (dougned for a 12 year flow) Lade grade and bed material to new culvert double and the second of the	Ensure a low flow channel (designed for a 1.2 year flow) Add suitable grade of bed materials to new cutvert Ensure Soury pool downstream of culvert to disubstee energy	Neutral	Negligible	Long (More than 6 years)	Negligible	<0.5		Improved continuity of sediment transfer due to upsized culv and natural bed in crossing		Upsized culvent to take 1:200 year flow Bed material added to culvent No Reduced length of culvent compared to previous design	8 Upsize	237.330 235.570 36.86 0.048	Arch Culvert	Overall- Good Water, flows and levels-Good Physical condition- Good	.3 0.07 Mainline Low	145 Pipe
N N	productify the datafile the dat	asing Anod projecting the outful linto the channel directory of the second second second second second second second second in Acoid positioning in flow convergence zones or where there is evidence of active bank ension/instability Direct outful away from the banks Minimize the inclusionant of the ancided bandwall		Major	Long (More than 6 years)	Small	155	e to Good to Moderate (one change down status)	(Approx 3 Km) and downstream during flood flows (due to opening of embankment) and more locally during all flows (du- removal of near from channel)	None	Removal of piers from channel No Part removal of embankment from Roodplair	Upsized to pass more flow		Bridge	Overall- Good Water, flows and levels-Good Physical condition- Good	1.2 - Mainline Very High	152 Bridge
N N	decendence and an environis inspiration for particular and an environmental sector of the sector of	Direct each andfall downterman to minimise impacts to flow patterns Ander participting the addition lists the channel Ander participation addition at participation and additional angestion Another participation and a structure of the additional and additional additional Another participation and a structure of the additional additional additional Another participation additional additional additional additional additional Additional additional additional additional additional additional additional additional Additional additional additional additional additional additional additional additional additional additional Additional additional additional additional additional additional additional additional additional additional Additional additional additionadditional addited additional additional additiona	Neutral	Negligble	Long (More than 6 years)	Ningligible	<0.5	Good to Moderate (one charge down status)	None	Very small change in flow ^{In} Very small loss of natural bed and bank due to headwal	No Outfall removed or set to infiltrate in floodpla	-		2 Suds outfall	Overall- Good Water, flows and levels-Good Physical condition- Good		152 -
1 <th1< td=""><td>I demonstrates travelation for paratement productive the should into the should official at leasting the should into the should come of where the should of active take interconfly/should by Cert chalf into the should Cert chalf into the should Cert</td><td>Once each todid disoutneeme to anishina inquisit. In the patterns Award property the to addit in the schward Award postalation of outfails at todottors of thorows historical charant inquisiton Award postalation gives a more of a where the additional of the additional todottors Direct codel away from the bank Marineme gives and any effect the outfails whereast</td><td>Neutral</td><td>Negligible</td><td>Long (More than 6 years)</td><td>Negligible</td><td><0.5</td><td>Good to Moderate (one charge down status)</td><td>None</td><td>Wery small charge in flow Very small loss of natural bed and bank due to headwall</td><td>No None</td><td>-</td><td></td><td>2 Drain outfails</td><td>Water, flows and levels-Good Physical condition- Good</td><td> Medium</td><td>135 -</td></th1<>	I demonstrates travelation for paratement productive the should into the should official at leasting the should into the should come of where the should of active take interconfly/should by Cert chalf into the should Cert	Once each todid disoutneeme to anishina inquisit. In the patterns Award property the to addit in the schward Award postalation of outfails at todottors of thorows historical charant inquisiton Award postalation gives a more of a where the additional of the additional todottors Direct codel away from the bank Marineme gives and any effect the outfails whereast	Neutral	Negligible	Long (More than 6 years)	Negligible	<0.5	Good to Moderate (one charge down status)	None	Wery small charge in flow Very small loss of natural bed and bank due to headwall	No None	-		2 Drain outfails	Water, flows and levels-Good Physical condition- Good	Medium	135 -
N </td <td>Improve planform of charenel Anternel Anternel 40.5 Negligible Leng (More than 6 years) Negligible Neutral Anterphology uzabili for the dware of prices and the price of the dware of the d</td> <td>a Improve planform of channel V Add wared bed and back morphology vulnities for the channel gradient and type Evance suitable is are a grade of substanties for channel acoditions.</td> <td>Slight Adverse due to change in downstream sediment supply</td> <td>Minor</td> <td>Long (More than 6 years)</td> <td>Very small</td> <td>0.5-1.5</td> <td>Good to Moderate (one charge down status)</td> <td>None</td> <td>Loss of natural bed and bank - more uniform form and change in flow patterns and sediment supply</td> <td>No 12 year low flow channel</td> <td>o .</td> <td> 137.380 0.010</td> <td>High Impact realignment</td> <td>Overall-Good Water, flows and levels-Good Physical condition- Good</td> <td></td> <td>155 -</td>	Improve planform of charenel Anternel Anternel 40.5 Negligible Leng (More than 6 years) Negligible Neutral Anterphology uzabili for the dware of prices and the price of the dware of the d	a Improve planform of channel V Add wared bed and back morphology vulnities for the channel gradient and type Evance suitable is are a grade of substanties for channel acoditions.	Slight Adverse due to change in downstream sediment supply	Minor	Long (More than 6 years)	Very small	0.5-1.5	Good to Moderate (one charge down status)	None	Loss of natural bed and bank - more uniform form and change in flow patterns and sediment supply	No 12 year low flow channel	o .	137.380 0.010	High Impact realignment	Overall-Good Water, flows and levels-Good Physical condition- Good		155 -
1 </td <td>prove planform of low flow shared Amphalogic starting and the shared starting and type and participation of low flow shared starting and type and participation of low flow shared starting and the shared starting and the</td> <td>n Improve planform of low flow channel γ Add varied bed and bask morphology suitable for the channel gradient and type Ensure suitable size and grade of substrate for channel conditions</td> <td>Slight Adverse due to change in downstream sediment supply</td> <td>Minor</td> <td>Long (More than 6 years)</td> <td>Very small</td> <td>05-1.5</td> <td>Good to Moderate (one change down status)</td> <td>None</td> <td>Loss of natural bed and bank - more uniform form and change in flow patterns and sediment supply</td> <td>No 12 year low flow channel</td> <td>6 -</td> <td>· · · 66.09 0.006</td> <td>High Impact realignment</td> <td>Overall- Good Water, flows and levels-Good Physical condition- Good</td> <td> DS Medium</td> <td>155 Straightene d channel</td>	prove planform of low flow shared Amphalogic starting and the shared starting and type and participation of low flow shared starting and type and participation of low flow shared starting and the	n Improve planform of low flow channel γ Add varied bed and bask morphology suitable for the channel gradient and type Ensure suitable size and grade of substrate for channel conditions	Slight Adverse due to change in downstream sediment supply	Minor	Long (More than 6 years)	Very small	05-1.5	Good to Moderate (one change down status)	None	Loss of natural bed and bank - more uniform form and change in flow patterns and sediment supply	No 12 year low flow channel	6 -	· · · 66.09 0.006	High Impact realignment	Overall- Good Water, flows and levels-Good Physical condition- Good	DS Medium	155 Straightene d channel
No. No. <td>k morphology suitable for the channel gradient and type <0.5 Negligible Long (More than 6 years) Negligible Neutral are and grade of substrate for channel conditions</td> <td>by Add varied bed and bank morphology suitable for the channel gradient and type Ensure suitable size and grade of substrate for channel conditions</td> <td>downstream sediment supply</td> <td>Minor</td> <td>Long (More than 6 years)</td> <td>Very small</td> <td>0.5-1.5</td> <td>Good to Moderate (one change down status)</td> <td>None</td> <td>Loss of natural bed and bank - more uniform form and change in flow patterns and sediment supply</td> <td>No 12 year low flow channel</td> <td>1 .</td> <td> 9.62 0.011</td> <td>realignment</td> <td>Water, flows and levels-Good Physical condition- Good</td> <td> US Medium</td> <td>155 Straightene d channel</td>	k morphology suitable for the channel gradient and type <0.5 Negligible Long (More than 6 years) Negligible Neutral are and grade of substrate for channel conditions	by Add varied bed and bank morphology suitable for the channel gradient and type Ensure suitable size and grade of substrate for channel conditions	downstream sediment supply	Minor	Long (More than 6 years)	Very small	0.5-1.5	Good to Moderate (one change down status)	None	Loss of natural bed and bank - more uniform form and change in flow patterns and sediment supply	No 12 year low flow channel	1 .	9.62 0.011	realignment	Water, flows and levels-Good Physical condition- Good	US Medium	155 Straightene d channel
N N	proce planform of low Bose channel Ampphology suitable for the dwared gradient and types 40.5 Negligible Long (More than 6 years) Negligible Ne	n beprove planform of low flow channel r Add varied bed and back merphology satisfiel for the channel gradient and type the channel satisfiel is the angle of satisfies for channel conditions between the channel satisfies and the satisfies of the channel conditions between the channel satisfies and the satisfies of the channel conditions between the channel satisfies and the sat		Minor	Long (More than 6 years)	Very small	0.5-1.5	status)	None	change in flow patterns and sediment supply Increased length of fixed channel position	No 12 year low flow channel	s .	· · 47.95 0.006	High Impact realignment		- DS AT Medium	
1 N </td <td>vier an endotate dot through curver oool downstream of culver to dissipate energy and detained for a "Date fload through the remainer and detained for a "Date fload through the remainer</td> <td>el Ensure Scour pool downstream of culvert to dissipate energy</td> <td>downstream sediment supply and additional culverted channel</td> <td>Minor</td> <td>Long (More than 6 years)</td> <td>Very small</td> <td>05-1.5</td> <td>status)</td> <td>None</td> <td>Loss of natural bed and banks Change in downstream sediment continuity due to increase unnatural bed increased length of fixed channel position</td> <td>No None</td> <td>· ·</td> <td></td> <td>TEC</td> <td>Water, flows and levels-Good Physical condition- Good</td> <td> Track- ATT1 Medium</td> <td></td>	vier an endotate dot through curver oool downstream of culver to dissipate energy and detained for a "Date fload through the remainer and detained for a "Date fload through the remainer	el Ensure Scour pool downstream of culvert to dissipate energy	downstream sediment supply and additional culverted channel	Minor	Long (More than 6 years)	Very small	05-1.5	status)	None	Loss of natural bed and banks Change in downstream sediment continuity due to increase unnatural bed increased length of fixed channel position	No None	· ·		TEC	Water, flows and levels-Good Physical condition- Good	Track- ATT1 Medium	
1 N </td <td>sure an eroEdble bed through culvert dissipate energy downstream of culvert to dissipate energy energy and energy end energy energy energy energy energy energy energy energy energy engines energy en</td> <td></td> <td></td> <td>Minor</td> <td>Long (More than 6 years)</td> <td>Very small</td> <td>0.5-1.5</td> <td></td> <td></td> <td>Loss of natural bed and banks Change in downstneam sediment continuity due to increase unnatural bed increased length of fixed channel position</td> <td></td> <td>New crossing</td> <td>тас тас тас тас</td> <td></td> <td>Water, flows and levels-Good Physical condition- Good</td> <td>- Track- ATT2 Medium</td> <td></td>	sure an eroEdble bed through culvert dissipate energy downstream of culvert to dissipate energy energy and energy end energy energy energy energy energy energy energy energy energy engines energy en			Minor	Long (More than 6 years)	Very small	0.5-1.5			Loss of natural bed and banks Change in downstneam sediment continuity due to increase unnatural bed increased length of fixed channel position		New crossing	тас тас тас тас		Water, flows and levels-Good Physical condition- Good	- Track- ATT2 Medium	
1 0 1 0 <th< td=""><td>sool dearnateran of cubert to dissipate eterny</td><td>Increased Add subtracting bandgeout is a Laryets introl Add subble grade of before material to account of Ensure Scour cool downstream of culvert to dissipate energy</td><td>signt waverse due to change in downstream sediment supply and increased length of culvert</td><td>Minor</td><td>Long (More than 6 years)</td><td>Very small</td><td>05-1.5</td><td>status)</td><td></td><td>Reduced downstream flow and sediment transport Loss of natural bed and banks</td><td>No Bed Material added to culvert removal of catchpit</td><td>· ·</td><td></td><td>ripe to Box culvert</td><td>Water, flows and levels-Good Physical condition- Good</td><td>- Mainline Medium</td><td></td></th<>	sool dearnateran of cubert to dissipate eterny	Increased Add subtracting bandgeout is a Laryets introl Add subble grade of before material to account of Ensure Scour cool downstream of culvert to dissipate energy	signt waverse due to change in downstream sediment supply and increased length of culvert	Minor	Long (More than 6 years)	Very small	05-1.5	status)		Reduced downstream flow and sediment transport Loss of natural bed and banks	No Bed Material added to culvert removal of catchpit	· ·		ripe to Box culvert	Water, flows and levels-Good Physical condition- Good	- Mainline Medium	
1 </td <td>k morphology suitable for the channel gradient and type 0.5-1.5 Very small Long (More than 6 years) Minor channel</td> <td>Add varied bed and bank morphology suitable for the channel gradient and type</td> <td>Slight beneficial due to daylighting of channel</td> <td>Minor</td> <td>Long (More than 6 years)</td> <td>Very small</td> <td>05-1.5</td> <td></td> <td></td> <td>None</td> <td>No Bed Material added to culvert</td> <td>4 -</td> <td>· · 102.54 0.044</td> <td>High Impact realignment</td> <td>Water, flows and levels-Good Physical condition- Good</td> <td>- US AT Medium</td> <td>155 Culverted channel</td>	k morphology suitable for the channel gradient and type 0.5-1.5 Very small Long (More than 6 years) Minor channel	Add varied bed and bank morphology suitable for the channel gradient and type	Slight beneficial due to daylighting of channel	Minor	Long (More than 6 years)	Very small	05-1.5			None	No Bed Material added to culvert	4 -	· · 102.54 0.044	High Impact realignment	Water, flows and levels-Good Physical condition- Good	- US AT Medium	155 Culverted channel
1 1	parte glafonde and beel beel bande gladest and types bier end genet of tabletere for channel conditions.	Improve planform of fow flow channel Add varied bed and bank morphology valiable for the channel gradient and type Ensure satiable size and grade of substrate for channel conditions	Neutral	Minor	Long (More than 6 years)	Very small	0.5-1.5	Good to Moderate (one change down status)	None	Loss of natural bed and bank - more uniform form and change in flow patterns and sediment supply	No 12 year low flow channel	s .	18.09 0.045	High Impact realignment	Water, flows and levels-Good Physical condition- Good	- DS Low	155 Straightene d channel
1 n_{1} n_{2} n	prove gradients law Neurohamie and services and services	Improve planform of fow flow channel Add varied bed and bank morphology vultable for the channel gradient and type Ensure suitable size and grade of substrate for channel conditions	Neutral	Minor	Long (More than 6 years)	Very small	0.5-1.5	Good to Moderate (one change down status)	None	Loss of natural bed and bank - more uniform form and change in flow patterns and sediment supply	No 12 year low flow channel					DS Low	156 Straightene d channel
N <th< td=""><td>k morphology suitable for the channel gradient and type U-5-1.5 very small Long (More man e years) and/or neutral bite and grad of Londrate for channel conditions with the channel conditions of the c</td><td>Add varied bed and bank morphology suitable for the channel gradient and type</td><td></td><td></td><td></td><td></td><td></td><td>status)</td><td>bank and sediment supply</td><td></td><td>Daylighting of existing culvert</td><td>2 .</td><td></td><td>realignment</td><td>Overall- Good</td><td>data No data US Low</td><td></td></th<>	k morphology suitable for the channel gradient and type U-5-1.5 very small Long (More man e years) and/or neutral bite and grad of Londrate for channel conditions with the channel conditions of the c	Add varied bed and bank morphology suitable for the channel gradient and type						status)	bank and sediment supply		Daylighting of existing culvert	2 .		realignment	Overall- Good	data No data US Low	
$ \frac{1}{2} \left[\frac{1}{2} \right] \left[\frac{1}{2} \left[\frac{1}{2} \left[\frac{1}{2} \right] \left[\frac{1}{2} \left[\frac{1}{2} \left[\frac{1}{2} \right] \left[\frac{1}{2} \left[\frac{1}{2$	able grade of bed material to new culvert 0.5-1.5 Very small Long (More than 6 years) Minor Neutral gool downstream of culvert to dissipate energy	Add suitable grade of bed material to new culvert Ensure Scour pool downstream of culvert to dissipate energy	Neutral	Minor	Long (More than 6 years)	Very small	05-1.5	ert status)	Improved continuity of sediment transfer due to upsized culv	Loss of natural banks	No Bed material added to culvert	6 Upsize	227.987 226.762 46.24 0.026	Arth	Water, flows and levels-Good Physical condition- Good	9 0.01 Mainline Low	155 Pipe
k k			Neutral	Negligible	Long (More than 6 years)	Negligible	<85	Good to Moderate (one charge down status)	None	Very small charge in flow Very small loss of natural bed and bank due to headwal	No None	-		1 SUDS outfall	Overall-Good Water, flows and Invels-Good Physical condition-Good		156 -
	projekting the solitiki line bit datandi hisha kolatisari disemen historial dharavan nigezitan ar zona or akine there is a vedence of attive lank ension/instability data. Ningligible Long (Mare than 6 years) Ningligible Nindral Concord utili angi year on baraha	Avoid projecting the cutful into the channel Avoid instaliation of outlinks at locations of known historical channel nigration Avoid positioning in flow convergence zones or where there is evidence of active bank erosion/instability Direct cutful laway from the banks	Neutral	Negligible	Long (More than 6 years)	Negligible	<0.5	Good to Moderate (one change down status)	Norre		No None	-		4 Drain outfalls	Overall- Good Water, Rows and Ievels-Good Physical condition- Good		156 -
	prova planform of low flow shared A megological plant of the dawned guidest and type and guided in the dawned guidest and type and guided in the shared availant of the shared guidest and type Neutral	al bed improve planform of tow flow channel ges in Add varied bed and basic morphology unitable for the channel gradient and type Ensure satisfies and grade of substrate for channel conditions	Slight Adverse due to loss of natural bed and banks and downstream changes in sediment movement	Minor	Long (More than 6 years)	Very small	0.5-1.5	Good to Moderate (one change down status)	None	Loss of natural bed and bank - more uniform form Potential for increased deposition and change in flow patterns and sediment transport	No 12 year low flow channel	9 -	46.73 0.109	High Impact realignment	Overall- Good Water, flows and levels-Good Physical condition- Good	US High	157 Straightene d channel
1 1	I downstream to minimize impacts to flow patterns	Direct each outfall downstream to minimise impacts to flow patterns	Neutral	Negligible	Long (More than 5 years)	Negligible	-05	Good to Moderate (one change down status)	None	Very small charge in flow Very small loss of natural bed and bank due to headwal	No None	-		3 Drain outfails	Overall- Good Water, flows and levels-Good Physical condition- Good		157 .

Hydro ID Saseline type	Baseline length (m)	Works e n) location of Receptor	Existing WFD Status	Proposed Works Type	Upstream Downstream Total length d bed invert bed invert of works Grading (m/s	Change in Activity ilent crossing limit discharge threshold	Embedded mitigation	Negative impacts of scheme	Positive impacts of scheme	Wont case degree of change in WFD Status	Design Spatial extent of impact	Scale of Impact	Duration of impact	Magnitude of Impact	Significance	Additional mitigation	Spatial extent of Impact	Scale of Impact	lesidual significance- After additional Duration of Impact	mitigation applied	Significance
157 Straighter d channe	oe	DS High	Overall- Good Water, flows and levels-Good Physical condition- Good	High Impact realignment	37.06 0.03	133 - No	1:2 year low flow channel	Loss of natural bed and bank - more uniform form Potential for increased deposition and change in flow patterns and sediment transport	None	Good to Moderate (one charge down status)	05-1.5	Very small	Long (More than 6 years)	Minor	Slight Adverse due to loss of natural bed and banks and downstream changes in sediment movement	Improve planform of low flow channel Add varied bed and bank morphology suitable for the channel gradient and type	-0.5	Negligible	Long (More than 6 years)	Negligible	Neutral
157 Pipe	17 0.05	5 Mainline Hisb	Overall-Good	Box culvert	228.020 225.432 64.26 0.04	40 Uasize No	Upsized culvert to take 1:200 year flow	Increased length of fixed channel position	Naturalised flow, due to increased discharge through crossing. Will reduce risk of upstream deposition and blockage. Improved continuity of estiment transfer due to ussied culvert	Good to Moderate (one charge down	0515	Very small	Long (More than 5 years)	Minor	Slight beneficial due to increased discharge	Ensure suitable size and grade of substrate for channel conditions Ensure a low flow channel [designed for a 1:2 year flow]	0.5-1.5	Very small	Long (More than 6 years)	Minor	Slight beneficial due to increased discharge at high flows, and more natural
			Water, flows and levels-Good Physical condition- Good				Pipe to Box culvert Bed Material added to culvert	Loss of natural banks Charge in flow patterns and sediment supply	and natural bed in crossing Improved flow width through crossing	status)		,			at high flows, and more natural downstream sediment transfer	Add suitable grade of bed material to new channel Reduce deposition problems and mix of blockage Direct auch outfall doserviraam to minimize invasits to firms ratifarms		,			at high flows, and more natural downstream sediment transfer
159 -			Overall-Good Water, flows and Invels-Good Physical condition-Good	1 Drain outfall		No	None	Very small change in flow Very small loss of natural bed and bank due to headwal	None	Good to Moderate (one charge down status)	40.5	Negligible	Long (More than 6 years)	Negligible	Neutral	Avoid projecting the solidil lists the channel Avoid thatliation of existing Avoid loading and another and an existing Avoid positioning in flow convergence zones or where there is existence of active bank ensisted/instability Directs calif lawary from the size of the avoid list headward Mermining the size/existent of the outsid headward	43.5	Negligible	Long (More than 6 years)	Negligible	Neutral
161 -			Overall-Good Water, flows and levels-Good Physical condition-Good	1 Drain outfall		No	None Upsized culvert to take 1:200 year flow	Very small charge in flow Very small loss of natural bed and bank due to headwal	None	Good to Moderate (one change down status)	41.5	Negligible	Long (More than 6 years)	Negligble	Neutral	Direct each notifiel downkream to minimise impacts to file parterns Acuel projecting the scattill lists for down in Manning and Statistical Channel Institution And scattilization of scattilists of nonem historical Channel Institution Acuel postnosing in New York (Statistical Channel Statistics) Direct costallist says from the lasts. Minimised by statistical Statistics	-0.5	Negligible	Long (More than 6 years)	Negligible	Neutral
161 Pipe	49 No da	ata Mainline Medium	Overall- Good Water, flows and levels-Good Physical condition- Good	Arth	226.350 225.907 50.90 0.00	U9 Upsize No	Bed material added to culvert Reduced length of culvert compared to previous design	Increased length of fixed channel position Loss of natural banks Change in flow patterns and sediment supply	Naturalised flow, due to increased discharge through crossing Improved continuity of sediment transfer due to upsized culvert and natural bed in crossing	Good to Moderate (one charge down status)	0.5-1.5	Very small	Long (More than 6 years)	Minor	Slight beneficial due to naturalised discharge at high flows, and more natural downstream sediment transfer	Ensure a low flow channel (designed for a 1.2 year flow) Add suttigg gade of bed matrini to new culver Ensure Score pool downtimes of culver to singlate energy	0.5-1.5	Very small	Long (More than 6 years)	Minor	Slight beneficial due to naturalised discharge at high flows, and more natural downstream sediment transfer
159 Pipe	70 0.08	E - Medium	Overall-Good Water, flows and levels-Good Physical condition-Good	Box culvert	232.699 232.174 51.85 0.03	10 - No	Increase in discharge Reduced length of culvert compared to baselin Charge from Pipe to Box Bed material added to culvert	e None	Reduced length of culvert Naturalised flow, due to increased discharge through crossing Improved continuity of sediment transfer due to upsized culvert and natural bed in crossing	Good to Moderate (one change down status)	0.5-1.5	Very small	Long (More than 6 years)	Minor	Slight Beneficial	Ensure a low flow channel (designed for a 1.2 year flow) Add suitable grade of brd material to new culvert Ensure Socior pool downtram of culvert to dissipate energy	0.5-1.5	Very small	Long (More than 6 years)	Minor	Slight Beneficial
159 Straighter	De	DS Medium	Overall- Good Water, flows and levels-Good Physical condition- Good	High Impact realignment	129.36 0.12	24 - No	Bed material added to culvert	Loss of natural bed and bank - more uniform form Potential for increased deposition and change in flow	and natural bed in crossing None	Good to Moderate (one charge down status)	0.5-1.5	Very small	Long (More than 6 years)	Minor	Slight Adverse due to loss of natural bed and banks and downstream changes in	Improve planform of low flow channel Add varied bed and bank morphology suitable for the channel gradient and type Ensure suitable size and grad of substantia for channel conditions	43.5	Negligible	Long (More than 6 years)	Negligible	Neutral
159 Straighter d channe	ne		Overall- Good	High Impact	15.12 0.15		12 year low flow channel	Potential for increased deposition and change in flow patterns and sediment transport Loss of natural bed and bank - more uniform form Potential for increased deposition and change in flow	None	Good to Moderate (one change down	0.5-1.5	Very small	Long (More than 6 years)	Minor	and banks and downstream changes in sediment movement Slight Adverse due to loss of natural bed and banks and downstream changes in	Improve planform of low flow channel	43.5	Negligible	Long (More than 6 years)	Negligible	Neutral
d channe	d		Water, flows and levels-Good Physical condition- Good Overall- Good	realignment				patterns and sediment transport		status) Good to Moderate (one change down					Slight Adverse due to loss of natural bed	Add varied bed and bask morphology suitable for the channel gradient and type Ensure suitable size and grade of substrate for channel conditions improve planform of low flow channel					
161 d channe	el · ·	DS Medium	Water, flows and levels-Good Physical condition- Good Overall- Good	realignment	· · 24.35 0.02	25 - No	1:2 year low flow channel	Potential for increased deposition and change in flow patterns and sediment transport Loss of natural bed and bank - more uniform form	Norw	status)	0.5-1.5	Very small	Long (More than 6 years)	Minor	and banks and downstream changes in sediment movement Slight Adverse due to loss of natural bed	Add varied bed and bask morphology suitable for the channel gradient and type Ensure suitable size and grade of substrate for channel conditions	-0.5	Negligible	Long (More than 6 years)	Negligible	Neutral
161 Straighter d channe	ne	US Medium	Water, flows and levels-Good Physical condition- Good	High Impact realignment	66.56 0.07	74 - No	12 year low flow channel	Potential for increased deposition and change in flow patterns and sediment transport	None	Good to Moderate (one change down status)	0.5-1.5	Very small	Long (More than 6 years)	Minor	and banks and downstream changes in sediment movement	Improve glasform of two flow channel Add varieb bed and bask mosphology suitable for the channel agradient and type Ensure suitable size and grade of substrate for channel conditions	40.5	Negligible	Long (More than 6 years)	Negligible	Neutral
159 Straighter d channe	ne	US AT Medium	Overall- Good Water, flows and levels-Good Physical condition- Good	High Impact realignment	12.13 0.04	H5 - No	1.2 year low flow channel	Loss of natural bed and bank - more uniform form Potential for increased deposition and change in flow patterns and sediment transport	None	Good to Moderate (one charge down status)	0.5-1.5	Very small	Long (More than 6 years)	Minor	Slight Adverse due to loss of natural bed and banks and downstream changes in sediment movement	Improve planform of low flow channel Add varied bed and back morphology suitable for the channel gradient and type Ensure suitable size and grade of substrate for channel conditions	-0.5	Negligible	Long (More than 6 years)	Negligible	Neutral
159 Straighter d channe	ne	US Medium	Overall- Good Water, flows and levels-Good Physical condition- Good	High Impact realignment	9.464 0.14	42 - No	1:2 year low flow channel	Loss of natural bed and bank - more uniform form Potential for increased deposition and change in flow patterns and sediment transport	None	Good to Moderate (one change down status)	0.5-1.5	Very small	Long (More than 6 years)	Minor	Slight Adverse due to loss of natural bed and banks and downstream changes in sediment movement	Improve planform of low flow channel Add varied bed and back morphology suitable for the channel agriftent and type Ensure suitable are and each of substrate for channel condition	40.5	Negligible	Long (More than 6 years)	Negligible	Neutral
159 Straighter d channe	ne	US Medium	Overall- Good Water, flows and levels-Good Physical condition- Good	High Impact realignment	9.464 0.03	110 - No	12 year low flow channel	Loss of natural bed and bank - more uniform form Potential for increased deposition and change in flow patterns and sediment transport	None	Good to Moderate (one charge down status)	0.5-1.5	Very small	Long (More than 6 years)	Minor	Slight Adverse due to loss of natural bed and banks and downstream changes in sediment movement	Improve planform of low flow channel Add varied bed and back morphology suitable for the channel gradient and type Ensure suitable size and advanced for channel conditions	42.5	Negligible	Long (More than 6 years)	Negligible	Neutral
159 Straighter d channe	ne	DS Medium	Overall- Good Water, flows and levels-Good Physical condition- Good	High Impact realignment	9.464 0.25	50 - No	12 year low flow channel	Loss of natural bed and bank - more uniform form Potential for increased deposition and change in flow patterns and sediment transport	None	Good to Moderate (one change down status)	0.5-1.5	Very small	Long (More than 6 years)	Minor	Slight Adverse due to loss of natural bed and banks and downstream changes in sediment movement	Improve planform of low flow channel Add varied beal and bank morphology suitable for the channel gradient and type Ensure suitable size and grade of substrate for channel conditions	-0.5	Negligible	Long (More than 6 years)	Negligible	Neutral
																Ensure suctable size and grade or substrate for fraction constants Direct each outfail downstream to minimize impacts to flow patterns Avoid projecting the outfail into the channel					
162 .			Overall- Good Water, flows and levels-Good Physical condition- Good	1 SUDS outfail		- No	None	Very small change in flow Very small loss of natural bed and bank due to headwal	None	Good to Moderate (one change down status)	-0.5	Negligible	Long (More than 6 years)	Negligble	Neutral	Avaid installation of outfalls at locations of known historical channel migration Avoid positioning in flow convergence comes or where there is evidence of active bank erosion/instability Direct outfall away from the bank. Minimizing the size/instent of the outfall headwall	40.5	Negligible	Long (More than 6 years)	Negligible	Neutral
162 -			Overali-Good Water, flows and levels-Good Physical condition-Good	4 Drain outfalls		- No	None	Very small change in flow Very small loss of natural bed and bank due to headwal	None	Good to Moderate (one charge down status)	40.5	Negligible	Long (More than 6 years)	Negligible	Neutral	Dref tash and did averations to nonine injects to like pattern And graphical bodies and the additional the standard And installation of additional discussion of inners hostical charant angestim And grantomic the standard and additional and an adversarial And grantomic the standard and and additional additional and adversarial Mannaing the standards of the additional additional Mannaing the standards of the additional additional	42.5	Neglgble	Long (More than 6 years)	Negligible	Neutral
162 Bridge	14.2 No da	ata Mainline High	Overall-Good Water, flows and levels-Good Physical condition- Good	Bridge		Upsize No	Upsized crossing	Loss of natural bank form due to extension of bridge Fixing channel position	Naturalised flow, due to increased discharge through crossing Improved continuity of sediment transfer due to upsized crossing	Good to Moderate (one charge down status)	40.5 (any positive change in flow and sediment transfer will be limited by road)	Negligible	Long (More than 6 years)	Negligible	Neutral	Set back embankments further from the channel banks. Restore channel upstream and downstream to reduce deposition problem under Broad bridge	cuts (any positive change in flow and sediment transfer will be limited by road)	Negligible	Long (More than 6 years)	Negligible	Neutral
165 -				1 Drain outfall		No	Number of outfails has been reduced	Very small change in flow Very small loss of natural bed and bank due to headwal	None	Good to Moderate (one charge down status)	-0.5	Negligible	Long (More than 6 years)	Negligible	Neutral	Direct each outfail downstream to minimize impacts to flow patterns Anniel mathematika and projecting the cutilitation that channel Anniel mathematika and an anniel anniel and anniel anniel an anniel annie an annie	-0.5	Negligible	Long (More than 6 years)	Negligible	Neutral
165 Pipe and catch pit	4	Mainline Low	Overall- Good Water, flows and levels-Good Physical condition- Good	Box culvert	233.804 233.041 76.25 0.07	10 Upsize No	Upsized culvert to take 1:200 year flow Pipe to Box culvert Bed Material added to culvert	Increased length of fixed channel position Loss of natural banks	Naturalised flow, due to increased discharge through crossing More natural flow width Improved continuity of sediment transfer due to upsized culvert	Good to Moderate (one charge down status)	-0.5	Negligible	Long (More than 6 years)	Negligible	Neutral	Ensure a low flow charves (designed for a 12 year flow) through the crossing Ensure Scour pool downstream of culvert to dissipate energy Add suitable grade of bed material to new culvert	40.5	Negligible	Long (More than 6 years)	Negligible	Neutral
165 Natural channel		DS Low	Overall-Good Water, flows and levels-Good Physical condition- Good	High Impact realignment	52.65 0.04	41 - No	1:2 year low flow channel	Loss of natural bed and bank - more uniform form Potential for increased deposition and change in flow patterns and sediment transport	and addition of bed material None	Good to Moderate (one change down status)	41.5	Negligible	Long (More than 6 years)	Negligible	Neutral	Improve planform of low channel Add varied bred and bask morphology suitable for the duancel gradient and type Ensure suitable user and grad of substrate for channel conditions	-0.5	Negligible	Long (More than 6 years)	Negligible	Neutral
165 Natural channel		US Low	Overall- Good Water, flows and levels-Good	High Impact	32.18 0.33	30 - No	12 year low flow channel	Loss of natural bed and bank - more uniform form Potential for increased deposition and change in flow	None	Good to Moderate (one charge down	40.5	Negligible	Long (More than 5 years)	Negligble	Neutral	Improve planform of low flow channel	40.5	Negligible	Long (More than 6 years)	Negligible	Neutral
			Physical condition- Good Overall- Good Water, flows and levels-Good Physical condition- Good	High Impact realignment	42.85 0.02		1:2 year low flow channel	patterns and sediment transport	None	status) Good to Moderate (one charge down	41.5	Negligible	Long (More than 6 years)	Negligible	Neutral	Add varied bed and back morphology suitable for the channel gradient and type Ensure suitable size and grad of substrate for channel conditions improve planform of low flow channel	-0.5	Negligible	Long (More than 6 years)	Negligible	Neutral
165 Natural channel		- Low	Physical condition- Good	realignment	42.85 0.02	- NG	112 year low now channel	Potential for increased deposition and change in flow patterns and sediment transport	Norse	status)	205	Negligitie	Long (More than 6 years)	witches	NUUTAI	Improve planform of low flow channel Add varied bed and bank morphology suitable for the channel gradient and type Ensure satable size and stask of substatute for channel conditions Direct such outfail downstream to minimize instacts to flow patterns	-0.5	NIGLEON	Long (More than 6 years)	Negrgone	NECETA
106 -			Overall-Good Water, flows and Invels-Good Physical condition-Good	1 Drain outfall		- No	None	Very small change in flow Very small loss of natural bed and bank due to headwal	None Naturalised flow, due to increased discharge through crossing	Good to Moderate (one change down status)	-0.5	Negligible	Long (More than 6 years)	Negligble	Neutral	Dref tech and/di diversitivano to nonicola injento to like patterno. Ander grangene the antificiant bet ander anti- Ander traditione of another and the antificiant bet and antificiant Antificiantification of antificiant and antificiant and the anti- al patternism (b). Decote antificiant any from the basic Mornising the singlement of the ander beer and Mornising the singlement of the ander beer and	-0.5	Negligible	Long (More than 6 years)	Negligible	Neutral
165 Pipe	58 No da	ata Mainline Low	Overall-Good Water, flows and levels-Good Physical condition-Good	Box culvert	242.912 242.523 38.43 0.03	10 Upsice No	Upsized culvert to take 1.200 year flow Pipe to Box culvert Bed Material added to culvert Reduced Length of culvert from baseline	Fixed channel position	Naturalised flow, due to increased discharge through crossing Moles natural flow width. Improved continuity of sedment transfer date to upsteed culvert and addition of bed material Bedoed learch of colvert	Good to Moderate (one change down status)	<0.5	Negligible	Long (More than 6 years)	Negligible	Neutral	Ensure a low flow channel (designed for a 12 year flow) through the crossing Ensure Scour pool downstream of culvert to dissipate energy Add suitable grade of bed material to new culvert	-0.5	Negligible	Long (More than 6 years)	Negligible	Neutral
165 Straighter d channe	ne	DS Low	Overall- Good Water, flows and levels-Good Physical condition- Good	High Impact realignment	52.08 0.25	55 - No	12 year low flow channel	Loss of natural bed and bank - more uniform form Potential for increased deposition and change in flow patterns and sediment transport	None	Good to Moderate (one charge down status)	-0.5	Negligible	Long (More than 6 years)	Negligible	Neutral	Improve planform of low flow channel Add varied bed and bank morphology suitable for the channel gradient and type Ensure suitable size and grade of substrate for channel conditions	42.5	Negligible	Long (More than 6 years)	Negligible	Neutral
165 Straighter d channe	or	US Low	Overall- Good Water, flows and levels-Good Physical condition- Good	High Impact realignment	95.52 0.05	50 - No	12 year low flow channel	Loss of natural bed and bank - more uniform form Potential for increased deposition and change in flow patterns and sediment transport	None	Good to Moderate (one change down status)	-0.5	Negligible	Long (More than 6 years)	Negligible	Neutral	Improve planform of low flow channel Add varied bed and back morphology suitable for the channel gradient and type Ensure suitable size and grade of substrate for channel conditions	40.5	Negligible	Long (More than 6 years)	Negligible	Neutral
168 Pipe	67 No da	ata Mainline Medium	Overall- Good Water, flows and levels-Good Physical condition- Good	Box culvert	240.806 240.217 43.11 0.01	124 Upsize No	Upsized culvert to take 1:200 year flow Pipe to Box culvert Bed Material added to culvert	Fixed channel position	Naturalised flow, due to increased discharge through crossing More natural flow width Improved continuity of sediment transfer due to upsized culvert and addition of bed material	Good to Moderate (one change down status)	<0.5	Negligible	Long (More than 6 years)	Negligible	Neutral	Ensure a low flow channel (generate for a 12 year flow) through the crossing Ensure Scour post downthream of culvert to dissipate energy Add suitable grade of brid material to new culvert	40.5	Negligible	Long (More than 6 years)	Negligible	Neutral
168 Straighter d channe		D5 Medium	Physical condition- Good Overall- Good Water, flows and levels-Good	High Impact realignment	38.81 0.53	35 · No	Reduced Length of culvert from baseline Some improvement in planform when compared to the previously straightened	Loss of adjusted channel	and addition of bed material Berliored length of robert Small improvement likely in flow conditions	Good to Moderate (one charge down	-0.5	Negligible	Long (More than 6 years)	Negligible	Neutral	Add suitable grade of bed material to new culvert Improve planform of low flow channel Add varied bed and back morphology suitable for the channel gradient and type	43.5	Negligible	Long (More than 6 years)	Negligible	Neutral
168 Straighter d channe	_	DS of Medium	Physical condition- Good Overall- Good Water, flows and levels-Good Physical condition- Good	High Impact realignment	137.26 0.00	02 - No	baseline channel 1:2 year low flow channel Some improvement in planform when compared to the previously straightened baseline channel	Loss of adjusted channel	Small improvement likely in flow conditions	Good to Moderate (one change down status)	40.5	Negligible	Long (More than 6 years)	Negligible	Neutral	Add varies ones also dank mergehoogily standards nor the channel apparent non type Ensure stabilities are and readed of substrate for Hannel monitors Intercome planeform of two flow channel Add varies has into heads one should be channel and seafaset and head	43.5	Negligible	Long (More than 6 years)	Negligible	Neutral
168 Straighter d channe		US Medium	Physical condition- Good Overall- Good Water, flows and levels-Good Physical condition- Good	High Impact realignment	95.52 0.11	10 - No	2 year low flow channel Some improvement in planform when compared to the previously straightened baseline channel	Loss of adjusted channel	Small improvement likely in flow conditions	Good to Moderate (one change down	-0.5	Negligible	Long (More than 6 years)	Negligible	Neutral	Ensure suitable size and ende of substrate for channel conditions improve planform of low flow channel	-0.5	Negligible	Long (More than 6 years)	Negligible	Neutral
a channe			Physical condition- Good	reaugnment			baseline channel 12 war low flow channel			status						Add varied bad and back morphology suitable for the channel gradient and type Reverse suitable size and analysis of substrate for channel condition. Direct each outfail downstream to minimie impacts to flow patterns					
170 -			Overall- Good Water, flows and Invels-Good Physical condition- Good	1 Drain outfall		- No	None	Very small change in flow Very small loss of natural bed and bank due to headwal Loss of natural bed and bank - more uniform form	None	Good to Moderate (one change down status)	-0.5	Negligible	Long (More than 6 years)	Negligible	Neutral	Anod statistical projecting the stuffill into the channel Anod statistical or distribution all stochastical daman injugation Anod positioning in flue acrossing areas and any firm is a solared of active bank ensois/instability Merintung the star/astient of the code/all baadwail	-0.5	Negligible	Long (More than 6 years)	Negligible	Neutral
170 Natural channel		DS Medium	Overall- Good Water, flows and levels-Good Physical condition- Good	High Impact realignment	3.83 0.11	35 - No	12 year low flow channel	Potential for increased deposition and change in flow patterns and sediment transport	None	Good to Moderate (one change down status)	41.5	Negligible	Long (More than 6 years)	Negligible	Neutral	Improve planform of low flow channel Add varied bed and knocpbalogy suitable for the channel gradient and type Ensure suitable size and grade of substrate for channel conditions	40.5	Negligible	Long (More than 6 years)	Negligible	Neutral
170 Natural channel		US Medium	Overall- Good Water, flows and levels-Good Physical condition- Good	High Impact realignment	40.59 0.00	112 - No	1.2 year low flow channel	Loss of natural bed and bank - more uniform form Potential for increased deposition and charge in flow patterns and sediment transport	None	Good to Moderate (one charge down status)	-0.5	Negligible	Long (More than 6 years)	Negligible	Neutral	Improve planform of low flow channel Add varied best and bask morphology suitable for the channel gradient and type Ensure suitable size and grade of substrate for channel conditions	40.5	Negligible	Long (More than 6 years)	Negligible	Neutral
170 Unknown		Mainline Medium	Overall- Good Water, flows and levels-Good Physical condition- Good	Pipe	224.638 223.992 64.74 0.07	10 Not upsized No	Bed Material added to culvert	Increased length of fixed channel position Loss of natural banks	Improved continuity of sediment transfer due to natural bed in crossing	Good to Moderate (one change down status)	-0.5	Negligible	Long (More than 6 years)	Negligible	Neutral	Ensure a low flow channel (designed for a 12 year flow) Add ustable grade of bed material to see scalart Ensure Scour pool downtineam of culturi to dissipate energy	-0.5	Negligible	Long (More than 6 years)	Negligible	Neutral
138_1 .			Overall-Good Water, flows and levels-Good Physical condition- Good	Drain outfall		No	Avoid projective personal for the partners Avoid projective audial into the channel learn historical channel ingresion Avoid positioning in flow convergence acress o where there is evidence of acress bank erosion/instability Direct outfall avoys from the banks Minimising the size/action of the outfall bandwall	r Very small change in flow Very small loss of natural bed and bank due to headwal	Nane	Good to Moderate (one change down status)	-0.5	Negligible	Long (More than 6 years)	Negligible	Neutral	Event each actual dissentions to anointo regark to Boyelanna. Acus deviations of actual action of the sector of th	-0.5	Negligible	Long (More than 6 years)	Negligible	Neutral
138_1 Ppe		Mainline -	Overall- Good Water, flows and levels-Good Physical condition- Good			- No	Additional crossing removed	-										-	-	-	
118_2 .			Overall- Good Water, flows and levels-Good Physical condition- Good			- No	Drainage outfalls have been removed	None	Nane	-	-	-		-	-		-		-	-	
138_2 Pipe and catch pit		Mainline Medium	Overall-Good Water, flows and levels-Good Physical condition- Good	Pipe Culvert	261.490 261.14 40.93 0.00	09 Upsize No	Upsized culvert to take 1:200 year flow Bed material added to culvert	Increased length of fixed channel position Loss of natural bed and banks Change is downstream sediment continuity due to increase unnatural bed	Naturalised flow, due to increased discharge through crossing Improved continuity of sediment transfer due to upsized culvert	Good to Moderate (one change down status)	05-1.5	Very small	Long (More than 6 years)	Minor	Slight Beneficial due to upsized culvert allowing natural downstream flows and a natural bed	Ensure a low flow charnel (designed for a 12 year flow) through the crossing Ensure Sour pool downstnam of culvert to dissipate energy Add watable grade of bed material to culvert	0.5-1.5	Very small	Long (More than 6 years)	Minor	Slight Beneficial due to upsized culvert allowing natural downstream flows and a natural bed
138_2 Small natural channel		US Medium	Overall- Good Water, flows and levels-Good Physical condition- Good		102.73 0.07	171 - No	1:2 year low flow channel	Loss of natural bed and bank - more uniform form and change in flow patterns and sediment supply	None	Good to Moderate (one charge down status)	0.5-1.5	Very small	Long (More than 6 years)	Minor	Slight Negative as more uniform channel replaces natural channel	inprove planform of low flow channel Add varied bed and bank morphology suitable for the channel gradient and type Ensure suitable size and grade of substrate for channel conditions	-0.5	Negligible	Negligible	Negligible	Neutral
138_2 Small channel		US AT Medium	Overall-Good Water, flows and levels-Good Physical condition- Good	High Impact realignment	38.15 0.14	43 - No	1.2 year low flow channel	Loss of natural bed and bank - more uniform form and change in flow patterns and sediment supply	None	Good to Moderate (one charge down status)	0.5-1.5	Very small	Long (More than 6 years)	Minor	Slight Negative as more uniform channel replaces natural channel	Improve planform of low flow channel Add varied bed and bank morphology suitable for the channel gradient and type	40.5	Negligible	Negligible	Negligible	Neutral
channel 138_2 Small channel		Track Medium	Physical condition- Good Overall- Good Water, flows and levels-Good Physical condition- Good	Pipe Culvert	255.674 TBC - TB	IC Upsize No	None	change in flow patterns and sediment supply increased length of fised channel position Loss of natural bed and banks Change in downitream sediment continuity due to	None	status) Good to Moderate (one change down status)	05-15	Very small	Long (More than 6 years)	Minor	replaces natural channel Slight adverse due to new culvert fixing the channel position and creating artificial bed and banks	Add warde bed and bank morphology wuitable for the channel gradient and type Ensures statistic is tean and started is substanting for channel conditions Ensure a low flow channel (charging for a 12 year flow) through the crossing Ensure an enclude bed through cuivert Add wuitable gradie of bed material to new cuivert	40.5	Negligible	Long (More than 6 years)	Negligible	Neutral
144_1 Straighter d channel		DS Low	Overall- Good Water, flows and levels-Good	High Impact realignment	14.75 0.63	30 - No	1.2 year low flow channel	Loss of natural bed and back - more uniform form and change in flow patterns and sediment supply	None	Good to Moderate (one charge down status)	05-1.5	Very Small	Long (More than 6 years)	Minor	and banks Neutral	Ensure Scour of down to the instrument of the divisate ensure Ensure Scour coll down than the divisate ensure Improve planform of John flow flow channel Add warde beat and bank morphology witable for the channel gradient and type	0.5-1.5	Very Small	Long (More than 6 years)	Minor	Neutral
144_1 Straighter	ne	US Low	Physical condition- Good Overall- Good Water, flows and levels-Good Physical condition- Good	High Impact realignment	12.29 0.40	02 - No	1.2 year low flow channel	Loss of natural bed and bank - more uniform form and change in flow patterns and sediment supply	None	status) Good to Moderate (one change down status)	05-15	Very Small	Long (More than 6 years)	Minor	Neutral	Ensure suitable size and grade of substrate for channel conditions	0.5-1.5	Very Small	Long (More than 6 years)	Minor	Neutral
144_1 Arch	27 0.12	2 Mainline Low	Physical condition- Good Overall- Good Water, flows and Irveit-Good Physical condition- Good	Pipe	261.535 260.120 35.05 0.04	41 Upsized No	Upsized culvert to take 1:200 year flow	change in now parterns and seament supply Increased length of flated channel position Loss of natural banks	Naturalised flow, due to increased discharge through crossing Improved continuity of sedment transfer due to upsized culvert	status) Good to Moderate (one change down status)	05-15	Very Small	Long (More than 6 years)	Minor	Neutral	Add varied beta on basic morphology utilable for the channel gradient and type Ensure saturable size and grade of substrate for channel conditions Torura to built four channel (designed for a 1.2 year flow) Add suitable grade of bed material to new culvert Ensure Socro pool dommitram of channel to displate energy	0.5-1.5	Very Small	Long (More than 6 years)	Minor	Neutral
144_1 Cuivert		Track Low	Physical condition- Good Overall- Good Water, flows and levels-Good Physical condition- Good	Pipe		New crossing No	None	Loss of natural banks Increased length of fised channel position Loss of natural bed and banks Change is downitream sediment continuity due to	Improved continuity of sediment transfer due to upsized culvert None	status) Good to Moderate (one change down status)	0.5-1.5	Very Small	Long (More than 6 years)	Minor	Neutral	Ensure a low flow channel (designed for a 12 year flow) through the crossing Ensure an erodible bed through culvert Ensure Sour pool downtream of culvert to dissipate energy	0.5-1.5	Very Small	Long (More than 6 years)	Minor	Neutral
	1 1		Hysical condition- Good				1	increase unnatural bed	1	L	1	1	1	1		Add suitable anade of bed material to new cubert			1	ı – İ	

		Baseline					-	hS	inde				Design	1					-	De	sidual significance- After additional	mitigation applied	
Hydro Baseline B ID type ler	seline slope Work gth (m) (m/m) locatio	s Sensitivity on of Receptor	Existing WFD Status	Proposed Works v Type	Upstream Do watercourse with bed invert b level	ed invert of works level	Gradient (m/m)	ge in Acti sing lin arge threa		Negative impacts of scheme	Positive impacts of scheme	Worst case degree of change in WFD Status	Spatial extent of Impact	Scale of Impact	Duration of Impact	Magnitude of Impact	Significance	Additional mitigation	Spatial extent of Impact	Scale of Impact	Duration of Impact	Magnitude of Impact	Significance
144_1 Straightene d channel		Low	Overall-Good Water, flows and levels-Good Physical condition- Good	1 Drain outfall	-			. N	No Number of outfails has been reduced	Very small change in flow Very small loss of natural bed and bank due to headwall	Nore	Good to Moderate (one charge down status)	đ3	Negligible	Long (More than 6 years)	Negligble	Neutral	Direct and constrainers to enclosure that the flow patterns Acad sequences and the second second second second second second Acad matchines of softhin it locations of theses historical dwared impattion Acad patterning the flow convergence one of where their a second of attach task reason/instability Direct softial array too the lackst Materiang the second for the lackst	41.5	Negligisle	Long (More than 6 years)	Negligible	Neutral
144_1 Straightene d channel	DS AT	T Low	Overall- Good Water, flows and levels-Good Physical condition- Good	High Impact realignment	-	- 21.69	0.008 -	N	to 12 year low flow channel	Loss of natural bed and bank - more uniform form and change in flow patterns and sediment supply	None	Good to Moderate (one change down status)	05-1.5	Very Small	Long (More than 6 years)	Minor	Neutral	Improve planform of low flow channel Add waried bed and bask morphology stubies for the channel gradient and type Ensure stubies itse and easted or substrates for channel conditions	0.5-1.5	Very Small	Long (More than 6 years)	Minor	Neutral
145_1 Pipe	50 0.05 Mainlin	due to length of me channel downstrea m of the	Overall-Good Water, flows and levels-Good Physical condition-Good	Box culvert	245.488	245.670 76.77	0.011 Ups	ize N	Upsized culvert to take 1.200 year flow Pipe to Box culvert so improved flows and bed	Increased length of fixed channel position loss of natural bed and banks Change in flow patterns and sediment supply	Naturalised flow, due to increased discharge through crossing improved continuity of sediment transfer due to upsized culvert	Good to Moderate (one charge down status)	135	Small	Long (More than 6 years)	Moderate	Moderate beneficial due to more natural flows downstream	Dosson a low Row Alexand (Songard for a 1-2 year Roy) Add suitable goals of load started in an exclusion Ensure Sociar pool downstream of cultivert to dissipate energy	15-5	Small	Long (More than 6 years)	Moderate Mo	oderate beneficial due to more natural flows downstream
145_1 .		-	Overall- Good Water, flows and Invels-Good Physical condition- Good	1 SUDS outfail	-			· N	So None	Very small change in flow Very small loss of natural bed and bank due to headwall	Nace	Good to Moderate (one charge down status)	45	Negligible	Long (More than 6 years)	Negligible	Neutral	Dest task nucleif disentions to minimism impacts to files partners. Noted programping the andfoll into the downed interact downed impacts And installations of softbalk a locations of themes hostical downed impacts And pastituting in their convergence on any other the six advanced at latter bank messary/installity downed in the size of the size of the softbalk interaction of the could be advanced Misroming the size(starts of the could) handwell	-0.5	Negligible	Long (More than 6 years)	Negligible	Neutral
145_1 .		-	Overall- Good Water, flows and levels-Good Physical condition- Good	3 Drain outfails	-			- N	Number of outfails has been reduced	Very small change in flow Very small loss of natural bed and bank due to headwall	Nore	Good to Moderate (one charge down status)	-0.5	Negligible	Long (More than 6 years)	Negligble	Neutral	Dott sink outful discriminant to minimize inputs in Mang parama Mont of geographic and full in the Annual And mathematical and a locations of themas hostical dwarfs ingention And particularly for convergeror one or where there a subscale at later to have even dynamical And particular and an annual state of the state of the state of the state of the Annual Annual Annual Annual Annual Annual Annual Annual Annual Materiaring the singlestent of the could breadward	-0.5	Negligible	Long (More than 6 years)	Negligible	Neutral
145_1 Natural channel	DS	due to length of modified channel downstrea m of the	Overall-Good Water, flows and levels-Good Physical condition-Good	High Impact realignment	-	- 14.91	0.017 -	• N	So 1:2 year low flow channel	Loss of natural bed and bank - more uniform form and small change in flow patterns and sediment supply	Nore	Good to Moderate (one charge down status)	0.5-1.5	Very Small	Long (More than 6 years)	Minor	Slight adverse	improve planform of low flow shannel Add writed bed and back morphology utilable for the channel gradient and type Ensure suitable size and grade of substrate for channel conditions	-0.5	Negligible	Long (More than 6 years)	Negligible	Neutral
145_1 Natural channel	us	due to length of modified channel downstrea m of the	Overall-Good Water, flows and levels-Good Physical condition-Good	-	-			- N	to 1:2 year low flow channel	Loss of natural bed and bank - more uniform form and small change in flow patterns and sediment supply	None More naturalised flow, due to increased discharge through	Good to Moderate (one change down status)	0.5-1.5	Very Small	Long (More than 6 years)	Minor	Slight adverse	Improve planform of low flow channel Add writed bed and back morphology validate for the channel gradient and type Ensure satisfies size and grade of substories for channel conditions	-0.5	Negligible	Long (More than 6 years)	Negligible	Neutral
146_1 Pipe and catch pit	Mainle	ne Medium	Overall-Good Water, flows and levels-Good Physical condition-Good	Box culvert	236.365	233.368 72.62	take a	⊢but ily to N 1:200 flow	Upsized cuivert to take greater than existing flow Pipe to Blox cuivert Bed Material added to cuivert	Increased length of fixed channel position Loss of natural bed and banks Change in flow patterns and sediment supply	More naturalised flow, due to increased discharge through crossing Improved continuity of sediment transfer due to upsized culvert, but still problems associated with the catch pit More natural Bowardth and derath	Good to Moderate (one change down status)	155	Small	Long (More than 6 years)	Moderate	Moderate beneficial due to more natural flows downstream	Ensure a low flow channel (designed for a 1.2 year flow) Add sutable gade of bod material to new calvert Ensure Scoar pool downstream of calvert to disalpte energy	155	Small	Long (More than 6 years)	Moderate Mo	oderate beneficial due to more natural flows downstream
146_1 .		-	Overall- Good Water, flows and levels-Good Physical condition- Good	1 SUDS outfail	-			. N	io None	Very small change in flow Very small loss of natural bed and bank due to headwall	Nore	Good to Moderate (one charge down status)	48.5	Negligible	Long (More than 6 years)	Negligible	Neutral	Once each occlud downinneam to animize impacts to file patterns And invalidation of and the location of foreas hotenical downed impacts And invalidation of and/oth at locations of foreas hotenical downed impacts And pastering the foreas compares and an other them is a downed at attach take and on- Stand and the state of the state of the state of the state of the state Manage the state optimal take and foreas hotenical downed the state optimal take and foreas hotenical	41.5	Negligible	Long (More than 6 years)	Negligible	Neutral
146_1 .		-	Overall- Good Water, flows and levels-Good Physical condition- Good	2 Drain outfails	-			. N	iio None	Very small change in flow Very small loss of natural bed and bank due to headwall	Nore	Good to Moderate (one charge down status)	48.5	Negligble	Long (More than 6 years)	Negligble	Neutral	Direct and constrainers to enclose the table of the gentrems And enabled on constraints of the second second second second second And enables of solidar is based on a direct in based on a direct table of the second seco	-0.5	Negligisle	Long (More than 6 years)	Negligible	Neutral
146_1 Natural channel	· · D5	Medium	Overall-Good Water, flows and levels-Good Physical condition- Good	High Impact realignment		- 40.25	0.038 -	N	to 12 year low flow channel	Loss of natural bed and bank - more uniform form and change in flow patterns and sediment supply	None	Good to Moderate (one change down status)	0.5-1.5	Very Small	Long (More than 6 years)	Minor	Slight adverse	broprove planform of low flow channel Add varied bed and bank mosphology valiable for the channel gradient and type Ensure variables have and grade of substrate for channel conditions	-0.5	Negligible	Long (More than 6 years)	Negligible	Neutral
146_1 Natural channel	us	Medium	Overall-Good Water, flows and levels-Good Physical condition- Good	High Impact realignment	-	- 41.51	0.116 -	N	to 12 year low flow channel	Loss of natural bed and bank - more uniform form and change in flow patterns and sediment supply	None	Good to Moderate (one change down status)	05-1.5	Very Small	Long (More than 6 years)	Minor	Slight adverse	begrow planform of low flow channel Add varied bed and back morphology subable for the channel gradient and type Ensure subable hirs and grade of subAttra for channel condition.	-0.5	Negligible	Long (More than 6 years)	Negligible	Neutral
147_1 Large natural channel	us	Low	Overall- Good Water, flows and levels-Good Physical condition- Good	High Impact realignment	-	. 191.47	0.010 -	N	io 12 year low flow channel	Change in flow in 147_1 under the bridge	None	Good to Moderate (one charge down status)	-0.5	Very Small (length of channel realignment)	Long (More than 6 years)	Minor	Neutral	There is a second secon	-0.5	Very Small (length of channel realignment)	Long (More than 6 years)	Minor	Neutral
147_1 .		-	Overall- Good Water, flows and Ievels-Good Physical condition- Good	2 SUDS outfail				. N	80	Very small charge in flow Very small loss of natural bed and bank due to headwall	Nore	Good to Moderate (one charge down status)	-0.5	Negligible	Long (More than 6 years)	Neglighte	Neutral	Orect each social desentment to minimar impacts to flow patterns. And in such as a second of the sec	-0.5	Negligible	Long (More than 6 years)	Negligible	Nextral
147_1 2x Ardh Culvert	07.5 - Mainlie	ne High	Overall-Good Water, flows and levels-Good Physical condition-Good	2x Box culverts	-		- Upst	ized N	to Upsized crossing	Loss of natural bed and banks through extension of culvert Loss of existing bed material from culvert more uniform form and change in flow patterns and sediment supply borreated leasth of flow changed position	Upsking will increase downstream discharge to natural levels	Good to Moderate (one change down status)	0.5-1.5	Very Small	Long (More than 6 years)	Minor	Slight Adverse due to loss of natural bed and banks and downstream changes in sediment movement	Fingle with embartment out well back from the channel OF Arch culture at the models hard Ensure a bar flow channel (designed for a 12 year flow) Add sutualize grade of both materials to new culturet Ensure Scour good domainteam of culturet to dispatse energy forean our comman document are customer.	-0.5	Negligible	Long (More than 6 years)	Negligible	Neutral
147_1 -		-	Overall- Good Water, flows and Invels-Good Physical condition- Good	4 Drain outfalls	-			N	No None	Very small change in flow Very small loss of natural bed and bank due to headwall	Nore	Good to Moderate (one charge down status)	-0.5	Negligtle	Long (More than 6 years)	Negligble	Neutral	Given each headed discussions to encircles logication for particulars. Accel grangeling the accellants the theorem in the accel and accel and accel and accel Accel including of accels and accels accelerations of acceleration of acceleration Accel particulary of the acceleration of acceleration of acceleration of acceleration of the Direct acceleration of the acceleration back acceleration of the Acceleration of the acceleration of the acceleration back acceleration of the Acceleration of the acceleration of the acceleration back acceleration of the acceleratio	-0.5	Negligisle	Long (More than 6 years)	Negligible	Neutral

Annex 11.4.6

Geomorphological Channel Design



Background

11.4.6.1 This note is intended to provide a summary of geomorphological information on the characteristics of different River Types found in the UK. This information is intended to provide guidance to the engineering team to aid in the design of sustainable channel realignments, with suitable morphology for the river setting.

Fluvial concepts theory

- 11.4.6.2 The established conceptual model of river system operation suggests that their key driving variables are the inputs of water and sediment. These independents interact with boundary characteristics (slope/ topography, bed and bank materials, and riparian vegetation) to generate the channel form (e.g. Knighton, 1998; Sear & Newson, 2010). As a consequence of these interactions a variety of channel forms (geometric characters) exist. These are described across a number of planes of adjustment, within which there are a number of representative parameters. Knighton (1998) classifies these broadly as:
 - Cross-sectional form (size and shape parameters, e.g. width, depth, area etc.);
 - Bed configuration (e.g. sand or gravel beds);
 - Channel pattern (form of channel as viewed from above, e.g. straight, meandering or braided; descriptive parameters include sinuosity, meander arc length etc.);
 - Channel bed slope (i.e. gradient, which is related to channel pattern).
- 11.4.6.3 The adjustment of these channel geometry parameters and that of the shorter-term variations of flow geometry, are interdependent; therefore a change in one parameter may manifest a response in others such that a river channel can perform its function, i.e. the transference of energy and matter, ideally in dynamic equilibrium (if conditions permit). Variations result in complex patterns of form, flow, and materials across both space and time.
- 11.4.6.4 This conceptual basis is important, as it establishes that channel design has to take into consideration the complexities of the river environment, and that by understanding these principles, more effective channels may be designed to work with nature.

Planform type

11.4.6.5 Mean valley slope and design bankfull discharge can be used to determine the most likely/ desirable channel planform type (Figure 11.4.6.1 and Table 11.4.6.1).





Figure 11.4.6.1 Longitudinal, cross sectional and plan views of major stream types (Rosgen, 1994)

Table 11.4.6.1 Channel characteristics based on Rosgen, 1994.

Characteristics	Type Aa+	Туре А	Туре В	Туре С
General	Very steep, deeply entrenched, debris transport streams	Steep, entrenched, step- pool streams, high energy	Moderately entrenched, moderate gradient, riffle dominated channel with infrequent pools, stable planform and long profile	Low gradient, meandering, point bar, riffle/pool, alluvial channel with broad floodplain
Entrenchment ratio (width of flood prone area/bankfull channel width)	<1.4	<1.4	1.4-2.2	>2.2
Width/depth ratio	<12	<12	>12	>12
Sinuosity	1.0-1.1	1.0-1.2	>1.2	>1.4
Slope (m/m)	>0.1	0.04-0.1	0.02-0.039	<0.02
Slope (%)	>10	4-10	2-3.9	<2
Meander width ratio (beltwidth /bankfull width)	N/A	1-3	2-8	4-20

Bed morphology

11.4.6.6 Channel bed slope is a major driver of channel bed form (Rosgen, 1994); hence bed slope, planform and bed morphology are highly interrelated in natural channels. In order to best account for this association, mean channel bed slope and proposed planform information can be used in association with the literature (Figure 11.4.6.2 and Table 11.4.6.2) to suggest appropriate channel bed morphology.





Figure 11.4.6.2 Slope distribution for different channel reaches (Montgomery and Buffington, 1997)

Geology		Slope	Sinuosity	Туре		
Bedrock	Any		Any	Bedrock, Cascade		
Not Bedrock	>0.1		Any	Cascade		
	>0.03	≤0.1	Any	Step-pool, Plane Bed		
	>0.005	≤0.03	≤1.1	Step-pool, Plane Bed		
			>1.1	Plane-riffle, Braided, Wandering		
	>0.001	≤0.005	Any	Plane-riffle, Braided, Wandering		
	>0.0005	≤0.001	≤0.001 ≤1.4 Plane-riffle, Braid Wandering			
			>1.4	Actively Meandering		
	>0.0001	≤0.0005	Any	Actively Meandering		
	≤0.0001		Any	Low Gradient Passive Meandering		

Characteristics of Cascade morphology

11.4.6.7 The channel should typically have the characteristics outlined below and in Figures 11.4.6.3, 11.4.6.4 and 11.4.6.5 (Montgomery and Buffington, 1997):



- Tumbling flow around large clasts
- Steep slopes (over 0.1 m/m)
- Confined channel by valley sides
- Low sinuosity
- Lack of in channel storage
- Bed dominated by large particle size
- Supply limited channels



Figure 11.4.6.3. Example cascade (Montgomery and Buffington, 1997)



Figure 11.4.6.4. Example cascade planform (Montgomery and Buffington, 1997)





Figure 11.4.6.5. Example cascade long profile (Montgomery and Buffington, 1997)

Characteristics of Step-Pool bed morphology

- 11.4.6.8 These channel types form on steep slopes, with energy dissipation through tumbling flow over and around large clasts (cobbles and boulders) (Figure 11.4.6.6). Bed material is a mix of stable coarse casts, and finer material that gets trapped around the coarse material, and mobilised during flood flows (Montgomery and Buffington, 1997). These systems have a high transport capacity relative to sediment supply and will rapidly supply sediment downstream in the event that is available (i.e. supply limited system).
- 11.4.6.9The channel should typically have the characteristics outlined below and in Figures 11.4.6.7,
11.4.6.8 and 11.4.6.9 (Knighton, 1998, and Montgomery and Buffington, 1997):
 - Pools and alternating bands of channel-spanning flow obstructions typically occur at a spacing of every 1–4 channel widths;
 - Typical gradients of 0.03–0.1 m/m
 - Low sinuosity
 - Fast water at steps/falls and chutes, slow water at pools.
 - Step spacing increasing with decreasing channel bed slope, with L=0.31s^{-1.19} where s=mean slope m/m and L=Step wavelength parallel to mean slope
 - Step height is controlled by the largest particle, and pool scour (with approximately 1/3 of the mean step height due to pool scour)
 - Pool width approximately 20% greater than steps (Thomas *et al*, 2000)
 - Boulders, interlocked with each other and the bed, and arranged in a broad v-shape, with the apex of the weir pointing upstream to prevent bank erosion





Figure 11.4.6.6. Example of a step pool channel (Montgomery and Buffington, 1997)



Figure 11.4.6.7 Example long profile of step –pool channel (based on Montgomery and Buffington, 1997)





Figure 11.4.6.8 Example planform for a step –pool channel (based on Montgomery and Buffington, 1997)



Figure 11.4.6.9 Example cross sections for a step- pool channel

11.4.6.10 Longitudinal spacing of step and pool sections is important for stability and function of the channel. Step crest wavelength (L) (Figure 11.4.6.10) can be calculated by L=0.31s^{-1.19} where (s=mean slope m/m). The shape and size of the transition between each step and pool also needs to be carefully considered.







Characteristics of Plane bed

- 11.4.6.11 The channel should typically have the characteristics outlined below and in Figures 11.4.6.11, 11.4.6.12 and 11.4.6.13 (Montgomery and Buffington, 1997):
 - Large values of relative roughness (90th percentile grain size to bankfull flow depth)
 - Lack of discreet bars and bed forms
 - Straight channels
 - Moderate to high slopes
 - Dominated by cobble and gravel bed



Figure 11.4.6.11. Example of a plane bed channel (Montgomery and Buffington, 1997)





Figure 11.4.6.12. Example of a plane bed channel planfrom (Montgomery and Buffington, 1997)



Figure 11.4.6.13. Example of a plane bed channel long profile (Montgomery and Buffington, 1997)

Characteristics of Plane-Riffle bed morphology

- 11.4.6.12 Plane riffle bed channels have characteristics that fall between pool-riffle and plane bed types (SEPA, 2011). Typically, this will include deposition on the inside of bends forming small point bars and poorly defined shallow pools on the outside of bends. These will then be separated by both riffles and plane bed extents, at inflexion locations between the bends (Figures 11.4.6.14, 11.4.6.15 and 11.4.6.16). More detailed characteristics of pools and riffles are outlined in Table 3; however it should be noted that this information originates form research on pool-riffle channels, not plane- riffle channels, and therefore should only be used with this in mind. Other characteristics will fit with the proposed Type A planform, of width/depth ratios less than 12 and sinuosity between 1 and 1.2 (Table 11.4.6.1).
- 11.4.6.13 Plane riffle bed morphology will require a collection of cross sections. Bends will need greater cross sectional asymmetry (Figure 11.4.6.16) to create small pools on the outside of bends and bars on the inside; with wider, shallower straighter sections, to form riffles and plane bed units.
- 11.4.6.14 Shields (1996) recommends:
 - Outer banks of bends should have slopes of 1V [V= vertical]: 2H [H= horizontal] or steeper to cause convergence of high flows;
 - Inner banks, where point bars may develop should have bank slopes of 1V: 3H or less;
 - Inflexion points are shallower and more symmetrical in shape.





Figure 11.4.6.14 Example long profile of a plane – riffle channel (SEPA, 2011)



Figure 11.4.6.15 Example planform of a plane – riffle channel



Figure 11.4.6.16 Example cross sections for plane- riffle channels



Table 11.4.6.3 Recommendations for the reinstatement of pools and riffles, focussing on key geomorphic attributes (Thorne et al., 2010; Brookes & Sear, 1996)

Feature	Characteristic	Recommendation
Pool	Size	 Occupy over 50% of the river length 25% narrower than associated riffles At least 0.3 m below the mean bed elevation Maximum scour depths typically don't exceed 4 times the depth in the approach channel upstream
	Shape	 Asymmetrical cross sections Shallow progressively downstream to the next riffle, with the deepest point within the upstream half of the pool's length
	Location	Located at bends in the meander planform (around and downstream of a bend apex)
	Sedimentology	 Bed composed of loose and un-compacted mixed gravels (and coarser), overlain by fines during low flows
Riffle	Size	 Collectively occupy 30-40% of river length 0.3 to 0.5m above mean bed level 25% wider than associated pools
	Shape	Near symmetrical cross sectionsVariable planform geometries
	Location	 Locally steep, shallow section of the channel profile Slopes typically 0.005 to 0.200 m/m At cross over points in the meander planform
	Longitudinal riffle spacing	 3 to 10 times the bankfull channel width between riffle crests (1 wavelength), but more typically 5 to 7 widths apart. Although some variability in spacing would be natural Shorter spacing where bed slopes are higher In straight reaches they are found in alternate channel side locations
	Sedimentology	 Coarse armour, overlying mixed gravel substrate. This may be created by flow winnowing away some fines Avoid uniform size gradations and over-large substrate Size gravels according to that in similar undisturbed reaches, or within the floodplain or palaeochannels High proportion of angular gravels to permit particle interlocking. But avoid excessive imbrication as this limits their ecological benefits Ideally locally derived substrate
	Riffle stability	 In the absence of coarse sediment supply from upstream material should be static under all flows or replaced periodically

11.4.6.15 The location and sequencing of these cross sections is important to achieving the required planform and long-profile morphology. In planform there is a need for the asymmetrical bend cross sections to alternate between the right and left bank side of the channel, with the deeper section always on the outer bank side (OB), and the shallower bank on the inner bank (IB) (Figure 11.4.6.17). These bend sections then join the straight sections via a transitional section, that flairs smoothly between the two which have differing side slope angles (Figure 11.4.6.17). The spacing of the morphological units (cross sections) is also important to create a suitable long profile



(Figure 11.4.6.14). The straighter sections (riffles/ planes) should be located at inflexion locations between bends (pools).



Figure 11.4.6.17 Example locations of plane - riffle cross sections



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