

M60/M62/M66 Simister Island Interchange

TR010064

ENVIRONMENTAL STATEMENT APPENDICES

APPENDIX 13.3 HYDROMORPHOLOGY BASELINE REPORT

APFP Regulation 5(2)(a)

Planning Act 2008

Infrastructure Planning (Applications: Prescribed
Forms and Procedure) Regulations 2009

Infrastructure Planning

Planning Act 2008

**The Infrastructure Planning
(Applications: Prescribed Forms and
Procedure) Regulations 2009**

**M60/M62/M66 Simister Island Interchange
Development Consent Order 202[]**

**ENVIRONMENTAL STATEMENT APPENDICES
APPENDIX 13.3 HYDROMORPHOLOGY BASELINE REPORT**

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Appendix 13.3. Hydromorphology baseline report

1 Introduction

- 1.1.1 As required under the Design Manual for Roads and Bridges (DMRB) LA 113 Road Drainage and the Water Environment (Highways England, 2020) a hydromorphological assessment has been carried out for the M60/M62/M66 Simister Island Interchange (the 'Scheme').
- 1.1.2 This report details the findings of the hydromorphological survey, which aims to provide an outline of the baseline characteristics of watercourses identified within the study area (defined as a 500m buffer from the Order Limits).
- 1.1.3 Characteristics include fluvial features, including planform, cross-section, flow behaviour, depositional features, areas of erosion and accretion, and any pressures. The findings of this report have informed Chapter 13: Road Drainage and the Water Environment of the Environmental Statement (TR010064/APP/6.1).

2 Methodology and scope

2.1 Desk study

2.1.1 The desk study has been carried out to identify contemporary and historical catchment characteristics and historical changes along each watercourse within the study area.

2.1.2 Key data sources included:

- Flood Estimation Handbook (FEH) (UK Centre for Ecology and Hydrology (UKCEH), 2022)
- Ordnance Survey (OS) mapping (2023) and aerial imagery (2023)
- Multi-Agency Geographic Information for the Countryside (MAGIC) Map (Department for Environment, Food and Rural Affairs (Defra, 2022)
- Historical mapping (National Library of Scotland, 2022).

2.1.3 Where accessibility issues inhibited surveyors from evaluating every scoped in watercourse in the field, a desk study acted as surrogate. Therefore, potential gaps in the assessment remain for each of the surveyed watercourses and assumptions were sought based on thorough analysis of aerial imagery and historical maps. Watercourses solely assessed via desk study are:

- Western Tributary of Parr Brook
- Tributary of Parr Brook 2
- Hollins Brook
- Brightley Brook
- Whittle Brook
- Unnamed Watercourse 1
- Tributary of River Irk 2
- Heaton Park Reservoir.

2.2 Site walkover

2.2.1 Within the study area, and where accessible, hydromorphological reconnaissance surveys sought to characterise the nature of each watercourse, investigating:

- Overall hydromorphology (cross-sectional character, planform, flow behaviour)
- Hydromorphological forms and processes (erosion and deposition)
- Sediment sources

- Artificial barriers and features
- Key habitats
- Vegetation character.

2.2.2 Chapter 4 of this report provides a detailed overview of survey findings, whilst displaying appropriately supportive photographic evidence. Furthermore, a summary table provides a general overview of channel hydromorphology.

2.2.3 Two hydromorphological reconnaissance surveys took place in September 2021 and January 2022. The watercourses surveyed were:

- Blackfish
- Castle Brook
- Castle Brook Tributary
- Parr Brook
- Tributary of Castle Brook Tributary
- Tributary of River Irk 1.

3 Contemporary channel characteristics

3.1 Introduction

3.1.1 This section describes each watercourse within the study area (see Figure 13.1: Surface Water Receptors of the Environmental Statement Figures (TR01064/APP.6.2) for locations), including catchment characteristics, channel form, riparian characteristics, modifications and pressures, and a short summary of findings.

3.2 Parr Brook

Catchment characteristics

3.2.1 Parr Brook has its source at Heywood Road (National Grid Reference (NGR): SD 8258 0545) and flows generally north to the River Roch (NGR: SD 8074 0780) for 4.5km. The watercourse is largely culverted from south of the M60 (NGR: SD 8251 0564) to Cunningham Drive, Unsworth (NGR: SD 8154 0633). Open reaches are either enveloped by pastoral agriculture and residential properties, thus historically and currently impacted by urbanised and agricultural practices. This has fragmented longitudinal continuity and, in places, lateral connectivity to any historical flood plains. Parr Brook drains a catchment area of approximately 0.59km².

3.2.2 Carboniferous mudstone, siltstone and sandstone, Triassic sandstone and Permian mudstone make up catchment bedrock geology. Superficial geology predominately comprises Quaternary till, glaciofluvial deposits, head (clay, silt and gravel) and hummocky glacial deposits.

Channel form

3.2.3 Parr Brook has a largely artificially straight planform surrounded by grazed pastures. The channel cross-section is symmetrical but poaching immediately upstream of a culvert inlet is causing localised channel over-widening.

3.2.4 Both banks are predominately steep and poached, comprising of soil where grasses have taken root along both bank faces. Bank heights, estimated as 1.5m (left bank) and 1m (right bank), potentially provide some lateral connectivity with its floodplain, but embankments formed of dredging does impede some connectivity.

3.2.5 Water width and depth estimations come to 0.1m and 0.2m, respectively. Estimations of Bankfull width (3.0m) and depth (1.3m) are based on bank heights.

3.2.6 Bed substrate largely comprises silt and vegetation, with the latter made up of both macrophytes and encroaching terrestrial grasses. The presence of vegetation dictates flow paths and variation. Flow types are largely featureless changing to unbroken standing waves and rippled flow where vegetation constricts flow.

Riparian zone

- 3.2.7 Riparian vegetation comprises short grasses and scrub. A dense deciduous tree line makes up some of the vegetated riparian zone at the upstream end of the open channel and downstream of Heywood Road. At the inlet of the M60 culvert, an individual tree sits on the right bank.

Modifications and pressures

- 3.2.8 Parr Brook is heavily modified. A culvert allows Parr Brook to flow beneath the M60 and a residential estate for approximately 1.5km. Also, an additional culvert, the alignment and length of which is unclear, allows Parr Brook to flow beneath Heywood Road and potentially underneath Parrenthorn High School. The diameter of the road culvert is not described in this report due to accessibility issues.
- 3.2.9 The main pressure on the upstream section of the watercourse is poaching from livestock. Maps then indicate several weirs through Bury Golf Club and at Lamb Lodge Reservoir, approximately 100m upstream of Parr Brook's confluence with the River Roch.

Summary

- 3.2.10 A summary of the principal hydromorphological features observed on site is shown in Table 3.1.

Table 3.1 Baseline description of hydromorphological quality elements – Parr Brook

Quality Elements	Description
Quantity and dynamics of water flow	A perennial watercourse comprising unbroken standing waves and both rippled and featureless flows. Some imperceptible flow is present where vegetation has impounded flow.
Connection to groundwater bodies	None observed.
River continuity	Some lateral connectivity upstream of the M60, albeit partial as dredging from the channel have been used to form informal embankments. Culverting fragments longitudinal connectivity.
River depth and width variation	Left bank height: 1.5m Right bank height: 1m Water width: 0.2m Bankfull width: 3m Water depth: 0.1m Bankfull depth: 1.3m Overwide where livestock has poached the banks.

Quality Elements	Description
Structure and substrate of the river bed	The bed substrate comprises silt and vegetation.
Structure of the riparian zone	The riparian zone comprises deciduous trees, grasses and scrub.
Photos	
 <p data-bbox="165 853 699 913">Downstream view from left bank towards culvert inlet.</p>	 <p data-bbox="809 853 1366 913">Upstream view from left bank. Evidence of poaching.</p>
 <p data-bbox="165 1406 748 1467">Channel conditions immediately upstream of the M60 culvert inlet (circled red)</p>	

3.3 Western Tributary of Parr Brook

Catchment characteristics

- 3.3.1 The Western Tributary of Parr Brook flows for approximately 0.6km from Tamar Close (NGR: SD 8143 0565) to its confluence with Parr Brook at Parr Brook Close (NGR: SD 8151 0620). The catchment area for the Western Tributary of Parr Brook is approximately 1.8km², where residential properties largely make up catchment land use.
- 3.3.2 The underlying bedrock of the catchment comprises Carboniferous mudstone, siltstone and sandstone. Superficial geology is predominately made up of Quaternary till and some peat.

Channel form

3.3.3 Only 90m of the Western Tributary of Parr Brook is open channel, which is likely to have been artificially straightened. No bed features are visible on aerial imagery. Residential properties surround the channel and likely disconnect lateral connectivity with any historical floodplain.

Riparian zone

3.3.4 Where open, the riparian zone of the Western Tributary of Parr Brook comprises a dense yet narrow band of deciduous trees along both banks. Grasses make up the remainder of the vegetated riparian zone.

Modifications and pressures

3.3.5 The Western Tributary of Parr Brook Western Tributary is culverted for approximately 0.5km. Where the open channel sits within the valley, residential properties restrict its vegetated riparian zone.

Summary

3.3.6 A summary of the principal hydromorphological features of Western Tributary of Parr Brook is shown in Table 3.2.

Table 3.2 Baseline description of hydromorphological quality elements – Western Tributary of Parr Brook

Quality Elements	Description
Quantity and dynamics of water flow	It was not possible to establish flow types from the desk study.
Connection to groundwater bodies	None observed.
River continuity	It was not possible to establish river continuity from the desk study.
River depth and width variation	It was not possible to establish channel dimensions from the desk study.
Structure and substrate of the river bed	It was not possible to establish the structure and substrate of the river bed from the desk study.
Structure of the riparian zone	The riparian zone consists of deciduous trees, which could aid bank stability.

3.4 Tributary of Parr Brook 2

Catchment characteristics

- 3.4.1 The Tributary of Parr Brook 2 is entirely culverted, from source – Rothay Close (NGR: SD 8222 0581) - to confluence. Flowing typically south-west to a confluence with Parr Brook (NGR: SD 8222 0562) for 0.2km beneath residential properties. The catchment of the Tributary of Parr Brook 2 is too small to be determined from FEH data.
- 3.4.2 Bedrock geology comprises Carboniferous mudstone, siltstone and sandstone, whilst Quaternary till and a small area of peat makes up superficial geology.

Channel form

- 3.4.3 The whole of Tributary of Parr Brook 2 is culverted and not accessible. As such, a desk study of contemporary characteristics is not possible.

Riparian zone

- 3.4.4 Tributary of Parr Brook 2 is culverted; therefore, has no riparian zone.

Modifications and pressures

- 3.4.5 The culvert is the main modification and pressure to Tributary of Parr Brook 2.

Summary

- 3.4.6 As the Tributary of Parr Brook 2 is entirely culverted, no hydromorphological features would be present.

3.5 Blackfish

Catchment characteristics

- 3.5.1 The Blackfish has its source in an agricultural field north of Heaton Park (NGR: SD 8325 0536) from where it flows south-east for approximately 1.8km to its confluence with the River Irk (NGR: SD 8400 0428). The catchment area is approximately 1.1km² and is predominately covered in woodland, whilst the source of the watercourse is enveloped by agricultural fields.
- 3.5.2 Underlying catchment bedrock comprises Triassic sandstone, whilst the superficial geology is predominately made up of Quaternary head (clay, silt and gravel) and hummocky glacial deposits.

Channel form

- 3.5.3 Blackfish exhibits two distinct reaches separated by a public footpath and the boundary wall of Heaton Park. Upstream of Heaton Park, Blackfish is artificially straight and has a largely silted channel which has been modified to drain surface flows from the surrounding agricultural fields. As such, erosion and depositional features were absent, whilst flows are largely indiscernible due to the deep layer of silt along the channel bed. Towards the culvert into Heaton Park, silt reduces in quantity, and sand replaces it. At this point, flow becomes discernible exhibiting rippled flow types.

- 3.5.4 Downstream of the boundary wall to Heaton Park, Blackfish develops into a definable channel with visible flow. Here, like that of the upstream reach, channel planform is constricted by valley walls. However, flow has carved out a gently sinuous channel.
- 3.5.5 Channel dimensions, downstream of the boundary wall, are approximately 1m (water width) and 0.1m (water depth) respectively. Bankfull width estimations suggest the channel can reach 3m (wide) further expanding to 5m where the valley opens up. Accessibility issues prevent successful estimations of bankfull depth and bank height, due to the steep valley walls.
- 3.5.6 Bed substrate material along Blackfish, downstream of the boundary wall, comprises mainly coarse gravels with occasional smaller-sized cobbles. However, a continuously thin layer of silt sits atop the bed substrate material. This is likely due to a lack of understorey vegetation combined with the availability of silt from upstream. Furthermore, leaf litter is present along the bed and influences flow dynamics through impoundment. Where the channel is free of leaf litter, flow types vary between rippled flow and unbroken standing waves.
- 3.5.7 Blackfish exhibits little in natural processes, as erosion and depositional features are absent along the banks. Instead, sporadic clasts of very coarse gravel and cobble break the surface water along the channel. These are likely source locally and have not been transported from upstream.

Riparian zone

- 3.5.8 The riparian zone of the Blackfish comprises deciduous trees along both banks. The width of the tree line differs upstream and downstream of the boundary wall to Heaton Park. Upstream, agricultural fields restricts riparian vegetation, whilst downstream the tree line makes up part of the woodland in Heaton Park.

Modifications and pressures





- 3.5.9 Blackfish is culverted under Bridle Road and Middleton Road and at various locations through Heaton Park. The watercourse also flows through three online ponds in Heaton Park.

Summary

- 3.5.10 A summary of the principal hydromorphological features observed on site is shown in Table 3.3.

Table 3.3 Baseline description of hydromorphological quality elements – Blackfish

Quality Elements	Description
Quantity and dynamics of water flow	Overall, a perennial watercourse. Flow was present towards the culvert accessing Heaton Park but largely encroached upon by the quantity of silt along the bed. Downstream, in Heaton Park, flow is visible comprising rippled flows and broken standing waves. Vegetation matter impounds some flow along the channel.

Quality Elements	Description
Connection to groundwater bodies	None observed.
River continuity	The channel has no floodplain. Ponds and the culvert into Heaton Park fragment longitudinal connectivity.
River depth and width variation	Water width: 1m Bankfull width: 5m Water depth: 0.1m
Structure and substrate of the river bed	The bed substrate comprises silt, sand and cobbles. The quantity of silt is greater upstream of Heaton Park but remains as a superficial layer a top the other bed material in Heaton Park.
Structure of the riparian zone	The riparian zone comprises deciduous trees, which could aid bank stability.
Photos	
 <p data-bbox="165 1294 785 1361">View from right bank to left bank. Dry channel at source of watercourse.</p>	 <p data-bbox="813 1294 1426 1361">View from right bank to left bank. Sand substrate.</p>
 <p data-bbox="165 1693 785 1760">Upstream view from right bank of Bridle Road Culvert.</p>	 <p data-bbox="813 1693 1426 1760">Downstream view from right bank showing bed substrate.</p>

3.6 Brightley Brook

Catchment characteristics

- 3.6.1 Brightley Brook has its source at Pilsworth Road (NGR: SD 8407 0928), from where it flows south-west, for approximately 2km, to a confluence with Hollins Brook (NGR: SD 8238 0824). Land use across its approximate catchment area of 3.3km² comprises scrubland and grazed pastures.
- 3.6.2 Catchment geology comprises Carboniferous mudstone, siltstone and sandstone making up bedrock conditions. Superficial geology is made up of Quaternary till and head (clay, silt, sand and gravel) deposits.

Channel form

- 3.6.3 Brightley Brook has a gently sinuous planform, where much of the channel is indiscernible due to the presence of vegetation. Where visible, the watercourse is largely absent of formalised depositional features. Some toe material suggests erosion does occur but the presence of vegetation along the bank face indicates this is intermittent.

Riparian zone

- 3.6.4 The riparian zone of Brightley Brook comprises largely of a dense deciduous tree line. Where the tree line is absent, grasses make up the remainder of the vegetated riparian zone.

Modifications and pressures

- 3.6.5 Brightley Brook has been extensively modified with culverts, weirs, outfalls, sluices and offline ponds. Also, the channel has been realigned around the ponds through bypass channels.

Summary

- 3.6.6 A summary of the principal hydromorphological features of Brightley Brook is shown in Table 3.4.

Table 3.4 Baseline description of hydromorphological quality elements – Brightley Brook

Quality Elements	Description
Quantity and dynamics of water flow	It was not possible to establish flow types from the desk study.
Connection to groundwater bodies	None observed.
River continuity	It was not possible to establish river continuity from the desk study.
River depth and width variation	It was not possible to establish channel dimensions from the desk study.

Structure and substrate of the river bed	It was not possible to establish the structure and substrate of the river bed from the desk study.
Structure of the riparian zone	The riparian zone consists of deciduous trees and open sections of short. The trees could aid bank stability.

3.7 Whittle Brook

Catchment characteristics

- 3.7.1 Whittle Brook has its source at Collop Gate Farm (NGR: SD 8609 1812), from where it initially flows south-west for approximately 1km. Then, the watercourse flows north-west for approximately 2.5km to a confluence with Hollins Brook (NGR: SD 8238 0824). Land use across its approximate 9.4km² catchment area is scrubland and pasture.
- 3.7.2 The bedrock geology beneath the catchment comprises Carboniferous mudstone, siltstone and sandstone, whilst Quaternary till and head (clay, silt, sand and gravel) deposits make up the superficial geology.

Channel form

- 3.7.3 Whittle Brook has a meandering planform comprising irregular channel bends indicative of a dynamic watercourse. Bed substrate material is indiscernible on aerial imagery; however, the channel displays an array of fluvial processes. Bank erosion is extensive and accompanied by toe material, whilst side bars and berms are also present.

Riparian zone

- 3.7.4 The vegetated riparian zone largely comprises grasses and scrub. A deciduous tree line of varying width and density also lines some of the channel; however, it is not continuous where open spaces comprise of grass and scrub.

Modifications and pressures

- 3.7.5 Whittle Brook is culverted at the road crossing (Castle Road) but is otherwise free of modifications. Agricultural practices restrict the vegetated riparian zone.

Summary

- 3.7.6 A summary of the principal hydromorphological features of Whittle Brook is shown in Table 3.5.

Table 3.5 Baseline description of hydromorphological quality elements – Whittle Brook

Quality Elements	Description
Quantity and dynamics of water flow	It was not possible to establish flow types from the desk study.

Quality Elements	Description
Connection to groundwater bodies	None observed.
River continuity	It was not possible to establish river continuity from the desk study.
River depth and width variation	It was not possible to establish channel dimensions from the desk study.
Structure and substrate of the river bed	It was not possible to establish the structure and substrate of the river bed from the desk study.
Structure of the riparian zone	The riparian zone consists of deciduous trees and shrubs and open sections of short. The trees could aid bank stability.

3.8 Hollins Brook

Catchment characteristics

- 3.8.1 Hollins Brook has its source at a confluence between Brightley Brook and Whittle Brook (NGR: SD 8238 0824), from where it flows west for approximately 2.1km to a confluence with the River Roch (NGR: SD 8085 0835). Land use across its approximate catchment area of 1.5km² largely comprises scrubland and industrial properties.
- 3.8.2 The bedrock geology comprises Carboniferous mudstone, siltstone and sandstone whilst the superficial geology is Quaternary head (clay, silt, sand and gravel).

Channel form

- 3.8.3 Hollins Brook has a meandering planform with irregular bends, likely due to the extent and quantity of modifications exacerbating channel instability. Bed substrate material is indiscernible in aerial imagery; however, the watercourse exhibits evidence of extensive bank erosion, with toe material present along both banks. Side bars and mid-channel bars are also visible along the channel, albeit in a reduced quantity relative to the extent of bank erosion.

Riparian zone

- 3.8.4 The riparian zone of Hollins Brook predominately comprises deciduous tree line along both banks, with varying width and density. In the absence of trees, along gaps in the tree line, grasses and scrub make up the vegetated riparian zone.

Modifications and pressures

- 3.8.5 Hollins Brook has been extensively modified with culverts, weirs, outfalls and offline ponds.

Summary

- 3.8.6 A summary of the principal hydromorphological features of Hollins Brook is shown in Table 3.6.

Table 3.6 Baseline description of hydromorphological quality elements – Hollins Brook

Quality Elements	Description
Quantity and dynamics of water flow	It was not possible to establish flow types from the desk study.
Connection to groundwater bodies	None observed.
River continuity	It was not possible to establish river continuity from the desk study.
River depth and width variation	It was not possible to establish channel dimensions from the desk study.
Structure and substrate of the river bed	It was not possible to establish the structure and substrate of the river bed from the desk study.
Structure of the riparian zone	The riparian zone consists of deciduous trees and open sections of short. The trees could aid bank stability.

3.9 Castle Brook

Catchment characteristics

- 3.9.1 Castle Brook has its source at Unsworth Moss Farm (NGR: SD 8338 0690), from where it initially flows south-west for approximately 0.5km before flowing north-west for approximately 1.5km towards a confluence with Whittle Brook (NGR: SD 8261 0800). The predominate land use across its approximate catchment area of 2.5km² is pasture, whilst recreational land in the form of Pike Fold golf course also occupies the catchment.
- 3.9.2 The bedrock geology comprises Carboniferous mudstone, siltstone and sandstone. Superficial geology is made up of Quaternary till, head (clay, silt, sand and gravel) deposits and hummocky glacial deposits.

Channel form

- 3.9.3 Castle Brook through Pike Fold golf course has an artificially straight planform and modified cross-section. The channel is largely enveloped within Pike Fold Golf Course, whilst pastoral agricultural land lines both banks, north of the golf course. Water width and depth are approximately 1m and 0.1m respectively. Estimations of the bankfull dimensions come to 6m (wide) and 1.6m (deep).

- 3.9.4 Both banks are largely steep and heavily vegetated, suggesting a stable channel with little evidence of erosion. Some bank failure is present, however sporadic. Poaching of bank material provides a source of fine sediment along the channel.
- 3.9.5 Bed substrate material largely comprises silt along the upstream lengths of the watercourse, which provides an opportunity for channel margin and bank face vegetation to colonise much of the channel bed. Downstream, towards the agricultural fields, gravels are visible but remain coated in a fine layer of silt due to the vegetative monoculture typical of golf courses. Despite the increased presence of gravels, relative to the upstream end of the watercourse, depositional features remain absent and any coarse sediment protruding from the water's surface remain sporadic, likely sourced locally. Flow conditions along the channel reflect the largely silted and featureless nature of the bed (i.e., largely uniform and featureless). Where vegetation chokes the channel, along the upstream end of the watercourse, flow becomes imperceptible.

Riparian zone

- 3.9.6 The vegetated riparian zone along both banks comprises grass and individual deciduous trees. Maintenance of the golf course and agricultural fields restrict much of the riparian vegetation, where grass is largely mown up to the bank top. This lends to the presence of silt along the channel.

Modifications and pressures



- 3.9.7 Castle Brook is culverted in several places through the golf course for footpath and track crossings. Each culvert is made up of either concrete or plastic, but all have a piped cross-section. Localised channel widening, upstream and downstream of the culvert, result from the culverts themselves. Along the agricultural field a footbridge spans the channel. Abutments are set back and the bridge itself has little-to-no influence on channel processes.

Summary

- 3.9.8 A summary of the principal hydromorphological of Castle Brook is shown in Table 3.7.

Table 3.7 Baseline description of hydromorphological quality elements – Castle Brook

Quality Elements	Description
Quantity and dynamics of water flow	Perennial watercourse with largely featureless flows. Some rippled flows and unbroken standing waves present along the gravel bed.
Connection to groundwater bodies	None observed.
River continuity	Modified cross-section disconnects the channel from its floodplain. The numerous access culverts fragments longitudinal continuity.

Quality Elements	Description
River depth and width variation	Water width: 1m. Water depth: 0.1m. Bankfull width: 6m. Bankfull depth: 1.6m.
Structure and substrate of the river bed	Largely comprising silt and encroaching vegetation along the upstream end of the watercourse. Gravels and sand present further downstream but adjacent land management contributes to a superficial layer of silt atop such material.
Structure of the riparian zone	The riparian zone comprises tall grasses and herbs and isolated deciduous trees
Photos	
	
Upstream view from left bank.	Downstream view from left bank towards culvert inlet.

3.10 Castle Brook Tributary

Catchment characteristics

- 3.10.1 Castle Brook Tributary has its source to the south of Pike Fold Gold Club (NGR: SD 8269 0641), from where it flows north-east for approximately 0.4km to its confluence with Castle Brook (NGR: SD 8288 0667). Pastures and recreational land (Pike Fold Golf Course) make up land use across the catchment, which has an approximate area of 0.6km².
- 3.10.2 The catchment is underlain by bedrock comprising of Carboniferous mudstone, siltstone and sandstone. Superficial geology comprises Quaternary peat.

Channel form

- 3.10.3 During the site visit, Castle Brook Tributary is artificially straight and largely used as a drainage channel. Along the left bank, the golf course makes up land use, whilst grazed pastures lines the right bank. Water width and depth is 1m and 0.1m respectively. Estimations of bankfull conditions are 1.2m (wide) and 0.5m (deep).

- 3.10.4 The modified nature results in reprofiled banks and a trapezoidal cross-section. In places along both banks, poaching of bank material provides the channel with a supply of fine sediment. Estimations of bank height found that both banks are 0.5m tall.
- 3.10.5 Bed substrate material comprises silt, whilst channel margin and riparian vegetation colonises some of the bed. An absence of depositional features and depositional features result from the modified and potential artificial nature of the channel. Consequently, flow was uniform and featureless, whilst vegetation choking the channel causing locally imperceptible flows.

Riparian zone

- 3.10.6 The riparian zone on both banks of Castle Brook Tributary comprises tall grasses and individual deciduous trees. Riparian vegetation is largely restricted by adjacent land use.

Modifications and pressures


- 3.10.7 Adjacent to the left bank top, offline ponds provide the channel with additional flow and fine sediment during specific flow periods. The ponds are dammed therefore flow draining into the watercourse only occurs following periods of heavy rain.

Summary

- 3.10.8 A summary of the principal hydromorphological features observed on site is shown in Table 3.8.

Table 3.8 Baseline description of hydromorphological quality elements – Castle Brook Tributary

Quality Elements	Description
Quantity and dynamics of water flow	Perennial channel that is fed by the online ponds. Drainage channel therefore flows are largely featureless or imperceptible.
Connection to groundwater bodies	None observed.
River continuity	Lateral and longitudinal connectivity is present throughout the channel.
River depth and width variation	Left bank height: 0.5m Right bank height: 0.5m Water width: 1m Bankfull width: 1.2m Water depth: 0.1m
Structure and substrate of the river bed	The bed substrate comprises silt.

Quality Elements	Description
Structure of the riparian zone	The riparian zone comprises tall grasses and herbs, and deciduous trees. Restricted and in places absent due to local land management practices.
Photos	
	
Upstream view from left bank. Channel to left, pond to right.	

3.11 Tributary of Castle Brook Tributary

Catchment characteristics

- 3.11.1 The Tributary of Castle Brook Tributary has its source at Lower Droughts Farm (NGR: SD 8344 0628). From its source, the watercourse flows north-west for approximately 0.7km towards a confluence with Castle Brook Tributary (NGR: SD 8287 0661). Grazed pastures make up land use across the catchment, which has an area of 0.9km².
- 3.11.2 Bedrock geology of the catchment comprises Carboniferous mudstone, siltstone and sandstone, whilst the superficial geology is Quaternary till and peat.

Channel form

- 3.11.3 Tributary of Castle Brook Tributary is drainage channel with an artificially straight planform. Grazed pastures make up land use along both bank tops. Water width and depth are 1m and 0.1m, respectively, whilst estimations of bankfull dimensions highlight a 1.2m wide and 0.5m deep channel.
- 3.11.4 Both banks measure 0.5m in height and are reprofiled, resulting in a trapezoidal channel. Both banks are heavily vegetated, with vegetation encroaching upon the channel and choking it.

3.11.5 The bed substrate comprises silt, whilst vegetation also makes up much of the channel bed. Depositional features and depositional features are absent and this, combined with the choked channel, result in predominately featureless and imperceptible flows. However, rippled flows are present immediately upstream of the confluence with Castle Brook Tributary, likely due to a sudden change in gradient.

Riparian zone

3.11.6 The riparian zone of the Tributary of Castle Brook Tributary largely comprises grasses and individual deciduous trees on both banks. Agricultural fields along both bank tops restrict the vegetated riparian zone, as livestock graze upon it.

Modifications and pressures



3.11.7 The Tributary of Castle Brook Tributary is modified by the addition of culverts for the M62 and Egypt Lane crossings. The main pressure to the watercourse comes from the land use and surface water runoff from the M62. Maintenance of the channel and restriction of the vegetation riparian zones has opened up large unshaded lengths. This results in the overgrown nature of the channel.

Summary

3.11.8 A summary of the principal hydromorphological features observed on site is shown in Table 3.9.

Table 3.9 Baseline description of hydromorphological quality elements – Tributary of Castle Brook Tributary

Quality Elements	Description
Quantity and dynamics of water flow	Perennial watercourse with largely imperceptible and featureless flow types. Rippled flow visible immediately upstream of the confluence with Castle Brook tributary.
Connection to groundwater bodies	None observed.
River continuity	Modified cross-section likely disconnecting the watercourse from its floodplain. Culverting fragments some of the longitudinal connectivity.
River depth and width variation	Left bank height: 0.5m Right bank height: 0.5m Water width: 1m Bankfull width: 1.2m Water depth: 0.1m
Structure and substrate of the river bed	The bed substrate comprises silt.

Quality Elements	Description
Structure of the riparian zone	The riparian zone comprises tall grasses and herbs, and deciduous trees. Heavily restricted by agricultural practices.
Photos	
 <p data-bbox="165 846 791 981">View upstream from left bank of Castle Brook Tributary showing discharge of the Tributary Castle Brook Tributary (green arrow) into Castle Brook Tributary (blue arrow).</p>	 <p data-bbox="817 958 1430 1025">View from left bank to right bank of vegetated channel.</p>

3.12 Unnamed Watercourse 1

Catchment characteristics

- 3.12.1 Unnamed Watercourse 1 has its source at Mellalieu Farm (NGR: SD 8396 0603), from where it flows south for approximately 0.3km to a confluence with Tributary of River Irk 1 (NGR: SD 8402 0576). Catchment land use is made up of pastures. Due to the channel being largely a drainage channel, FEH fails to recognise a catchment area.
- 3.12.2 The bedrock geology comprises Carboniferous mudstone, siltstone and sandstone whilst the superficial geology is Quaternary head (clay, silt, sand and gravel)

Channel form

- 3.12.3 Unnamed Watercourse 1 has an artificially straight planform. Aerial imagery does not identify any depositional features, but the channel bed appears vegetated and therefore natural processes are likely to be minimal.

Riparian zone

- 3.12.4 Intense agricultural practices largely restricts the vegetated riparian zone. Where present, riparian vegetation comprises a narrow band of grasses and individual trees that line both banks.

Modifications and pressures

- 3.12.5 A culvert crossing drains surface waters into the developed channel at the upstream end of the watercourse. Furthermore, intense agriculture acts as the main pressure on Unnamed Watercourse 1.

Summary

- 3.12.6 A summary of the principal hydromorphological features observed on site is shown in Table 3.10.

Table 3.10 Baseline description of hydromorphological quality elements – Unnamed Watercourse 1

Quality Elements	Description
Quantity and dynamics of water flow	It was not possible to establish flow types from the desk study.
Connection to groundwater bodies	None observed.
River continuity	It was not possible to establish river continuity from the desk study.
River depth and width variation	It was not possible to establish channel dimensions from the desk study.
Structure and substrate of the river bed	It was not possible to establish the structure and substrate of the river bed from the desk study.
Structure of the riparian zone	The riparian zone consists of deciduous trees, which could aid bank stability.

3.13 Tributary of River Irk 1

Catchment characteristics

- 3.13.1 The Tributary of River Irk 1 has its source at Parkwood Cottages (NGR: SD 8364 0555). It flows north-east from approximately 0.5km, before flowing south-east for approximately 1.3km towards the River Irk (NGR: SD 8404 4473). The catchment has an approximate area of 0.8km², which largely comprises agricultural land and residential properties.
- 3.13.2 Bedrock geology comprises Carboniferous mudstone, siltstone and sandstone, whilst the superficial geology is Quaternary head (clay, silt, sand and gravel) and hummocky glacial deposits.

Channel form

- 3.13.3 Tributary of River Irk 1 has a largely artificially straight planform with some lengths of gentle sinuosity. A floodplain is visible downstream of an access track culvert, but it remains patchy. Land use along both banks comprises agricultural land, whilst a narrow woodland also lines both banks. Water width and depth are 0.3m and 0.1m, respectively, whilst bankfull estimations indicate a 3m wide and 0.5m deep channel.
- 3.13.4 The bed substrate comprises silt, clay and gravels. Coarser material, likely washed-out bank reinforcement, lines both channel margins. Flow types are largely featureless but interjected by rippled flows and unbroken standing waves. The variation in flow type was likely a result of the varying width of the channel influenced by the presence of large woody debris and washed-out bank reinforcement.

Riparian zone

- 3.13.5 The riparian zone of Tributary of River Irk 1 consists of short grass, scrub and deciduous trees on both banks.

Modifications and pressures



- 3.13.6 Mapping identifies weirs and culverts on Tributary of River Irk 1, whilst a reservoir and overflow drain in from the left bank of the watercourse.

Summary

- 3.13.7 A summary of the principal hydromorphological features observed on site is shown in Table 3.11.

Table 3.11 Baseline description of hydromorphological quality elements – Tributary of River Irk 1

Quality Elements	Description
Quantity and dynamics of water flow	Perennial watercourse with unbroken standing waves and well as both rippled and featureless surface waters.
Connection to groundwater bodies	None observed.
River continuity	Upstream of the access track, no floodplain is present. Downstream, a two-stage channel comprises of a floodplain along both banks. The access track culvert fragments longitudinal continuity.
River depth and width variation	Left bank height: 1m Right bank height: 1m Water width: 0.3m Bankfull width: 3m Water depth: 0.1m

Quality Elements	Description
Structure and substrate of the river bed	The bed substrate comprises silt and cobbles.
Structure of the riparian zone	The riparian zone comprises short grasses, scrub and deciduous trees. The trees could aid bank stability.
Photos	
 <p data-bbox="165 1021 703 1120">Downstream view from crossing showing floodplain connectivity within two-stage channel.</p>	 <p data-bbox="807 1021 1422 1084">Upstream view from crossing showing bed substrate and washed-out bank reinforcement.</p>

3.14 Tributary of River Irk 2

Catchment characteristics

- 3.14.1 Tributary of River Irk 2 has its source adjacent to the M60 (NGR: SD 8305 9010). It flows south-east for 0.6km, parallel to the M60, to the north-west end of Old Hall Lane (NGR: SD 8404 2767), from there it is culverted to River Irk. its catchment is too small to determine from the FEH data. The dominant land use is a golf course and highway infrastructure.
- 3.14.2 The bedrock geology consists of Triassic sandstone whilst the superficial geology is Quaternary hummocky glacial deposits.

Channel form

- 3.14.3 The Tributary of River Irk 2 has an artificially straight planform and appears largely vegetated with grasses. No depositional features are visible along the channel, which shows little to no evidence of significant natural processes.

Riparian zone

- 3.14.4 The riparian zone of Tributary of River Irk 2 comprises dense deciduous trees on both banks.

Modifications and pressures

- 3.14.5 The Tributary of the River Irk 2 is heavily modified with pressures arising from the M60 and culverting of its lower reach.

Summary

- 3.14.6 A summary of the principal hydromorphological features of the Tributary of River Irk 2 is shown in Table 3.12.

Table 3.12 Baseline description of hydromorphological quality elements – Tributary of River Irk 2

Quality Elements	Description
Quantity and dynamics of water flow	It was not possible to establish flow types from the desk study.
Connection to groundwater bodies	None observed.
River continuity	It was not possible to establish river continuity from the desk study.
River depth and width variation	It was not possible to establish channel dimensions from the desk study.
Structure and substrate of the river bed	It was not possible to establish the structure and substrate of the river bed from the desk study.
Structure of the riparian zone	The riparian zone consists of deciduous trees, which could aid bank stability.

3.15 Heaton Park Reservoir

- 3.15.1 Heaton Park reservoir is located to the south-west of Simister Island. It has a surface area of 0.3km² and is embanked on all sides. The reservoir is strategically significant for Manchester's water supply and is supplied with potable water from the Lake District via the Thirlmere and Haweswater aqueducts.
- 3.15.2 Vegetation at the edge of the reservoir consists of mown grass. Due to the artificial nature of the reservoir, which acts as a body or largely still water, hydromorphological processes are absent.

3.16 Ponds and other surface water bodies

- 3.16.1 There are numerous ponds within the Order Limits. See Figure 8.8.2: Great Crested Newt Habitat Suitability Index Assessment Results in Appendix 8.8: Great Crested Newt Survey Report of the Environmental Statement Appendices (TR010064/APP/6.3) for their locations.

- 3.16.2 To the north-west of Simister Island, there are four ponds (Pond 34, 37, 73 and 74). To the north-west, there is one pond close to Simister Island (Pond 38) and one pond adjacent to Castle Brook Tributary (Pond 9). During an ecology site visit, Ponds 34, 37, 38 and 73 were seen to be dry and absent of hydromorphological processes.

4 Historical channel characteristics

4.1 Introduction

4.1.1 This section outlines a review of historical changes for each of the watercourses.

4.2 Parr Brook

4.2.1 The position of the upstream section of Parr Brook remains unchanged; however, it has developed some sinuosity. It is assumed that the culverting of Parr Brook occurred in the early 1970s during the construction of the M60 motorway as part of the urbanisation of the area.

4.2.2 The culverted reach of Parr Brook was first recorded on OS maps between 1892-1914. A straight channel also flowed north from Heyward Road, in the current position of Parr Brook typically flowed south-west along the current route of the M60 before turning north, where a junction between Albert Road and Albert Drive are now present. Sewage works at the downstream end of the historical channel have since been replaced by playing fields at the back of Cunningham Drive. The position of Parr Brook through the playing fields is as it was on the 1885-1900 mapping.

4.3 Western Tributary of Parr Brook

4.3.1 Between 1892-1914 the Western Tributary of Parr Brook can be seen as a straight drainage channel flowing from Thatch Leach Lane, along field boundaries to Parr Brook. Present day maps exhibited an almost entirely culverted channel, with exception to approximately 90m of open channel. Culverting likely took place in the early 1970s during the construction of the M60.

4.4 Tributary of Parr Brook 2

4.4.1 Tributary of Parr Brook 2 can be seen on OS maps drawn between 1892-1914. During this period, maps recorded a watercourse which flowed south-west from Corday Lane Farm, now under Simister Island to its confluence with Parr Brook. It is assumed that the watercourse was realigned as part of the urbanisation of the area.

4.5 Blackfish

4.5.1 The course of the watercourse and planform have not changed since the earliest available historical maps which date between 1888-1913.

4.6 Brightley Brook

4.6.1 There are several offline reservoirs on Brightley Brook, which the watercourse flows around via bypass channels between 1888-1913. The largest of these reservoirs can be seen on from 1885, with others being formed sometime after 1970. These reservoirs are likely associated with the Pilsworth Clough woollen mill and the Pilsworth Bleach works. Brightley Brook appears to have been straightened and there are several weirs, outfalls and sluices identified on mapping which pre-date available historical maps.

4.7 Whittle Brook

4.7.1 Several culverts on Whittle Brook, including a 160m long culvert which allows Whittle Brook to flow under Langley Lane and can be seen from maps dating back to 1885. There is a 65m long culvert under Heywood Old Road dating back to 1885. An additional culvert located south-west of Birch Services and allowing Whittle Brook to flow under the M62 was likely constructed as part of the motorway, which became operational in 1971. The planform of Whittle Brook, however, remains unchanged and pre-dates the earliest available historical maps.

4.8 Hollins Brook

4.8.1 Hollins Brook can be seen in its current position on the earliest available map from 1885-1900. As shown on the 1888-1913 map, bleach works were constructed adjacent to or over Hollins Brook. These activities suggest modifications to the channel, although no specific modifications are visible on aerial imagery. Another major modification to Hollins Brook was the culverting of approximately 190m of open channel to accommodate the M66 motorway, which became operational in 1978.

4.9 Castle Brook

4.9.1 Castle Brook's planform remains unchanged and pre-dates the earliest available historical maps (1885).

4.10 Castle Brook Tributary

4.10.1 The source of the watercourse was originally at Egypt Lane, approximately 100m south of its current location. The location of its source changed between 1949 and 1970, pre-dating the construction of the M60. There are offline ponds on the left (north) bank of Castle Brook Tributary, which were excavated between 1949 and 1970.

4.11 Tributary of Castle Brook Tributary

4.11.1 The Tributary of Castle Brook Tributary retains its planform, which pre-dates the earliest available historical map (1885). The only change to the watercourse is an 85m culvert under the M62, that would have been constructed in the early 1970s.

4.12 Tributary of River Irk 1

- 4.12.1 Tributary of River Irk 1 remains unchanged, which pre-dates the earliest available map (1885). A reservoir on the western bank of the watercourse close to Heaton Farm was first excavated in 1900. At the upstream end of Tributary of River Irk 1 there are offline ponds on the western bank. These do not appear on the latest historical maps dating back to 1970 but does appear on aerial photographs from 2000 suggesting they have been recently excavated.

4.13 Tributary of River Irk 2

- 4.13.1 Tributary of River Irk 2 flows parallel to the M60, north-west of Old Hall Lane. The watercourse can be first seen on the 1888-1913 map. Its planform remains unchanged from this time.

4.14 Unnamed Watercourse 1

- 4.14.1 Unnamed Watercourse 1 is a short channel flowing from south of Simister Lane to a confluence with Tributary of River Irk 1. The watercourse can be first seen on the 1888-1913 map. Its planform remains unchanged from this time.

4.15 Heaton Park Reservoir

- 4.15.1 Heaton Park Reservoir is located in Heaton Park to the south-west of M60 J18. It is an artificial waterbody owned by United Utilities which was constructed in 1928.

Acronyms and initialisms

Acronym or initialism	Term
DMRB	Design Manual for Roads and Bridges
FEH	Flood Estimation Handbook
MAGIC	Multi-Agency Geographic Information for the Countryside
NGR	National Grid Reference
OS	Ordnance Survey

Glossary

Term	Definition
Bed substrate	The material that rests at the bottom of a stream and along the channel margins.
Carboniferous	A geological time period that spans from approximately 358 to 298 million years ago
Discharge	The volume of flow passing a point in a given time period.
Flow dynamics	The manner in which flow behaves, i.e., turbulent flows, non-energetic and laminar flows
Hydromorphology	The scientific study of the form and function of rivers and the interaction between streams and the landscape around them
Permian	A geological time period which follows the Carboniferous era, with dates ranging from approximately 298 to 251 million years ago
Permo-triassic	A geological time period which spans two periods (Permian and Triassic), with dates ranging from approximately 298 to 201 million years ago
Planform	The birds-eye view of the channel and the form of the channel from that perspective.
Riparian zone	The corridor of land which runs along the banks of a river channel. If vegetated, it is known as the vegetated riparian zone.
Sediment transport dynamics	The manner in which sediment is eroded, transported and deposited along a watercourse.
Sinuosity	The degree in which a channel meanders, a sinuous channel generally has a sinuosity ratio between 0 and 1.5. Straight channels have a ratio of 0.

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