Doveside Wetland Design

Final Report

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The Garganey Trust

JBA Project Manager

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Revision History

Revision Ref / Date Issued	Amendments	Issued to
Draft v1		The Garganey Trust

Contract

This report describes work commissioned by Jeff Lunn, on behalf of the Garganey Trust, by an email dated 21-1-15. The Garganey Trust's representative for the contract was Jeff Lunn. Alex Jones of JBA Consulting carried out this work.

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Purpose

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1 Introduction

1.1 Introduction and Background

JBA Consulting has been commissioned by the Garganey Trust to develop a wetland design on an area of land between Doveside Road and River Dove, Darfield, South Yorkshire. The Doveside Project is a partnership between the Garganey Trust, Environment Agency Barnsley Council and the RSPB intending to restore river habitats and floodplain wetlands along the River Dove in the Wombwell area of Barnsley. The River Dove has been extensively altered in the past to accommodate agriculture and to protect people and property from flooding. This project aims to mitigate the impact of these past activities in order to establish a healthy river with thriving wildlife that is an attractive place for people to visit and enjoy.

1.2 Objectives for the scheme

The objectives of the scheme have been developed in partnership to ensure that a delivers a range of functions. This includes:

- Development of a fen, reed bed, and open water wetland system to include UKBAP priority habitats;
- Improvement of existing woodland areas for lesser whitethroat and willow tit species through selective thinning;
- Improving or maintaining existing flood mitigation and drainage functions of the site for surrounding receptors;
- Provision of observation places and access for site visitors to parts of the site and appropriate measures (including fencing) to limit access where not desirable for health and safety and conservation management reasons.

1.3 Report Structure

The report below has two main sections:

- Baseline and Site Constraints
    - This describes the site and goes on to identify a range of constraints which should be incorporated into the site
- Wetland Design
    - Presentation of an outline design and a description of its function.

2 Baseline and Site Constraints

This section provides a baseline for the site. This baseline information is supplemented by information contained in the Geo-Environmental Appraisal and the Flood Risk Assessment contained within Appendix 0 and C respectively. The section then establishes site constraints which will need to be accounted and mitigated for within the wetland design.

2.1 Land Use and Topography

The site forms a hollow dominated by two ponds at its centre. Surrounding them are areas of grassland and scrub woodland. The land immediately rises to the north as the edge of the floodplain is reached. It appears from the local topography, that the edge of the housing estate which forms the northern boundary was raised during its construction on a platform. The southern edge of the site is formed by a raised engineered bank beside the River Dove.

The natural general slope of the valley floor is from west to east; with the flow of the River Dove; however; the east edge of the site is also formed by higher ground. This is due to the floodplain in the east being raised by a historic landfill (see Appendix 0).

Parts of the northern half of the site contain extant ridge and furrow features in the microtopography.

2.2 Hydrology

Figure 2-1 presents the site's main hydrological features:

- The area is a depression and discharges via a culvert installed through the raised river banks to the Dove (see Figure 2-2).
- On the northern boundary are three surface water sewer discharge culvert discharge points (see Figure 2-3). These service the housing development to the north.
- A small drain enters the site from the west. This is a shallow drain, which appears to have been poorly maintained (see Figure 2-6).
- Three ponds are mapped on the site. The southern pond has filled in with fen vegetation, whilst the eastern and western ponds remain open (see Figure 2-4).
- A series of small drains connect the sewer outfalls and the ponds (see Figure 2-5).
- The water level in the pond and drains is controlled by a hump in the drain bed leading to the outfall culvert.

Figure 2-1: Site Hydrology

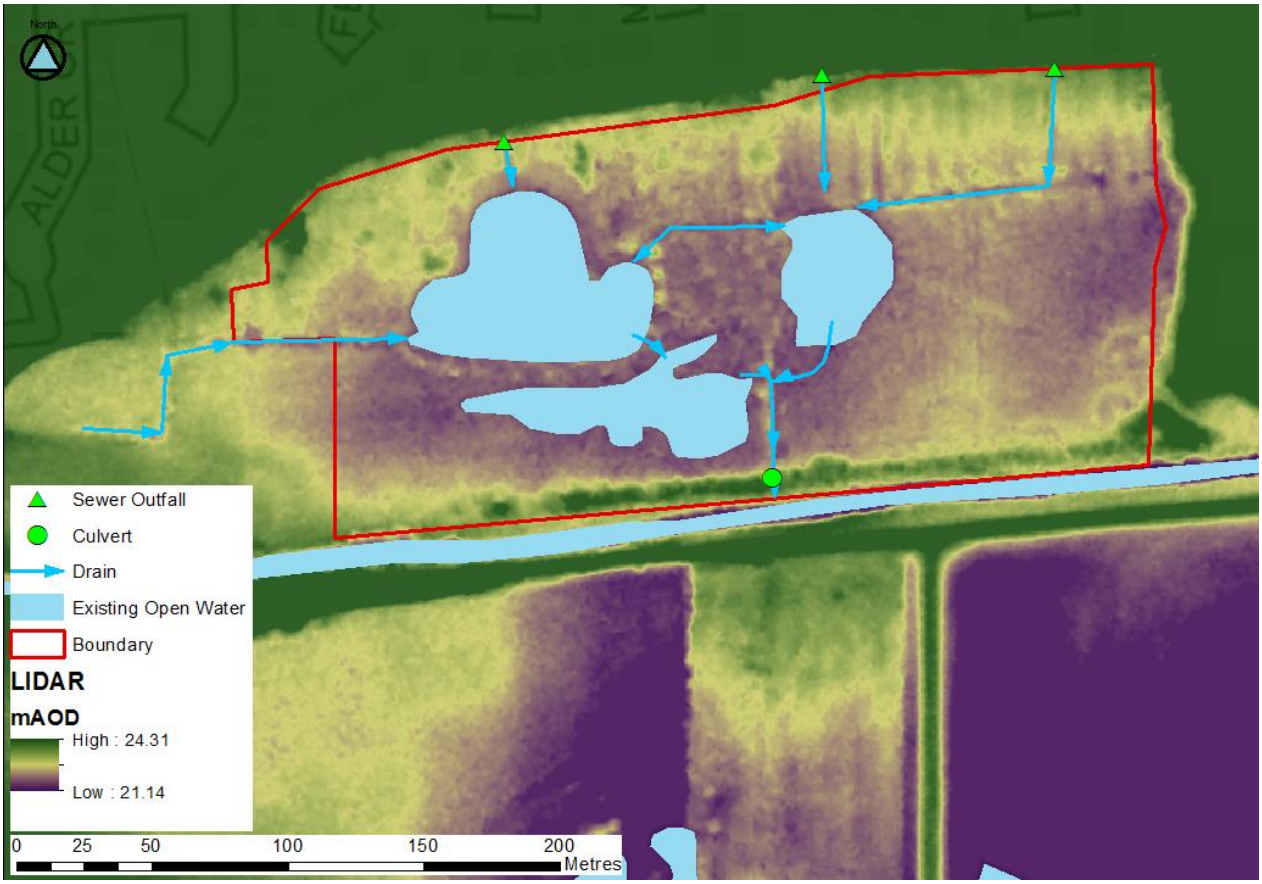


Figure 2-2: Drain discharge through culvert to River Dove

Figure 2-3: Eastern Sewer Outfall

Figure 2-4: Western Pond from the northern bank

Figure 2-5: Drain connecting East and West Ponds

Figure 2-6: Drain Entering the Site from the West

Figure 2-7: Humped Section of Outfall Drain

2.2.1 River Dove Model

In 2009, JBA modelled the River Dove using an ISIS-Tuflow model (JBA, 2016). Figure 2-8 presents the stage hydrograph for the Q2 event (the 2-year return period discharge event). Contained with the raised banks, for a significant proportion of the event the water level is above the floodplain (21.5 to 21.9mAOD).

Figure 2-9 presents the cross section from the river at a point close to the culvert outfall. It indicates that the base of the river is at 20.9mAOD.

The model is not suitable in understanding the stage at low flows. However, the information within Figure 2-8 and Figure 2-9 indicates that the river is likely to be regularly above the level of the floodplain in moderate flow conditions.

Figure 2-8: Stage Hydrograph for the Q2 event

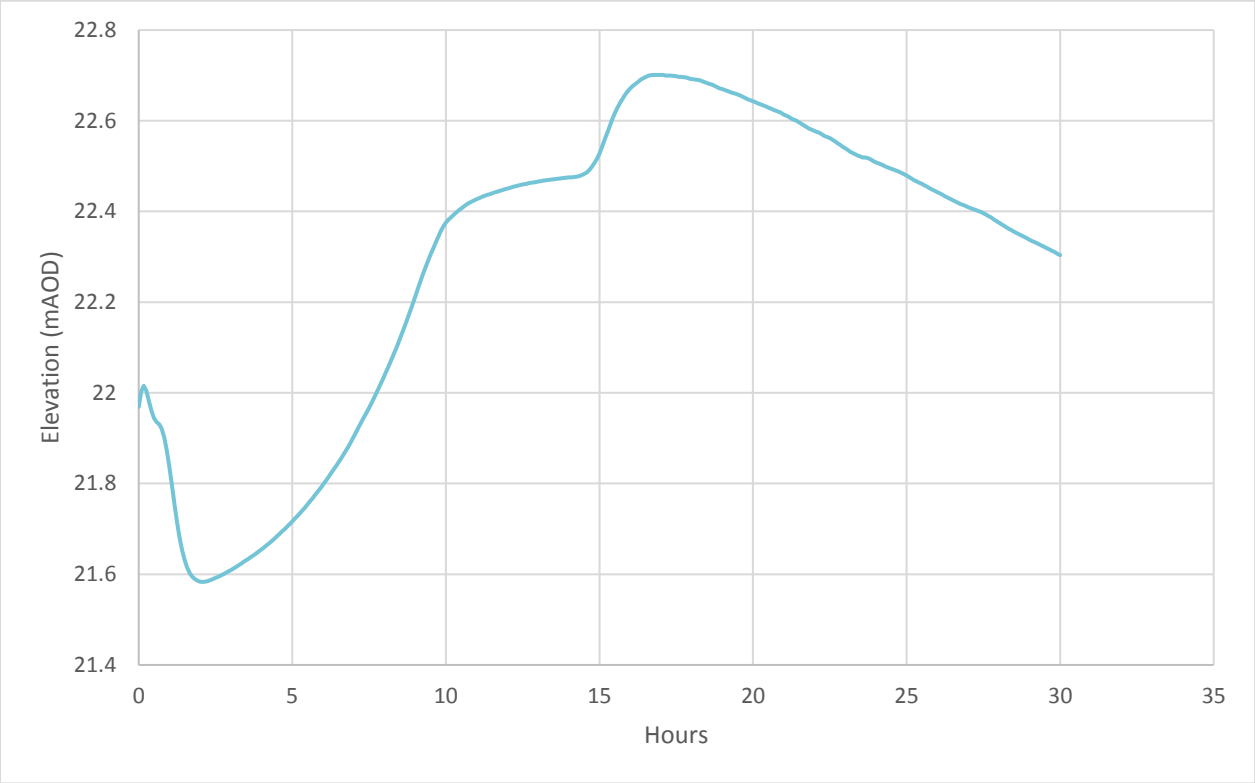
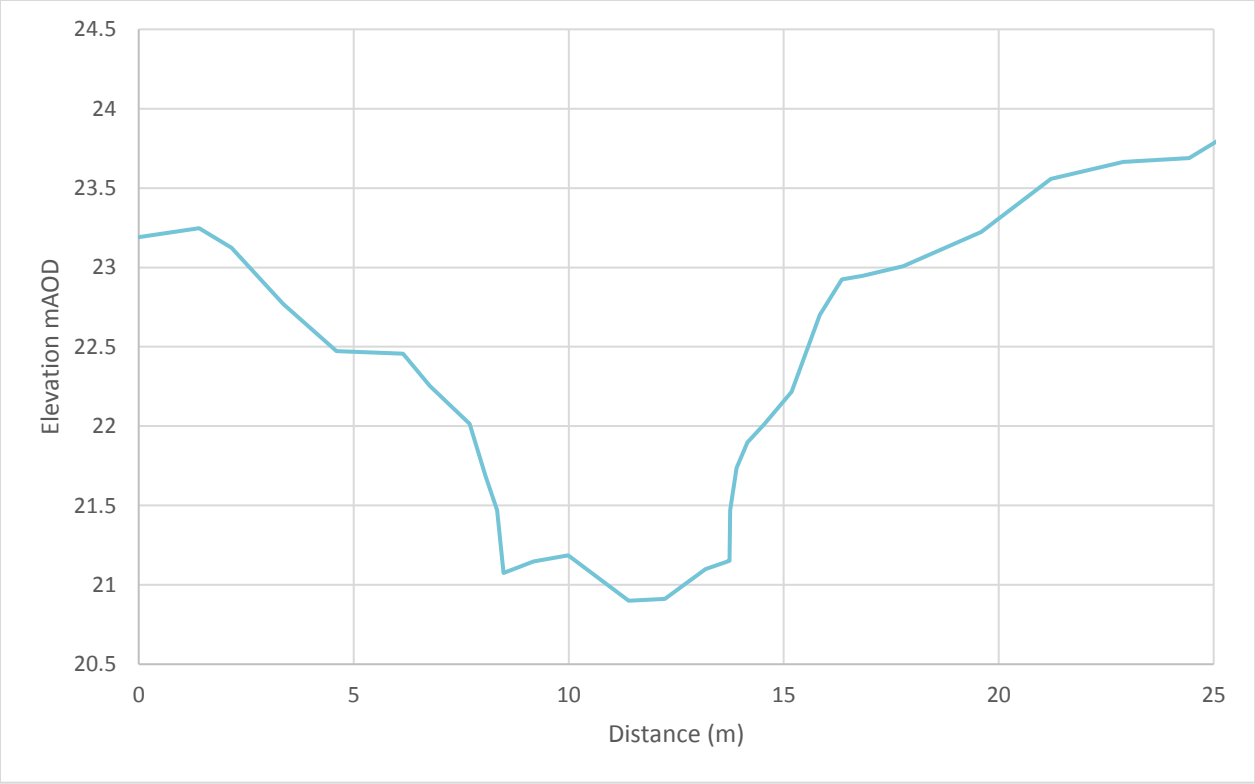


Figure 2-9: Model Cross Section (looking downstream)



2.2.2 Water Balance

A simple water balance has been produced for the site showing the difference between monthly average figures for rainfall and potential transpiration for the region containing the site obtained from the Agricultural Climate of England and Wales (MAFF, 1971) (see Table 2-1). The water balance uses rainfall input to the system and evaporative losses to determine the monthly and annual excess/deficit of water. This is a simple water balance and the following factors have not been taken into account:

- Lateral groundwater and surface water movement - surface run-off and shallow groundwater input from the higher ground to the south.
- Vertical groundwater movement - the site is located in the Dearne valley so vertical groundwater losses are likely to be relatively small (although potentially significant during drier periods).
- Flood events from the river - input from flood events overspilling onto the floodplain have not been accounted for in the water balance.
- The water balance does not represent losses from different land use types but represents average losses for the much larger agro-climatic region in which the site is located.

Table 2-1 Rainfall and potential transpiration data for the local agro-climatic are (MAFF, 1971)

	J	F	M	A	M	J	J	A	S	O	N	D	Annual Average
Rainfall (mm)	75	60	50	52	59	55	71	91	74	67	84	69	807
Potential Transpiration (mm)	1	8	28	52	79	88	85	70	41	19	3	0	474
Excess/Deficit (mm)	74	52	22	0	-20	-33	-14	21	33	48	81	69	333

The water balance shows that generally monthly rainfall received exceeds monthly evaporative losses, with the exceptions being April when inputs and outputs are balanced and May, June and July when there is a deficit of water (total 67mm). Surface water inputs from the surrounding area, including three surface water sewer outlets should provide significant inputs to the site. Overall, therefore, the water budget suggests that in typical years water supply should not be a constraint on an installed wetland.

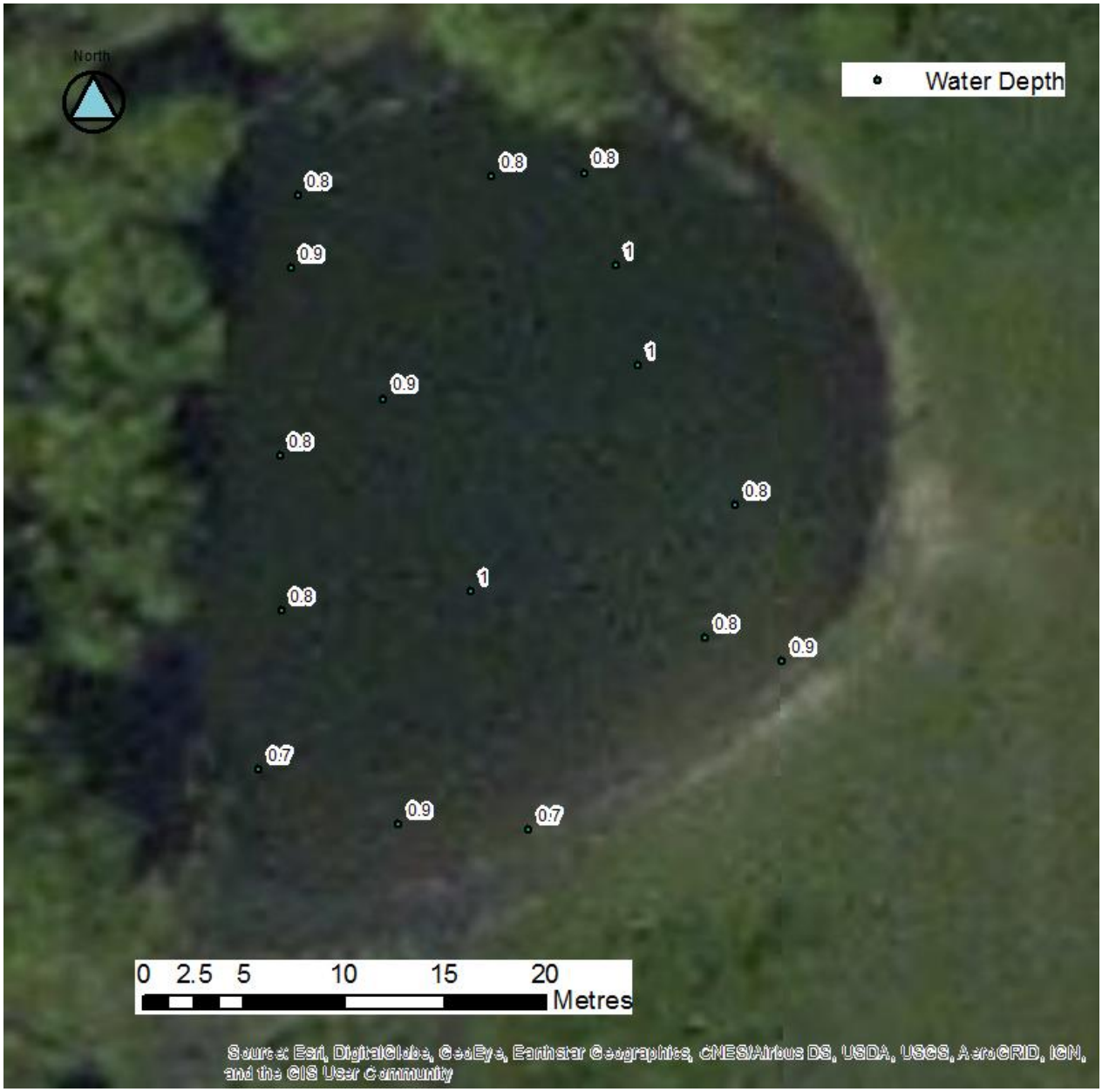
2.3 Bathymetry

A bathymetry survey, using a remote-controlled boat with a doppler depth finder, was conducted on 11/01/2017. The results of the survey are shown in Figure 2-10 and Figure 2-11 and show the following features:

- Away from the margins, the depth of the western pond ranged from 1.3 to 1.9m.
- It was not possible to survey the eastern part of the western pond due to gales experience on-site (a Met Office weather warning was in affect during the survey), however it is expected that the bed will be of a similar depth in the un-surveyed areas.
- The eastern pond is significantly shallower with the depth of water being between 0.8 to 1m away from the margins of the ponds.
- The elevation of the water surface on both ponds the day of the survey was 21.69mAOD.

Figure 2-10: Western Pond Bathymetry Survey

Figure 2-11: Eastern Pond Bathymetry Survey



2.4 Soil, Geology, and Contamination

The section below is a summary of the geological description given in Appendix 0. The geology beneath the site is summarised in Table 2-24.

Table 2-2 Site geology

Age	Group	Formation/Member	Description	Thickness
Recent		Made Ground		Unknown
Quaternary		Alluvium	Clay and silt	*~6-7.5 m
Carboniferous	Pennine Coal Measures Group	Pennine Middle Coal Measures Formation	Interbedded grey mudstone, siltstone, pale grey sandstone and commonly coal seams.	*up to 700m
Notes *BGS borehole logs available from BGS GeoIndex **BGS online Lexicon of named rock units				

The site is underlain by soils belonging to the Conway soil association which typically comprise deep stoneless fine silts and clayey soils variable affected by groundwater (Soil Survey of England and Wales, 1983).

The valleys of the Dearne and Dove are filled with alluvial deposits dominated by clay and silt, but will also contain sand and gravels. The majority of the site is underlain by such alluvial deposits, the exception of which is the north of the site on the steeper ground which is mapped as being free from superficial deposits.

A hand auger survey was conducted across the site (10 holes between 0.4-0.6m deep). It identified that the site was underlain by mottled gleyed silty clay. The exception to this was in the south-east corner of the site, where the OS mapping indicated that a pond had been present. This area was now a soft rush dominated waterlogged area. The upper 20cm of deposits were peaty clay deposited as the pond infilled. Beneath this the silty clay alluvium returned (see Appendix D).

The known area of landfill to the east of the site is mapped as made ground, though these made ground deposits are shown as extending within the site boundary and to the south of the site. The made ground mapped on site lies adjacent to the southern site boundary in the east of the site, extending up to 27m into the site, however the site survey has identified that this is restricted to the area of the raised embankments.

The site is underlain by the Carboniferous Pennine Middle Coal Measures Formation (PMCM) which consists of interbedded mudstone, siltstone, and sandstone There are a number of units within the PMCM that predominantly comprise sandstone, and though a number of these are mapped as outcropping in the vicinity of the site none immediately underlie the site.

2.4.1 Contamination

The geo-environmental appraisal in Appendix 0 identifies contaminated land risk associated with the site and wetland development. The main risk associated with the site is the historic landfill to the immediately to the east of the site. The embankment that forms the southern boundary was also installed at a similar time and therefore may be made of similar materials. The nature of those materials and the contaminants it contains is currently unknown. Therefore, in line with a precautionary approach, no scheme should raise water levels within the landfill as this could increase mobilisation of contaminants within it.

2.5 Service

No services cross the site (see Appendix D). As shown on Figure 2-1, there are three surface water sewer culvert discharge points to the site.

2.6 Site Constraints

Table 2-3 summaries the constraints to the wetland design identified during the baseline process.

Table 2-3: Site Constraints

Area	Constraints
Flood Risk	The flood risk assessment (see Appendix C) identify that the function of the sewer outfalls and the drain entering the site from the west should be maintained.
Services	No Services cross the site. Three surface water culverts discharge from housing development to the north. The function of these should not be impeded by the design.
Contamination	The contaminated risk assessment (see Appendix A), has identified a historic landfill on the eastern boundary of the site. The wetland design should not raise groundwater levels within the landfill, has this could have the potential to increase contaminant mobilisation
Archaeology	The LIDAR DTM and site walk-overs have identified historic ridge and furrow topography across the north of the site. No archaeological assessment has been undertaken so as a precaution, earthworks should avoid these areas

3 Wetland Design

3.1 Introduction

Based on the site constraints identified in Section 2.6 and the objectives for the scheme discussed in Section 1.2, a wetland design, aimed at creating a mixture of open water, reed bed and fen, has been developed.

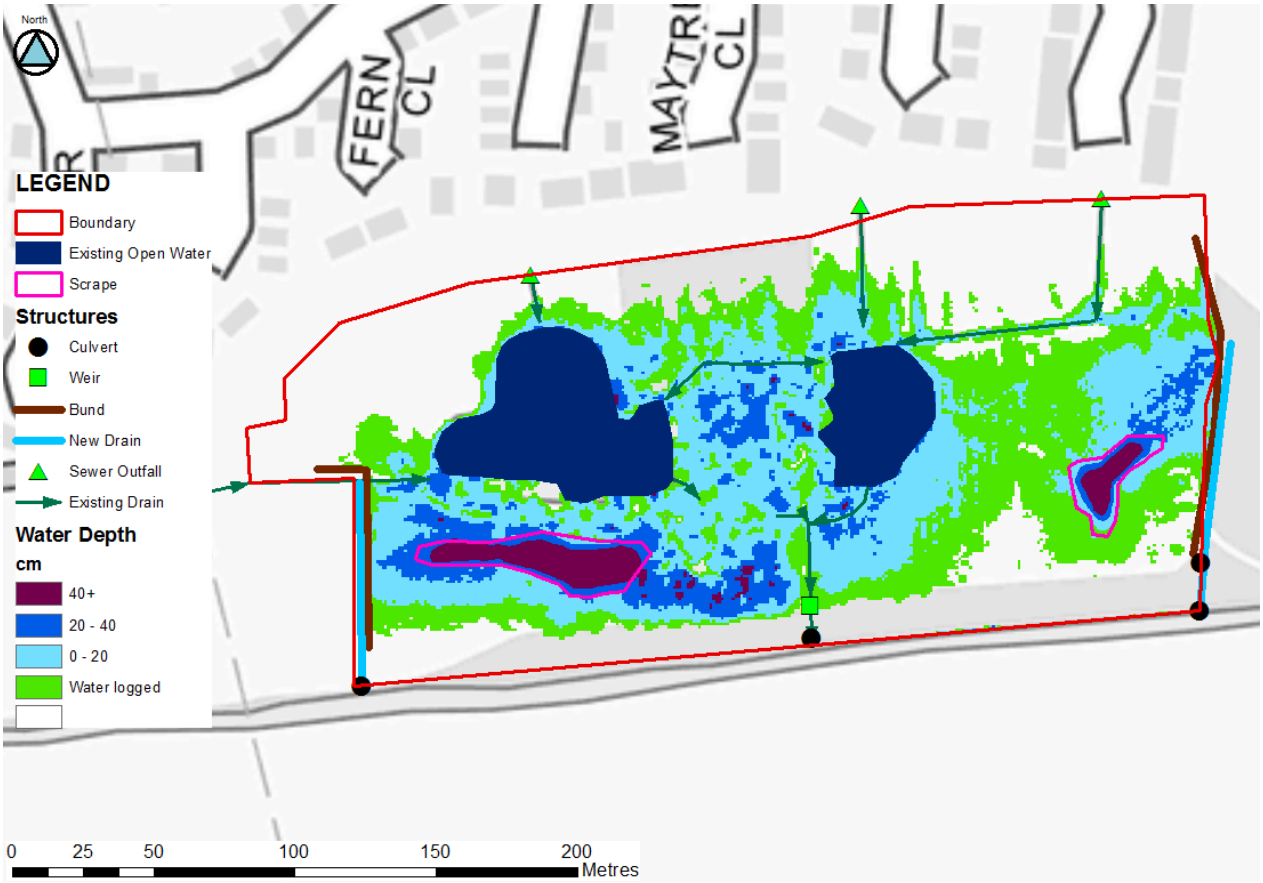
3.2 Design

Figure 3-1 presents the wetland design developed for the site. Map 1 and Map 2 in Appendix A presents more detailed versions of the figure. They show the following features:

1. Weir installed on the outfall drain set at 22mAOD:
    a. This has been set to allow water to shallowly inundate the floodplain with up to about 0.5m depth of water. The majority of the standing water created will be between 0 and 20cm deep.
    b. The weir will be of a dropboard construction. This will allow the water levels to be modified (not above 22mAOD) or allow the weir to be easily removed in future if required.
2. Two scrapes will be created. The locations of these have been set to increase the area of inundation and create areas of standing water which should persist for longer during drought conditions. As a result, these are relatively deep at around 30-50cm below the existing ground surface with a base at 21.4mAOD for the eastern scrape, 21.5mAOD for the western scrape.
3. The drain entering the west of the site will be diverted into a new drain which will run within the site boundary south and discharge via culvert to the river. This will be coupled with a bund to ensure that the land outside the site to the west will not be impacted by the raised water levels on site. This reconfiguration should improve the drainage of the land to the west as it will not be reliant on the difficult to assess and maintain drains on-site (see FRA in Appendix C). A flap will be installed within the new culvert to stop flow from the river flowing through them into the site.
4. A similar bund, drain and culvert configuration will be installed on the eastern edge of the site. This is mitigation to ensure that the scheme does not raise groundwater levels within the landfill and limit the potential to increase the mobilisation of any contaminants that might be present. A flap will be installed within the new culvert to stop flow from the river flowing through them into the site.
5. New drains will limit access to the site.

The annotation numbering in Map 2 relate to the numbering of the bullet points above.

Figure 3-1: Wetland Design



Note - water levels will be set at 22mAOD

3.3 Habitat Management

In addition to the physically installed elements of the design, there is a requirement for limited initial habitat management of the site. This will mainly focus on thinning the scrub in the north of the site for the benefit of bird species including lesser whitethroat and willow tit.

The wetland will require on-going management in the future. This may take the form of removing scrub within reedbed and fen areas to limit habitat succession.

3.4 Mitigation

Table 3-1 describes the mitigation measure incorporated within the design to address the site constraints identified in Table 2-3.

Table 3-1: Mitigation Measures within the Design

Area	Constraints	Mitigation Measures
Flood Risk	The flood risk assessment (see Appendix C) identify that the function of the sewer outfalls and the drain entering the site from the west should be maintained.	The weir set at 22mAOD is significantly below the inverts of the outfalls of the sewers. The drain to the west will be diverted into a new drain with increased capacity.
Services	No Services cross the site. Three surface water culverts discharge from housing development to the north. The function of these should not be impeded by the design.	
Contamination	The contaminated risk assessment (see Appendix A), has identified a historic landfill on the eastern boundary of the site. The wetland	A new drain and bund will ensure that water levels are not raised against the landfill

	design should not raise groundwater levels within the landfill, has this could have the potential to increase contaminant mobilisation	
Archaeology	The LIDAR DTM and site walk-overs have identified ridge and furrow topography across the north of the site. No archaeological assessment has been undertaken so as a precaution, earthworks should avoid these areas	The scrapes will be located away from areas of ridge and furrow topography.

3.5 Cut and Fill Calculations

Table 3-2 presents the outline cut and fill calculation developed for the scheme. The scrape volumes have been calculated based on ArcGIS analysis of the existing ground surface compared to post the excavation of the scrapes. The outline volumes of the bunds and drains were calculated based on length and an estimate of a typical cross sections area. The analysis indicates that 479m^3 of material will be excavated and potentially 72m^3 can be reused within the bunds. This means that there is 409m^3 of material to disposed of on site. The bathymetry analysis in Section 2.3, indicates that this material can be easily incorporated within the existing lakes and used to modify the profile of the banks to improve marginal habitats.

Table 3-2: Cut and Fill Calculations

Parameter	Value	Units
Scrape		
Scrape Area	1591	m^2
Scrape Average Depth below existing ground level	0.21	m
Volume	334	m^3
Drain		
Length	207	m
Depth	0.5	m
Cross sectional area	0.875	m^2
Volume	181	m^3
Bunds		
Length	192	m
Height	0.3	m
Cross sectional area	0.375	m^2
Volume	72	m^3
Totals		
Excavation Volume	515	m^3
Excess volume	443	m^3

The hand auger survey (see Section 0) indicated that part of the area of the western scrape was underlain by a thin layer of peaty clay. This material is unlikely to be suitable for bund creation. The silty clay alluvium identified beneath this layer and under the eastern scrape is more likely to be suitable may require geotechnical testing to confirm.

3.6 Future Implementation and CDM Regulations

This report provides outline design parameters for a range of structures. If these are taken forward towards detailed design and implementation, this work should follow the framework and fulfill the

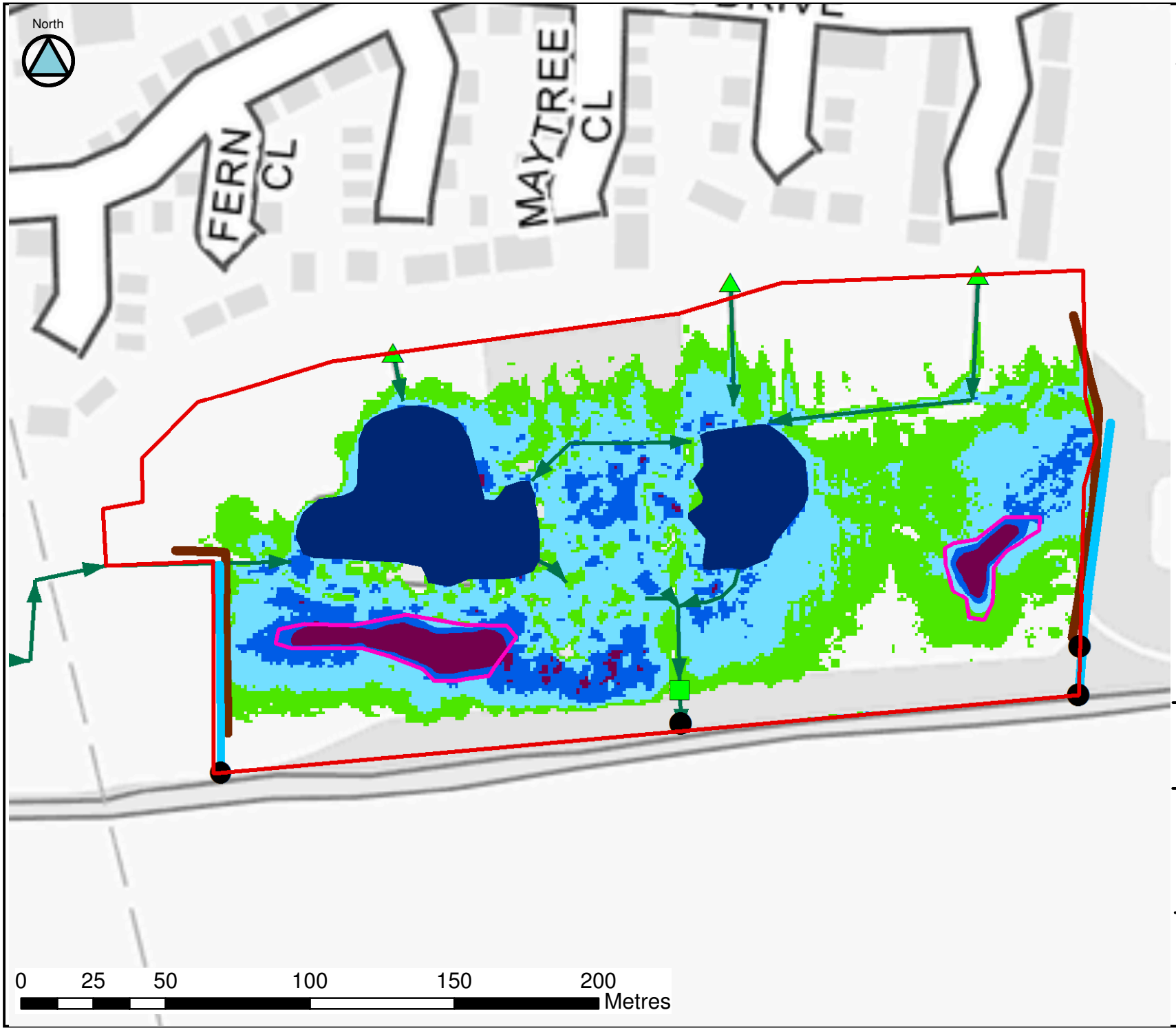
obligations outlined in the Construction (Design and Management) Regulations 2015 (CDM Regulations). At this stage, JBA Consulting has not been designated as the Principal Designer. It is assumed that this role currently falls with the client (further details are available here - http://www.hse.gov.uk/pubns/priced/l153.pdf). This report should form part of pre-construction information collated and distributed by the Principal Designer

Appendices

A Figures

Map 1: Wetland Design

Map 2: Wetland Design with Annotations



LEGEND

- Boundary
- Existing Open Water
- Scrape

Structures

- Culvert
- Weir
- Bund
- New Drain
- Sewer Outfall
- Existing Drain

Water Depth

cm

- 40+
- 20 - 40
- 0 - 20
- Water logged

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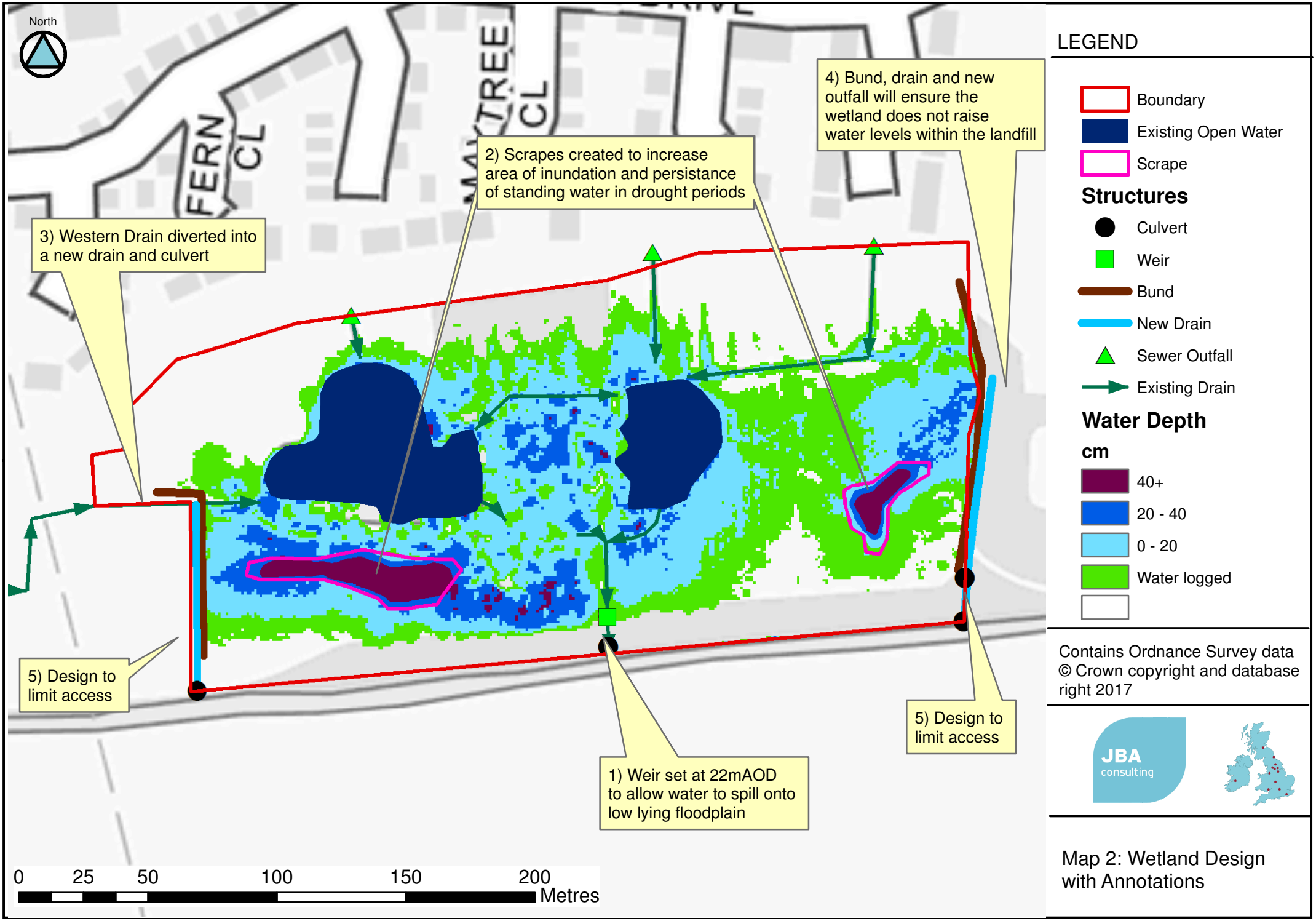
Map 1: Wetland Design


North
FERN CL
MAYTREE CL
2) Scrapes created to increase area of inundation and persistance of standing water in drought periods
4) Bund, drain and new outfall will ensure the wetland does not raise water levels within the landfill
3) Western Drain diverted into a new drain and culvert
5) Design to limit access
1) Weir set at 22mAOD to allow water to spill onto low lying floodplain
5) Design to limit access
0 25 50 100 150 200
Metres
LEGEND
Boundary
Existing Open Water
Scrape
Structures
Culvert
Weir
Bund
New Drain
Sewer Outfall
Existing Drain
Water Depth
cm
40+
20 - 40
0 - 20
Water logged
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Map 2: Wetland Design with Annotations

B Geo-Environmental Appraisal

C Flood Risk Assessment

D Auger Survey

E Services

References

JBA Consulting (March 2016), Hydraulic Model User Report: Wombwell

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