Beddington Farmlands

Revised Restoration Management Plan

On behalf of **Valencia Waste Management Ltd.**

Project Ref: 331201345 | Rev: FINAL | Date: February 2024

Registered Office: Buckingham Court Kingsmead Business Park, London Road, High Wycombe, Buckinghamshire, HP11 1JU
Office Address: 7 Soho Square, London.uk@stantec.com
T: +44 (0)20 7446 6888 E: Bristol@stantec.com

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	Name	Position
Prepared by:	EH IA	Associate Landscape Architect Senior Associate Ecologist
Reviewed by:	SD GP	Senior Associate Geomorphologist Planning Director
Approved by:	NM	Director of Waste and Resources

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Acronyms / Abbreviations

AOD	Above Ordnance Datum
BNG	Biodiversity Net Gain
BFBG	Beddington Farmlands Bird Group
BTO	British Trust for Ornithology
CMS	Conservation Management Scheme
CSG	Conservation Science Group
DfT	Department for Transport
EA	Environment Agency
ERF	Energy Recovery Facility
ERMP	Extant Restoration Management Plan
FAS	Flood Alleviation Scheme
HMP	Habitat Management Plan
LBS	London Borough of Sutton
LEMP	Landscape and Ecological Management Plan
MEC	Main Effluent Carrier
RRMP	Revised Restoration Management Plan
SINC	Site of Importance for Nature Conservation
SSSI	Site of Special Scientific Interest

1 INTRODUCTION

1.1 Overview

1.1.1 This report has been prepared by Stantec UK Limited on behalf of Valencia Waste Management ("the Applicant") to accompany a planning application by Valencia Waste Management (the Applicant). It is for the revised restoration for the 88.4 ha Beddington Landfill Site, Beddington Lane, Beddington, CR0 4TH ("the Site"). The Site is within the administrative area of the London Borough of Sutton (LBS).

1.1.2 Currently the restoration of the former landfill is controlled by planning permission D2015/72898 that was granted on 25th January 2016. Included within the 2015 planning application was a Site wide restoration management plan, hereafter referred to as the Extant Restoration management Plan (ERMP) (Lockhart Garrett 2015[1]). The history of the Site's development, linked to previous planning applications, is set out in the overarching Planning Statement[2] which accompanies the current planning submission.

1.1.3 Final restoration of the Site should have been completed on or before the 31st December 2023 pursuant to this permission (Condition 42). However, this is a complex restoration project and it is regrettable that substantial delivery has not been achieved in accordance with the timeframes previously conditioned. However, a substantial part of the former landfill still requires continued soil importation to take place as part of the restoration works.

1.1.4 Final restoration of the Site will be undertaken in accordance with this current document, hereafter referred to as the Revised Restoration Management Plan (RRMP). The layout of the Restoration Masterplan is shown in **Appendix A**. The programme of works to achieve the final restoration are included in **Appendix B** while phasing Figures are included in **Appendix C**. To support this new planning application, Stantec have reviewed the ERMP and made updates which are based on additional site works including viability assessments, water resource analysis, soil analysis and ground conditions.

1.1.5 The Beddington Landfill Site, which forms of the Beddington Farmlands is part of the wider Wandle Valley Regional Park and is recorded as a Site of Importance for Nature Conservation (SINC) as well as being classed as Metropolitan Open Land. As such the restoration of the Site is designed to support key habitats and species and promote public use and forms part of a long term 60-year vision.

1.2 Location and Site History

1.2.1 The Beddington Farmlands Site is approximately 161 hectares (ha), and located in Beddington, within the London Borough of Sutton (approximate centre grid reference: TQ 290 663). The Site forms part of the Wandle Valley Regional Park, a linear green space that runs the entire length of the River Wandle, from Croydon in the south, to Wandsworth in the north, adjacent to the River Thames. The shared vision for the Regional Park is the creation of sustainable and high quality spaces that are easily accessible, have a thriving biodiversity, and offer recreation, landscape, heritage, cultural and resource management benefits.

1.2.2 Beddington Farmlands has for over a century been a renowned location for bird watching in Greater London. The Site was originally used for agricultural purposes consisting of a mix of ploughed and marshy fields. From the 1940s, with increasing pressures from urbanisation,

[1] Lockhart Garrett (2015) Restoration Management Plan (RMP) Beddington Landfill Site, Croydon (Ref 13-1595 3204 D18 v9.1)

[2] Stantec (2023) Planning Statement (Ref: 331201345_500-Planning_Town Planning Draft Planning Statement)

demand for land to treat effluent resulted in an open field sewage treatment installed on the Site. By late 1970s, half of the Farmlands consisted of sludge beds.

1.2.3 Gravel extraction and landfill operations began in 1998. Viridor Waste Management Ltd as part of the South London Waste Partnership PFI bid, developed an Energy Recovery Facility ('ERF') on part of the Site. As part of the planning application for the ERF, Viridor submitted a restoration management plan for the remaining 'landfilled area' to include the creation of habitats such as wet grasslands, meadow grassland and acidic grassland. The restoration of the Site started in 2015 and by 2019, new wet grassland habitats had been introduced along with bird hides and habitat protection fencing.

1.2.4 The landfilled area has now been divested (as part of a company-wide landfill divestment - which took place on 1 April 2022) to a third-party, Valencia Waste Management Ltd ('Valencia'). It is now incumbent on Valencia to restore the landfilled area as part of the existing planning consent.

1.3 Report Objectives

1.3.1 This document provides the overarching document which sets out how the restoration of the Site will be achieved and how it matches with the general ambition of the original ERMP. Specifically, the objectives are as follows:

- Provide details of the habitats originally proposed for restoration as part of the earlier planning application and ERMP
- Assess the viability of the habitats originally proposed for the restoration
- How the RRMP is aligned with the main objectives of the restoration in the Conservation Management Scheme (CMS) drafted in 2012 (SLR, 20123)
- Provide details of the current Site baseline and how each of the proposed habitats for the RRMP meet the objectives set out in the CMS
- Provide details on hard and soft engineering which will be provided as part of the restoration, including bird hides, public access (including shared footway and cycle access), access controls, fencing and infrastructure.
- Detail a works programme and phasing plans to achieve a fully restored Site, including habitat and species monitoring.

1.4 Supporting Documents

1.4.1 The following reports have been appended and provide the evidence based used to inform the RRMP.

- Water Resources Report: provides an assessment of the water needs of the wet grassland habitats and the suitability of available water sources for the Beddington Farmlands Site (**Appendix D**)
- Ground Investigation Report (**Appendix E**)

[3] SLR (2012) Conservation Management Scheme – South London Energy Recovery Facility

1.4.2 This RRMP report is supported by other documents which provide detail on how Site restoration will be achieved. These are as follows with a summary of the purpose of each report provided below:

- Landscape and Ecological Management Plan (LEMP)[4]
- Habitat Management Plan (HMP)[5]
- Biodiversity Net Gain (BNG) Report[6]

Habitat Management Plan (HMP)

1.4.3 The habitat management plan sets out how each of the proposed habitats will be created across the existing Site, the planting and seeding regimes proposed and how they match with soil types, what management will be carried out, how they will be monitored and what will be undertaken in the event habitat creation is unsuccessful.

Landscape and Ecological Management Plan (LEMP)

1.4.4 The LEMP sets out the details of habitat aftercare, its ongoing management and the desired outcomes of the plan within the short and medium term, and as far as 60 years from now. The LEMP has been informed by the previous baseline surveys and assessment work for ecology and landscape, whilst considering current planning policy. Further, it outlines key considerations which must be taken account of as part of the Sites development, in particular the presence of statutory and non-statutory designated areas in close proximity to the Beddington Landfill Site which may have an influence on landscape designs.

Biodiversity Net Gain Report

1.4.5 This report is required to meet national policy whereby all new developments in England are now mandated to provide at least a 10% biodiversity net gain. This will include a Habitat Condition Assessment of the habitats recorded on Site during a baseline survey completed in 2023. The BNG report will set out the current habitat values and what will be achieved on completion of the restoration.

1.4.6 Not only will the BNG report demonstrate the net gain associated with the Sites restoration, but it will also compare the differences in net gain achieved between the ERMP and the RRMP.

[4] Stantec (2024a) Beddington Farmlands: Landscape and Ecological Management Plan

[5] Stantec (2024b) Beddington Farmlands: Habitat Management Plan

[6] Stantec (2024c) Beddington Farmlands: Biodiversity Net Gain Report

2 Extant Restoration Management Plan

2.1 Proposed Habitats

2.1.1 Condition 41 and 43 attached to Planning Permission D2015/72898/FUL required the development to be constructed in accordance with the then approved restoration management plan, now referred to as the ERMP. The ERMP confirmed by habitat and feature type how Viridor Waste Management Ltd intended to deliver the final restoration of Beddington Landfill Site, which makes up part of the wider Beddington Farmlands Site.

2.1.2 The ERMP was prepared for the landfill Site associated with the ERF, and consisted of restoration of areas of multiple habitats and their proposed areas, including:

- *Acid grassland:* (12.60 ha, in the centre of the Site)
- *Heathland:* (3.15 ha, in the centre of the Site)
- *Meadow grassland:* (17.59 ha, located in the southern section of the Site)
- *Neutral grassland:* (12.48 ha, multiple locations around the Site, primarily around edges of proposed acidic grassland and lakes)
- *Wet grassland:* (14.55 ha, primarily in the north of the Site with a smaller area in the southeast corner)
- *Ruderal vegetation:* (1.66 ha, patchy areas across the Site, usually on the border between other habitats)
- *Native scrub:* (4.58 ha, patchy areas across the Site, usually on the border between other habitats)
- *Wet woodland:* (0.21ha, between the Southern Lake and the southwest corner of the meadow grassland)
- *Broadleaf woodland:* (5.71 ha, mostly along the borders of the Site with gaps around access points)
- *Sacrificial crops:* (2.08 ha, a few areas around the Site, generally between other habitats)
- *Lakes:* (6.28 ha, 3 along the southwest edge of the Site)
- *Islands:* (1.26 ha, one island in the central lake, multiple islands in the Northern Lake)
- *Reed beds:* (2.70 ha, located in the Southern Lake)
- *Hedgerows:* (4453m, various locations around the Site)
- *Sand martin colony:* (1 set of structures intended to provide nesting habitat for sand martins)

2.1.3 The Extant RMP also included 7 bird hides, 2.89km of footpaths and 1.56km of cycleway for public use.

2.1.4 The ERMP was intended to be a live document, with alterations and updates allowed to consider changing circumstances.

> *"The RMP document is intended to act as a live document with scope for modification both in terms of timescales (as described above) and content. Long term restoration projects can develop in unforeseen directions with, on occasions, habitats of specific ecological value developing, which may be deemed more appropriate to the site and landscape than those previously planned. This document is therefore designed to be flexible and recognise opportunities for delivering further biodiversity gains within the scheme."*

2.2 ERMP Review

2.2.1 Prior to divestment, Viridor had identified deficiencies in the ERMP and had embarked on pre-application discussions with LBS to amend it. Since divestment, Valencia, rather than Viridor, is now working towards the full restoration of the Site.

2.2.2 Valencia further reviewed the ERMP from a viability, sustainability, soil management, ecological, hydrological and hydrogeology perspective and had reservations about the long-term viability of some of the habitats.

2.2.3 In support of Valencia, Stantec undertook a review of the ERMP in November 2022 prior to the submission of the new planning application. The assessment focussed on viability of some of the habitats originally proposed given that some elements of the restoration were not as successful as had hoped. The viability for each of these elements was assessed with respect to the following:

Ecology:

- Physical conditions on Site which would prevent habitat creation;
- Distance from proposed habitat location to the nearest known example of similar habitat. This will be estimated using Defra's MagicMap tool;
- Known threats or pressures common to the proposed habitat type. Locations of existing threats if known will be given using available data on Defra's MagicMap tool and the National Biodiversity Network; and
- Other viability concerns that do not fit into the above categories.

Hydrology:

- Review of the hydrological processes and the impact these will have on sediment processes, within the waterbodies and the surrounding watercourses.
- Review of existing groundwater information to determine the hydrological viability of the proposed habitats within the Extant RMP.

3 Viability Assessments

3.1.1 The assessment identified two habitats: acid grassland and heathland combined, and wet grassland which may not be viable. Details of the assessment for these habitats are summarised below.

3.1 Acid Grassland and Heathland

Physical Conditions:

3.1.1 The defining feature of these habitats is an acidic soil (when surveying the presence of acid tolerant plant species is used to define the habitat). Soil surveys[7] on Site show that the soil is predominantly alkaline. While modifying the soil to an acidic pH is possible, it would be an intensive, inefficient process that risks causing significant pollution events[8].

3.1.2 GeoChem consultants were commissioned by Viridor in 2020 to access the feasibility of converting soil media into restoration soils capable of sustaining an acid grassland *[A180505B-Project Memorandum II: Ferrous Sulphate Amendment],* their findings concluded that a direct discharge of leachates generated form the acid grassland to ground or influx into the Northern Lake by overland flow present an unacceptable risk to controlled waters, particularly due to iron and sulphate loading. Any adoption of an acid grassland restoration strategy utilising ferrous sulphate will require engineering controls to prevent pollution to the local controlled water receptors which in engineering terms would be difficult to achieve due to the current gradient complexity of the landfill, ongoing construction and maintenance cost, permitting / discharge consents and agreements.

Similar habitats:

3.1.3 The nearest similar acid grassland habitat is located approximately 7km to the northwest in Richmond Park. The landscape between is primarily urban environments unsuitable for the movement of many of the target species for the habitat.

Threats and pressures:

3.1.4 Primary threats to acid grassland include (but are not limited to) inappropriate levels of grazing and excess nutrient levels (through pollution or other mechanisms). The Extant RMP mentions the possibility of using grazing to manage the area but does not currently include further specifics. It is possible to manage acid grassland manually, but this is usually accomplished through grazing.

Other viability concerns:

3.1.5 Acid grassland is not included in Natural England's National Character Area Profile[9].

Conclusions:

3.1.6 This habitat detailed within the ERMP is deemed not viable from an ecological perspective. The soil on Site is unsuitable and the likelihood of successful intervention to create the proposed habitat is low. In addition, once created, the habitat would still be isolated from similar habitats and require suitable grazing levels to maintain.

[7] Project Memorandum (27th Jul 2020). *Geochem*

[8] Restoration Habitat Assessment (10th Feb 2021). *Code 7 Consulting*

[9] National Character Area Profile: 114 Thames Basin Lowlands (2014). *Natural England*

3.2 Wet Grassland

Physical Conditions:

3.2.1 Wet grassland habitats may support some standing water at certain times of the years, but overall the ground should be very damp and water-logged. Key features may include a high water table and temporarily flooded areas during periods of high rain fall or river flooding. They are often managed for grazing although some may be managed as hay meadows. Such habitats are key, both for foraging and nesting, of several species of wading birds.

Similar habitats:

3.2.2 A similar habitat Frays Farm Meadows is an example of a wet grazing meadow and designated as a Site of Special Scientific Interest (SSSI) and close to Denham, Hillingdon located 30km northwest.

Threats and pressures:

3.2.3 Where ground conditions may dry out during periods of extreme drought and habitats are succeeded by more ruderal vegetation then wet grasslands may be lost. Grasslands may also silt up and become choked with vegetation. Overgrazing can cause excessive amounts of poaching to grassland edges and damage the sward.

Other viability concerns:

3.2.4 The ERMP and reports prepared for previous phases of the restoration, indicate that the Phase 1, 2 and 3 grasslands should all interact with the perched groundwater table at the Site, located within the Hackney Gravel Member. The excavated channels and scrapes/pools within the wet grassland areas were proposed in the ERMP to be constructed at levels between 25.45 to 25.65m AOD (wet grassland 1), 25.95 to 26.25m AOD (wet grassland 2) and 28.6 to 30.0m AOD (wet grassland 3) to provide interaction with the perched groundwater table. However, historic groundwater monitoring locations at the Site do not extend any further north than the Northern Lake, so there has been no ongoing groundwater level monitoring at the Wet Grassland 1 and 2 locations, and data from other parts of the Site may not be consistent with groundwater levels in these areas. The groundwater table beneath the northern wet grasslands is unknown.

3.2.5 Additionally, no as-built information is available for Wet Grasslands 1 and 3 to confirm if the constructed levels of the ditches, scrapes and pools within the wet grassland areas are consistent with the originally proposed levels. When groundwater data is available, there is no means of comparison of the constructed bed levels to groundwater levels. This requires confirmation by survey.

3.2.6 Staff responsible for monitoring of habitats at the Site (Thames Water Biodiversity Officer; LBS Site Warden) have noted that the wet grassland areas are not functioning as outlined in the ERMP, with an overall trend towards being drier than expected, and this is supported by Site visits conducted by Stantec staff in 2022 and 2023, and Thames Water UAV (drone) survey images of the Site. Notably, the eastern side of wet grassland 1 is observed to retain water, but water on the western side is observed to infiltrate quickly into the underlying ground, indicating potentially different underlying soil conditions and that the habitat may not be interacting with groundwater.

3.2.7 Wet Grassland 1 is reported by Site staff to have dried out during the summer of 2022 (an extended period of hot, dry weather) and cracking of the soil surface was noted in the beds of the wet grassland. Groundwater and rainfall levels across the south-east of England were notably below average during this period; and with similar events expected to increase in

summer as a consequence of climate change; water supply from groundwater and rainwater during very dry periods cannot be relied upon.

3.2.8 The Phase 3 wet grassland area has been observed on Site to be consistently drier at its western end, and observational evidence indicates that the ground level is higher at the western end of the habitat than the east, which inhibits gravity flow and reduces the potential for groundwater interaction. The tilting weir at the western end of the habitat, designed to provide control of water levels, is disconnected from the constructed habitat and was dry during the Site visit in August 2023.

3.2.9 The issues identified indicate that the wet grassland habitats outlined in the extant RMP would not be viable if reliant on rainfall and groundwater supply alone, and other water sources are required to support the habitats.

3.2.10 The Water Resources Report in **Appendix D** outlines the viability of all available water sources at the Site to support the wet grassland and how a water supply to sustain the needs of the target species can be established for the three wet grassland areas, utilising water abstracted from the Main Effluent Carrier (MEC) channel to support wet grasslands 1 and 2; and the capture and storage of runoff from the landfill mound via a swale and storage pond, and flood flows abstracted from the River Wandle Flood Alleviation Scheme (FAS) channel, to support wet grassland 3. During the pre-application stage the EA have been consulted with and confirmed that abstraction from the MEC is possible.

Conclusions:

3.2.11 This habitat detailed within the ERMP is deemed viable from a water resources perspective subject to confirmation of groundwater levels and abstraction requirements. New boreholes have been sunk in selected locations across the Site adjacent to the wet grassland habitats, and groundwater levels will be monitored to establish the level of the groundwater table. It is envisaged that monitoring will be carried out over the course of winter 2023/24 and summer 2024 to establish the baseline.

3.3 Viability Assessment Conclusion

3.3.1 Following the viability assessment it was concluded that acid grassland / heathland should not be considered within the RRMP, and that a similar grassland habitat which would have a chance of successful creation be considered. To that end, meadowland will be substituted and managed on top of the landfill cap.

3.3.2 Ongoing work, including consultation with the Environment Agency (EA), is being undertaken to determine how wet grasslands can be managed, whilst being cognisant of the threat of drought conditions during summer and that much of the Site is part of a wider flood alleviation scheme for winter when high rainfall events are more likely to occur. Consequently, opportunities to alter the topography of the wet grasslands (and indeed lakes) are inappropriate and efforts have been focussed on obtaining water from the MEC, MEC Overflow and Wandle Overflow Channel to maintain these habitats throughout the year.

4 Revised Restoration Management Plan

4.1 Background

4.1.1 As some habitats were found not to be viable, or are at least being subject to ongoing monitoring, Stantec was commissioned to provide a RRMP to support a new planning application.

4.1.2 It is important to note that this RRMP, and the habitats therein, is still underpinned by the main objectives listed within the CMS and originally based on those developed by the Conservation Science Group (CSG) in 1994. These Objectives also formed the foundation of the original ERMP.

4.1.3 While the CMS covers a larger area than the RRMP, including both the area of the restored landfill and the historic sewage sludge beds to the north and south-east of the Site known as the 'Hundred Acre' and 'SAM' site, the overall objectives are still relevant. These additional sites outside the RRMP boundary are owned and operated by Thames Water.

4.1.4 In addition to the habitats being created and managed on Site, structures will also be included within the design and for which details are also presented in this document. This includes the installation of bird hides, the creation of public footpaths and shared access routes, the erection of predator proof fences and the inclusion of livestock grazing included as part of a long term strategy to manage habitats.

4.1.5 As previously mentioned, there are other supporting documents which provide more detail as to how this RRMP will be implemented across the Site and which should be referred to (i.e. LEMP, HMP, BNG Report and CMS Addendum).

4.2 Restoration Management Plan Objectives

4.2.1 The CMS (SLR, 2012) set out a framework for habitat creation and management of the Site both to maintain ecological interest features and to develop a long-term habitat resource that sustained bird populations. It also provided additional enhancements to support biodiversity gain.

4.2.2 Despite changes in bird populations recorded at the Site during ongoing annual surveys[10],[11] as well as changes to the landscape, these objectives were adopted and expanded upon to restore the Site such that it may be used by other species of local or regional importance, which although currently in decline, may re-populate the Site in the future.

4.2.3 The full list of seven objectives used in the CMS and which forms the basis of ERMP and RRMP are as follows:

- **Objective 1**: To develop and manage key habitats on Site for the main target species of lapwing, redshank*, tree sparrow** and yellow wagtail*;
- **Objective 2**: To develop and manage key habitats on Site for target species associated with ecologically immature wetland habitats such as little ringed plover, ringed plover and common tern;

[10] MKA Ecology (2023) Annual Ecology Report 2021-2022

[11] MKA Ecology (2022) Annual Ecology Report 2020-2021

- **Objective 3**: To develop and manage the Site for passage and migrant wildfowl and passerine community by appropriate hydrological management (also to consider water pipit and green sandpiper);
- **Objective 4**: To develop and manage the Site for breeding reedbed species (such as reed and sedge warbler, reed bunting (potentially bearded tit) and for wintering species such as bittern;
- **Objective 5**: To develop and manage the site as a continuing part of a Site of Metropolitan Importance to bats;
- **Objective 6**: To increase the biodiversity of the Site by restoring sustainable areas of habitat that is of value in its own right as well as for other fauna too; and
- **Objective 7**: To create and appropriate level of public access to allow enjoyment of the restored landform without impacting upon the nature conservation interests of the Site.

4.2.4 Pertinent to Objective 1, redshank and tree sparrow are not present at Site but habitat would be maintained to allow their re-establishment. Yellow wagtail are potentially absent from Site although some rare sightings are recorded. A full list of species covered by the RRMP is presented in Table 1, which also shows their importance in the local context and their key habitats.

4.2.5 In light of the loss of some key species from Site, and current European and UK bird population trends, it may be prudent to assess the target species lists and update them if necessary. This will make sure that birds which may be declining locally or nationally, but which are identified at Beddington can be supported with subtle habitat interventions if necessary.

4.2.6 However, despite habitat creation and interventions, there are no guarantees of attracting the target species in some instances due to population trends. For reference, details of target species population trends are included in **Appendix F**.

Table 1. List of Target Bird Species

Species	Conservation Status	Key Habitat
Lapwing	Birds of Conservation Concern 5[12]: Red List London BAP Priority Species	Wetlands, wet grasslands, bare soil and open farmland
Redshank	Birds of Conservation Concern 5: Amber List	Wetlands, wet grasslands, bare soil and open farmland
Tree sparrow	Birds of Conservation Concern 5: Red List Species of Principal Importance[13]	Mature woodland, Gorse scrub
Yellow wagtail	Birds of Conservation Concern 5: Red List Species of Principal Importance	Riparian habitats
Little ringed plover	London BAP Priority Species: Green List	Immature wetland habitats
Ringed plover	London BAP Priority Species: Red List	Immature wetland habitats
Common tern	Birds of Conservation Concern 5: Amber List	Open water, islands, Immature wetland habitats
Water pipit	Birds of Conservation Concern 5: Amber List	Wetlands
Green sandpiper	Birds of Conservation Concern 5: Amber List	Wetlands
Reed warbler	Birds of Conservation Concern 5: Green List	Reedbeds
Sedge warbler	Birds of Conservation Concern 5: Amber List	Reedbeds
Reed bunting	Birds of Conservation Concern 5: Amber List Species of Principal Importance	Reedbeds
Bearded tit	London BAP Priority Species: Green List	Reedbeds
Bittern	Birds of Conservation Concern 5: Amber List Species of Principal Importance	Reedbeds
Bats – all local species	The Conservation of Habitats and Species Regulations 2017 (as amended); Wildlife and Countryside Act 1981 (as amended); London BAP Priority Species Species of Principal Importance (some species)	Woodland / edge habitats; Open water and riparian habitats; hedgerows and linear features.

[12] Stanbury *et al* (2021) The status of our bird populations: the fifth Birds of Conservation Concern in the United Kingdon, Channel Islands and Isle of Man and second IUCN Red List assessment of extinction risk for Great Britain. British Birds 114; 723-747

[13] Species of Principal Importance are protected under Section 41 of the Natural Environment and Rural Communities (NERC) Act 2006.

4.3 Site Baseline

4.3.1 The Site has been subject to surveys as part of ongoing monitoring by MKA Ecology Limited during 2021 and 2022. Between these years, surveys have identified changes in habitat type and condition associated with the following: changes in landfill activities; ongoing restoration work; habitat succession in the absence of management, and; impacts of drought conditions. Drought conditions have previously resulted in wet grassland areas being almost dry and contributed to the spread of ruderal vegetation.

4.3.2 In addition to the Site visits carried out by MKA Ecology, Stantec undertook a visit in August 2023 and January 2024 to gather information on the current distribution of habitats across the Site and their condition. This information informs Biodiversity Net Gain (BNG) Calculations which are presented in the supporting BNG report. Figures showing the habitats recorded on Site are included in an Appendix to the BNG report.

4.3.3 The grassland across the main capped landfill was broadly homogenous, being a fairly species-poor sward characterised by common grasses, mainly creeping bent *Agrostis stolonifera*, red fescue *Festuca rubra* and some perennial Rye-grass *Lolium perenne*. The grassland was indicative of a seeded mix, with a high component albeit low diversity of herb species such as wild carrot *Daucus carota*, ribwort plantain *Plantago lanceolata* and clovers *Trifolium* sp.. However, self-seeded ruderal species such as bristly oxtongue *Helminthotheca echioides*, fleabanes *Conyza* sp. and willowherbs (*Epilobium* spp.) were widespread across the area, suggesting the capped area is subject to flushes of these types of vegetation (likely originating from the existing seedbank).

4.3.4 The grassland therefore presents as a community that is still becoming established, although grasses are dominant in terms of ground cover. A range of herbs were recorded such as bird's-foot trefoil *Lotus corniculatus* and salad burnet *Sanguisorba minor*. However, at the time of survey these had a rare relative abundance and were absent from most quadrats.

4.3.5 Given the most recent survey was in January, it is very likely that additional species would be evident in summer, with relative abundance of species also potentially varying. However, there was no strong indication that the grassland overall is likely (at present) to be significantly more species-rich.

4.3.6 At the time of survey, the capped area had evidently been subject to management by mowing, as the sward was short across large areas. However, some sections had been left uncut at the time, with dead flowerheads of some species still present. Although these areas appeared visually different in terms of structure, the species composition was very similar. Dead short cut stems of the larger ruderal species, such as bristly oxtongue, were still present with basal leaves growing through the grasses, confirming the overall composition was very similar.

4.3.7 Some variation in the sward was noted, for example with an area on a slope close to the eastern edge of the capped area being dominated by barren brome *Bromus sterilis* with very few herbs present. However, this area was small and discrete. Perennial rye-grass was also more evident toward the south of the capped area.

4.3.8 Areas of grassland at the base of the capped area had a very similar species composition. However, the structure of these areas was taller and appeared slightly more well-established. Creeping bent was abundant or frequent along with similar herb species such as ribwort plantain and wild carrot. Bristly oxtongue was also widespread, although generally less clumped than on the wider capped area. The lower grassland did not show signs of recent cutting or mowing, with taller (old) flower stems of crested dog's-tail *Cynosurus cristatus* present in some areas, albeit not widespread across the sward. This species is indicative of a seeded mix and may also occur on the capped area; however, it was not evident elsewhere at the time of survey.

4.3.9 Based on the January 2024 survey and comparing to the habitat descriptions in the UKHab, the grassland across the capped area does not readily fall into a specific category. It has some characteristics of modified grassland being species-poor and evidently subject to some management. However, some of the species present and general structure of the grassland are indicative of a seeded neutral grassland mix that is still in the process of becoming established.

4.3.10 Woodland was present across several areas of the Site, including planted woodland to the north. This was predominantly uniform in age comprising semi-mature trees of English elm *Ulmus procera*, silver birch *Betula pendula*, cherry *Prunus avium*, and field maple *Acer campestre* with occasional ash *Fraxinus excelsior* and pedunculate oak *Quercus robur*. This woodland had a mixed understorey although the ground flora was dominated by bramble *Rubus fruticosus* agg with occasional common nettle *Urtica dioica.*

4.3.11 Woodland to the west of Northern and Southern Lake comprised locally abundant willow Salix sp. and frequent field maple and alder *Alnus glutinosa* with occasional pedunculate oak and ash. The shrub layer consisted of occasional hawthorn, hazel, blackthorn *Prunus spinosa* and dog rose *Rosa canina*, although elder *Sambucus nigra* was locally frequent further south. The ground flora was generally sparse with frequent ivy *Hedera helix* (in clumps) with occasional bramble.

4.3.12 To the west of Southern Lake, the woodland was dominated by mature unpollarded willow with occasional pedunculate oak and locally frequent silver birch. Again the ground flora was dominated by bramble and nettle with some cleaver. Along the southern boundary of the Site, the woodland supported ash and willow with field maple and oak also present. Hazel dominated the shrub layer while ivy dominated the ground flora with cow parsley, creeping buttercup and bramble also present.

4.3.13 There were a number of dense stands of young willow either present on lake margins or on small islands within the lakes. In addition to willow, alder and silver birch were also present, while bramble, bulrush *Typha latifolia*, and common reed *Phragmites australis* were also present.

4.3.14 In addition to the terrestrial habitats, the Site supports a number of waterbodies. These are primarily North, Southern and Reedbed Lake but there are other shall channels. These include the MEC overflow which is a shallow drainage channel with steep concrete sides or earth/rubble banks. The channel is 2-3 m wide, shallow (15-20cm deep) with a gravel substrate and supporting great willowherb along the edges.

4.3.15 To the south of the Site is the River Wandle Overflow which has steep earth banks and a wide channel between 2-3m. Depth is between 30-50cm and the substrate is a mixture of gravel and silt. The channel was dominated by common reed with occasional greater pond sedge *Carex riparia*, bulrush and rare reed sweet-grass *Glyceria maxima*.

4.4 Habitat Proposals

4.4.1 A description of the habitats being created and managed at the Site and the objectives which they fulfil are presented below. Rather than attributing several objectives to each habitat type, only the key objectives will be indicated as it is anticipated that there will be overlap in suitability in the habitats across several species.

4.4.2 While wet woodland creation was proposed within the ERMP, this may be a challenge based on the long term availability of water for the 60 year duration of this project given the risks posed by climate change. An extensive period of drought has already occurred at the Site and there is the potential for such events to repeat.

4.4.3 As no wet woodland has been recorded on Site during any of the preceding surveys, it is proposed to create, retain and enhance the willow scrub at the edge of Southern Lake and in other marginal areas, rather than create wet woodland as per the UKHab (Version 2) definition. It is likely that this habitat will meet the same objectives proposed for Wet Woodland which is intentionally not listed below given its absence.

4.4.4 The location of the habitats across the Site is presented in the Restoration Masterplan shown in **Appendix A**. Details on how each habitat will be created and monitored is provided in the supporting Habitat Management Plan, while details on how they will be managed in the long term is covered within the supporting LEMP. The phasing programme and supporting phasing figures over the 5 year habitat creation phase is shown in **Appendix B** and **Appendix C**, respectively. **Appendices D** and **E** outline water resource management and ground conditions which were required to confirm the proposed habitats were feasible and how they would be managed.

Meadow grassland (Lowland Meadows g3a)

4.4.5 This habitat will occupy the centre of the Site which was the former landfill. The surface of the grassland will be punctuated by the former gas leachate, water and other monitoring wells. It will extend as far north as the Main Effluent Carrier (MEC) overflow channel, to the Northern and Southern Lakes inside the western boundary and as far south as the southern wet grassland.

Objectives: **1**, **6** and **7**

4.4.6 **(1)** The grass seed heads will offer a winter food source for tree sparrow (if they become re-established) with a proportion of the sward retained uncut each year to preserve this.

4.4.7 **(6)** This habitat will promote biodiversity at the Site by offering nesting habitat for ground nesting species such as skylark and meadow pipit. Small mammals such as field vole and shrew will become established species and thereby prey for birds such as owl and kestrel. By leaving parts of the sward uncut, flowers will act as food sources for butterflies, moths, and other pollinator species. An appropriate mowing regime will encourage grass growth of key indicator species and encourage floristic diversity.

4.4.8 **(7)** The inclusion of public walking routes that allow suitable access to the higher points of the former landfill which link to a circular route to the south-west. These routes also provide access to the existing permissive path along the western boundary.

Neutral grassland (Other Neutral Grassland g3c)

4.4.9 This habitat will follow the outer margins of the wet grassland restoration to the north and south of the Site; the higher ground around the lakes to the west and adjacent to the River Wandle overflow channel to the south. It will also form the perimeter of the reed beds in the

south-west corner of the Site. This habitat type will also be developed around the sludge lagoons in three corner field to the north-west.

Objectives: **1** and **3**

4.4.10 **(1)** This habitat will be good for wader species such as lapwing, supporting multiple potential food sources for both adults and chicks which may occupy the adjacent wet grassland.

4.4.11 **(3)** The abundance of invertebrate food within neutral grasslands will convey benefit to other passerines which occupy the Site.

Wet grassland (Other Neutral Grassland g3c)

4.4.12 Wet grasslands already exist both in the south-east (Wet Grassland 3) corner of the Site and to the north-west (Wet Grassland 1). Wet Grassland 2 is also currently being developed and will lie between Wet Grassland 1 and the ERF.

4.4.13 A swale will be constructed to intercept runoff from the eastern slope of the landfill which will carry water to a proposed storage basin on the eastern boundary. The primary purpose of the basin is to provide a water resource for Wet Grassland 3 in the south-east of the Site. Water provision for Wet Grassland 1 and 2 is sourced from rainfall and supplemented by abstracted water from the MEC channel. All wet grasslands, the proposed swale and Storage Basin are to be lined to minimise infiltration losses. Further details on the water requirements and proposed water resources for these habitats is described in the Water Resources Assessment report included in **Appendix D**.

Objectives: **1**,**2**,**3**,**5**, and **6**.

4.4.14 **(1)** Wet grasslands are key to several of the target species, in particular lapwing and redshank. This habitat is key to providing invertebrate food for adults and chicks and can provide nesting opportunities. Yellow wagtail and tree sparrow, if they re-colonise the Site, will also benefit from invertebrate prey as will several other species, including reed bunting.

4.4.15 **(2)** and **(3)** Wet grasslands will provide suitable food resources for adults and chicks during summer while muddy edges, created as water levels recede in summer, provide a source of mud for nest building. Over wintering species, including passage migrant wildfowl and passerines will also benefit from food sources while islands created during high water provide a safe refuge from predators.

4.4.16 **(5)** The standing water which will gather around wet grasslands and the high diversity of invertebrates it promotes will be beneficial to several species of bats.

4.4.17 **(6)** The wet grassland will not only benefit bird species, but small mammals such as voles and shrews will also make use of the greater number of invertebrates. Floristic diversity will differ from meadowlands and encourage butterflies, moths and other pollinators to make use of nectar bearing flowers.

Native and bramble scrub (Hawthorn Scrub h3f, blackthorn scrub h3a, mixed scrub h3h, and bramble scrub h3d))

4.4.18 Bramble scrub currently dominates the eastern fringe of Northern Lake, and the western edge of Southern Lake, although some dense strands occur on the eastern edge of the latter. Small stands are present on the higher ground to the north of Wet Grassland 3. There are existing groups of native scrub located within the meadow grassland which will be enhanced. These groups are enclosed by the public access routes.

Objectives: **1**,**5** and **6**.

4.4.19 **(1)** Both native and bramble scrub will offer good cover for breeding passerines including tree sparrow as well as encouraging greater invertebrate abundance which make use of nectar bearing flowers.

4.4.20 **(5)** Dense areas of scrub, and those which are encouraged to develop into linear features will benefit bats which forage along edge habitats. The increased invertebrate abundance, which may accumulate in leeward sides of stands of scrub will increase the suitability of the habitat for bats.

4.4.21 **(6)** Scrub will form areas of suitable cover for a wide range of terrestrial species of invertebrate, birds and mammals, including hedgehogs, voles, mice, and shrews. Flowers and berries will act as suitable food sources for these groups.

Broadleaf woodland (Other lowland mixed deciduous woodland w1f7)

4.4.22 Existing woodland is prevalent along the western boundary of the Site but also encloses the permissive path west of the Northern Lake. There is a more extensive stand between Northern Lake and Wet Grassland 1, while a narrow stand separates Wet Grasslands 1 and 2 from Three Corner Field. Broadleaf woodland is proposed along the eastern boundary toward the south of the landfill. The woodland pocket is designed around the proposed swale and storage basin. Woodland is a London BAP Habitat while lowland mixed deciduous woodland is also a UK BAP priority habitat.

Objectives: **5** and **6**

4.4.23 **(5)** Woodland will provide ideal edge habitat for several bat species, while those which feed on invertebrates at greater altitude will benefit from the tree canopy. Trees will also provide shelter for foraging bats during high winds as well as dark habitats for light sensitive species.

4.4.24 **(6)** Trees will benefit invertebrate, bird and mammal species through both shelter, cover and by providing greater food resources.

Native hedgerows (Native hedgerows h2a, native hedgerows with trees h2a~11)

4.4.25 Hedgerows will be included in the design, for example along the shared east/west public access route, along both sides of all footways around the landfill and locations along the paths that run along the eastern side of the lakes. Hedgerows form part of the long-term fencing strategy and when established and deemed suitable to act as secure boundary treatments in their own right, then stock fencing will be decommissioned to allow the Site to adopt a more natural feel. As hedgerows may impact on the ability of waders to detect predators, they will be limited to areas away from suitable wetland habitats. Hedgerows are a National BAP Priority Habitat.

Objectives: **1**, **5** and **6**.

4.4.26 **(1)** Hedgerows will provide suitable cover for tree sparrows if they recolonise the Site, as well as other breeding and over wintering passerines.

4.4.27 **(5)** Hedgerows act as linear features and can support echolocating bats at night allowing them to commute from roosts to feeding grounds. Hedgerows will provide additional food resources for bats across the wider Site.

4.4.28 **(6)** Hedgerows provide suitable cover for small mammals and birds, while nectar bearing plants and berry production will also generate food resources for several species groups.

Winter seed crops (Cereal Crops c1c)

4.4.29 Two stands of winter seed bearing crops are proposed. They will be located adjacent to the eastern boundaries of the Southern and Northern Lake.

Objectives: **1**, **3** and **6**

4.4.30 **(1)** Overwinter crops will be of benefit to tree sparrows if they re-colonise the Site.

4.4.31 **(3)** Several overwintering passerines will benefit from winter seed crops.

4.4.32 **(6)** By providing a food source in winter when invertebrate prey may be reduced in abundance, winter seed crops will be beneficial to birds and small mammals.

Lakes (Eutrophic Standing Water r1a and Ponds (Non-Priority r1~41))

4.4.33 The Northern, Southern and Reedbed Lakes have already been established on Site. Lakes and standing water are a London BAP habitat and a UK BAP Priority Habitat. However, it should be noted that only Northern Lake is considered as a lake based on UKHab (Version 2) criteria, with all other being classed as ponds (non-priority). A new Storage Basin which will hold water will be created as part of the restoration.

Objectives: **1**,**2**, **3** and **5**

4.4.34 **(1)**, **(2)** and **(3)** Standing bodies of water and their wetted edges will be beneficial for all target species as well as others which may occupy the Site throughout the year.

4.4.35 **(5)** Some species of bats utilise standing water to catch invertebrates on or close to the waters' surface (e.g. Daubenton's bats). The increased invertebrate resource around the edges will also benefit those which occupy the Site.

Islands

4.4.36 Islands are located in the Northern and Southern Lakes which are already present on Site. Ruderal vegetation has been allowed to dominate the islands limiting the required proportions of bare ground and gravels. The LEMP outlines management measures for the islands to ensure these habitats are suitably restored for variety of breeding waders, including he establishment of suitable nesting substrates.

Objectives: **1,2 3**

4.4.37 **(1), (2)** and **(3)**: The islands will provide a safe refuge for waders during the summer breeding and overwintering period. As water recedes during summer the muddy edges will provide access to aquatic invertebrates and a substrate which may be used in nest building (e.g. hirundines).

Reedbed Islands and Filter Reedbeds (Reedbeds f2e)

4.4.38 A small proportion of reedbeds have established within Reedbed Lake and will be retained. However, there are 7 reedbed islands which are still proposed within the Restoration Plan which have been brought forward based on the original proposals in the ERMP for Reedbed Lake. These reedbeds will be created using floating pontoons, reed-bed planting or a combination of both, where possible. As establishment of this habitat in a specific waterbody may be a challenge, establishing reed beds in other waterbodies should be considered. Reedbed is a London BAP habitat and a UK BAP Priority Habitat.

4.4.39 During recent ecological surveys, evidence of Himalayan balsam was also found in the River Wandle Overflow where an additional reedbed may be created. Appropriate removal will be necessary and a clearly marked 10m exclusion zone for plant and other works will be established to prevent displacement and spread of seeds.

Objectives: **4** and **6**

4.4.40 **(4)** Sedge and reed warbler and reed bunting will benefit from well-established reed beds for breeding.

4.4.41 **(6)** Reedbeds provide shelter for a number of species, including some key invertebrates such as moths, dragonflies and damselflies.

Invasive non-native species

4.4.42 Himalayan balsam, floating pennywort and goats rue have been recorded at the Site. Himalayan balsam and floating pennywort are listed on Schedule 9 of the Wildlife and Countryside Act 1981 (as amended).

Objectives:

4.4.43 Non-native invasive species are not considered within the CMS but given the potential risks to the habitats on Site and the success of this restoration management plan, their ongoing management and monitoring is of significant importance.

Sand martin colony

4.4.44 In 2003 an artificial sand martin colony was erected in the south-west corner of the Northern Lake. This was to provide nesting provision in light on the ongoing Site works and that this species was previously recorded as a breeding species at the Site. Sand martin is a London BAP species.

Objectives: **6**

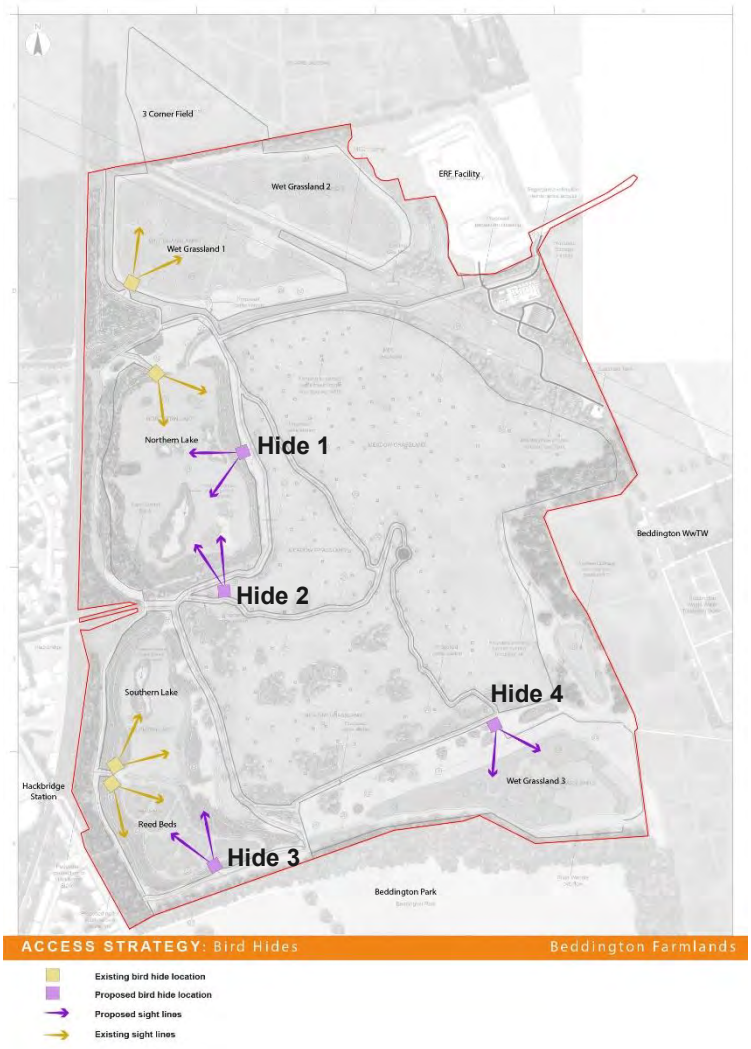
4.4.45 **(6)** The maintenance of the sand martin colony will enhance biodiversity at the Site and provide suitable habitat for an important local species.

4.5 Bird Hides

4.5.1 There are 3 hides which have been installed to date. In addition, the RRMP is proposing 4 additional bird hides at locations which have been agreed in consultation with the Beddington Farmlands Bird Group (BFBG). Their locations are included within the Restoration Masterplan while their sight lines and value to the local community and bird groups are shown in Figure 1.

4.5.2 The inclusion of bird hides, which will tie into the existing public access routes, will contribute to the delivery of Objective 7 and improve public access across the Site. The hides will also facilitate the long-term monitoring of habitats which have been developed to support target species, including waders, passage migrant wildfowl and passerines, as well as reed bed species.

Figure 1 Existing and Proposed Bird Hides



4.5.3 A description of each proposed location has also been summarised below:

Hide 1 - North Lake

The hide is to sit on the west edge of the pathway at the same level facing west. It has been placed so that is gives good views of the gap between to two large central islands and towards Elands Island.

Hide 2 - Visiting Migrants hide

The hide is located to the south of the Northern Lake facing north at the crest of this portion of the mound. It is a popular sky watching location during the migration seasons.

Hide 3 – Reed bed Hide

The hide is located on the southern bank of reedbed lake facing north-west. There is a channel between the islands. The hide is positioned to look down this channel offering a deep view into the reed bed once it has developed.

Hide 4 - Phase 3 Hide

The hide is located to the northernmost tip of Wet Grassland 3 outside of the fence line facing roughly southwest. The hide will be placed atop a raised earth platform so that the viewing slots are not obscured by the Wet Grassland 3 fence but must be set back sufficiently so that foxes cannot exploit it to gain access to the habitat.

4.5.4 The design of the hides was discussed with the BFBG and the then Viridor, as part of the ERMP. The original proposals are replicated here for reference.

> *"It is currently proposed that the hides will be created from salvaged shipping containers. Shipping containers will provide an ideal structure because of their size and shape and they are also resistant to vandalism."*
>
> *"The final design of each hide will depend largely on the type of shipping container available at the time of development. It is anticipated that the hides will have one side entirely open for access and to avoid the creation of enclosed areas. Viewing holes will be created on the wall facing the feature of interest (wet grassland, lakes or acid grassland [now not included in revised RMP]). In order to maximise biodiversity gains, to provide an attractive feature and to minimise visual impacts each hide will be topped with a green roof"*

4.5.5 It is noted in the ERMP that the hides are proposed to have a green roof. However, this will be subject to separate design work to determine the practicality of installing and maintaining green roofs on top of shipping containers.

4.6 Water Resource Strategy and Management

4.6.1 All water sources within the site boundary have been evaluated for their potential to support the Wet Grassland habitats. Direct rainfall to the wet grassland areas, runoff from the landfill mound and treated effluent from the MEC are considered to be the most reliable and feasible sources of water supply in the long term.

4.6.2 The continuous daily flow rate within the MEC above Q95 flow (the volume exceeded 95% of the time) is sufficient to sustain the water needs of all three wet grassland areas in all seasons when insufficient water is available from rainfall and runoff capture. Abstraction above the Q95 value safeguards the water needs of the downstream environment. Further information on the proposed water resource strategy is described in the Water Resource Report in **Appendix D**.

4.6.1 It is proposed to line the wet grassland areas such that water loss will be predominantly by evaporation, minimising water requirements. The calculated loss of water volume in each habitat, has informed the recommended monitoring frequency.

4.6.2 Water level management will be undertaken with the aim of developing cycles of water levels throughout the creation, aftercare and long-term management phases for the wet grassland habitats. Water levels will be managed through a system of adjustable weirs so that levels in each of the wet grassland habitats and lakes are suitable for target bird species and maintenance requirements.

4.6.3 The impacts of climate change have been considered and an adaptive approach to management discussed within the Habitat Management Plan. Management of the wet grassland during flood conditions needs to ensure the operation of the Wandle Flood Alleviation scheme is not altered to safeguard communities downstream. Increased monitoring during drought conditions will allow for frequent water abstraction of smaller volumes, whilst ensuring sufficient water for downstream habitats.

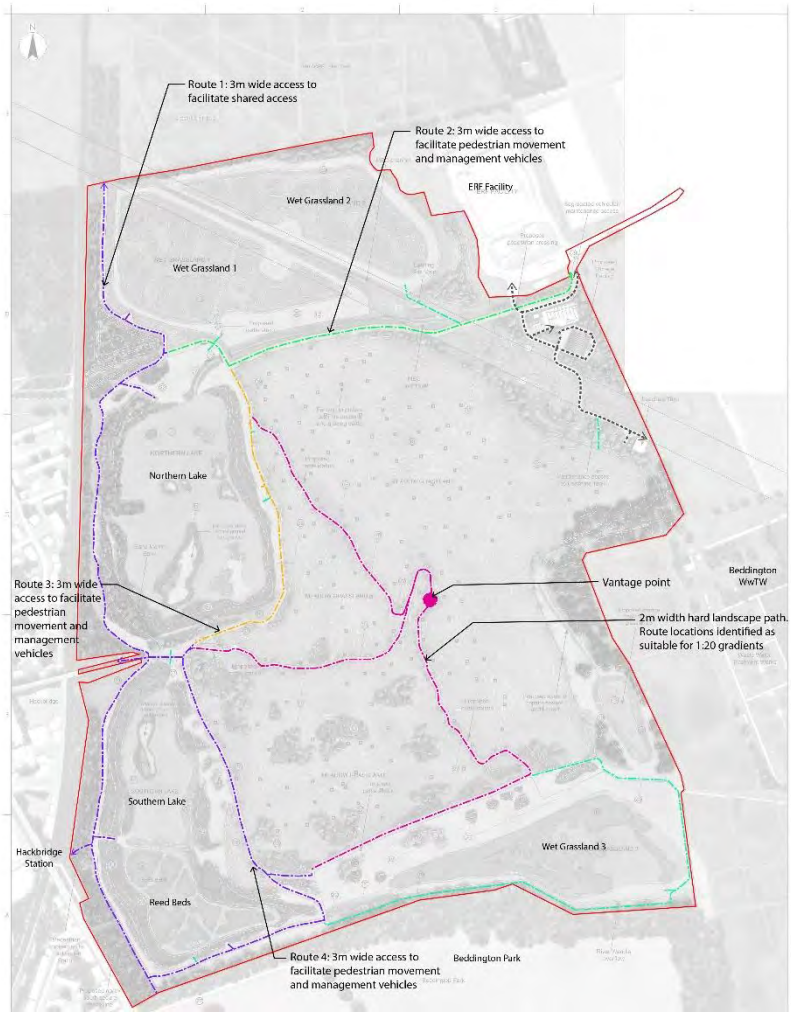
4.6.4 Should wet grasslands dry out during extreme drought, then birds should be able to make use of the lakes which are larger and deeper and therefore more likely to retain water.

4.7 Public Access Routes

4.7.1 A network of routes has been identified across the Site to facilitate public access, to promote habitat observation, provide amenity benefits, and protect the wildlife on Site. All routes have been designed in accordance with best practice inclusive mobility guidance. Each route has been considered in relation to what their intended use is, i.e. wide enough to facilitate side by side footfall traffic, future management operations and shared footway/cycle provision.

4.7.2 Gradients have also been considered carefully. Routes which approach higher levels of the former landfill have been designed to ensure a 1:20 gradient is achieved to promote good accessibility for all users. The public access routes are identified on the Restoration Masterplan. Figure 2 provides a summary of each route and its location.

Figure 2 Access Routes



4.7.3 **Route 1 - Permissive Footpath:** the route runs north to south along the entire length of the western boundary and will also be augmented by a circular link around the Southern Lake and an access point into the Site from Hackbridge Station.

4.7.4 **Route 2 - Shared Access East/West Link:** provides an east-west link across the northern portion of the Site. It will connect with the Northern Lake access route and crosses the Site to the south of the MEC overflow channel.

4.7.5 **Route 3 - Northern Lake Circular Route:** the route performs two functions, firstly, it provides a circular walk around the Northern Lake when utilised with the north/south permissive route. In addition to this, the path provides access to the centre of the Site at its highest point, providing views of Beddington, Hackbridge, Croydon and the surrounding urban landscape.

4.7.6 **Route 4 - Southern Lake Route:** provides a circular route around the central/southern part of the Site, allowing views over the Southern Lake, wet grasslands to the south of the Site as well as accessing the highest point of the Site for wide-ranging views.

4.7.7 Further information for route opening/closing times is provided in the Communication and Access Strategy which will be submitted as part of the current planning application.

4.7.8 New access paths will meet Objective 7 of the CMS specifically, “to create an appropriate level of public access to allow enjoyment of the restored landform without impacting upon the nature conservation impacts of the Site”.

4.7.9 The paths are connected to the proposed bird hides and located behind screening vegetation where they run adjacent to sensitive habitats. Gates will be included to prevent public access during sensitive periods or where management is being carried out and where people’s welfare is prioritised (e.g., during livestock grazing on meadow habitats).

4.7.10 Gates will be installed to control visitors’ movement around the Site. Specific gates will be closed at times of the year to ensure the appropriate level of protection is given to habitats and target species. Gates to facilitate future habitat management operations are strategically positioned around the Site.

4.8 Shared Footway/Cycle Access

4.8.1 The shared footway/cycle link running east/west to the north of the former landfill will be compliant with National Cycle Network and Department for Transport (DfT): Cycle Infrastructure Design Guidance and will also be accessible to wheelchair users.

4.8.2 The route will be a 3.0m minimum width for the entirety of the east/west link. The path line is to be prepared with a maximum linear gradient of 3%, although where unavoidable an absolute maximum gradient of 5% is permissible for maximum 100m lengths.

4.8.3 New cycleways and public access paths will meet Objective 7 of the CMS specifically, “to create an appropriate level of public access to allow enjoyment of the restored landform without impacting upon the nature conservation impacts of the Site”.

4.8.4 The path is to be finished with a 50mm surface layer aggregate to 12mm to dust to constitute self-binding material. This will be applied to paths of both 2m and 3m width. The surface layer is to have a compacted and self- bound surface that will be suitable for cycle use. The finished surface is to have a 2.5% cross fall or camber to enable water to naturally disperse and will have no depressions or low patches where water could collect.

4.9 Access Control

4.9.1 To control access to both protect habitats and allow for ongoing management, gates and fences will be erected across the Site. The locations of these and how they tie in to the proposed paths is presented in Figure 3.

4.9.2 A combination of manually operated lockable gates, automatic gates for foot and vehicular access coupled to signage will be provided to prevent trespass at night and manage site behaviours.

Figure 3 Gates and Fencing

4.9.3 Security gates will also be installed at the Site entrance at Beddington Lane, while 3 separate gates will be staggered along the permissive footpath which will prevent access to the Site at certain times of the day. The security gates will be accompanied by secure fence lines which will extend north to south along the permissive footpath and around the ERF facility.

4.9.4 Stock fencing will enclose the meadow grassland and footpath routes which take route through the habitat, the fencing will provide an enclosure for future grazing whilst preventing access by members of the public into sensitive habitats.

4.9.5 Maintenance gates will be used by Site operatives to access the meadow grassland habitat. Gates are also strategically placed to facilitate the movement of livestock between the field parcels which are divided by the walking routes.

4.10 Predator Exclusion Fencing

4.10.1 To protect target bird species and other waders, predator proof fencing will be erected around Wet Grasslands 1, 2 and 3. Maintenance gates along the fence line will allow future access for management.

4.10.2 Fences will be of a suitable specification to prevent incursion of terrestrial predators, including foxes and badgers, but will also prevent dogs moving into the habitat from adjacent paths and disturbing nesting or roosting birds.

4.10.3 Fences will include an angled return at the top to prevent them being scaled, but also incorporate a below ground return to reduce the likelihood of them being dug underneath. Fences will be made of galvanised steel or equivalent with a mesh of dimensions small enough to prevent small predators (e.g. mink and rats) passing through.

4.10.4 The detailed design of the exclusion fences, including routes of access for maintenance vehicles, will be determined once the alignment has been confirmed.

4.10.5 Fences along the eastern boundary of both lakes will tie into existing fences, which may themselves be upgraded, if necessary, to ensure they are predator proof. All fences will be checked monthly and maintained such that any breaks are repaired as soon as they are identified.

4.10.6 No provision is included in this RRMP to exclude avian predators such as corvids and raptors. Should individual birds become a nuisance and have an impact on nesting success of waders then management practices can be discussed with the Site Restoration Manager to prevent further nest loss.

4.11 Stock Fencing

4.11.1 The gas vents on Site with be protected from potential damage by grazing livestock by erecting stock fencing around each individual vent. This will prevent livestock getting too close or stepping on the structures.

4.11.2 The stock fencing and locked gateway access, in addition to hedgerow boundaries along public access routes within locations where gas vents are present, will prevent public access and avoid accidental or intentional damage by visitors to the Site.

4.11.3 The detailed design of the stock fences, including routes of access for maintenance vehicles, will be determined once the alignment has been confirmed and on agreement with LBS, the BFBG and Site Restoration Manager.

4.12 Livestock Infrastructure

4.12.1 The presence and distribution of livestock on Site will be coordinated by Valencia, the appointed grazier and Site based staff.

4.12.2 Livestock will be used to graze areas of meadow grassland and neutral grassland, on a rotational and seasonal basis. These grassland areas have been sub-divided on Site to facilitate the rotational management regimes set out in the LEMP.

4.12.3 The water provision for livestock has been considered and proposed water stations have been proposed within grazing areas near to the gateway/access points.

5 Phasing and Implementation

5.1 Overview

5.1.1 The phasing programme to create each habitat type on Site is detailed in Phasing Programme **Appendix B** with the Phasing figures presented in **Appendix C**. Consultation with LBS, the BFBG and the CSG will be carried out to confirm the proposed timelines are feasible and account for any current Site-based activities.

5.1.2 The ERMP originally proposed to develop discrete areas of land which became available following the cessation of operational activity. However, as the Site has been largely capped already, this approach is no longer appropriate. Nonetheless, where elements of the ERMP remain valid they have been included in the proposed phasing approach set out below.

- Following habitat creation outlined in the HMP, all areas of restored habitat will be maintained in line with the agreed restoration and management prescriptions detailed within the LEMP.
- Although not currently present on Site, the tree sparrow habitat requirements, in particular the provision of nesting habitat (in particular nest boxes), will be considered throughout the restoration programme. This may include erecting nest boxes to offer alternative habitat to birds displaced by ongoing works.
- All restoration works will need to be cognisant of the breeding bird season (March to August inclusive) of both target and non-target bird species.
- The implementation of the restoration works will be undertaken by employing the services of a reputable contractors. Contractors will work under the supervision of suitably qualified ecologists working on behalf of Valencia. Throughout the restoration programme, Valencia, the Contractors and ecological consultants will liaise with the Beddington Farmland Bird Group and Site Restoration Manager.

5.2 Monitoring

5.2.1 The ERMP committed the then client, Viridor, to undertake a period of monitoring to confirm the success of uptake of the target species and development of target habitats. However, as the assemblage of target species has changed, and the habitats created on Site have been altered given the unviability of some, the post works monitoring should account for this.

5.2.2 Any monitoring programme will be agreed with between, Valencia, the Conservation Science Group, the Beddington Farmland Birds Group, LBS and the Site Restoration Manager.

5.2.3 To monitor habitats, a survey using UKHab methodology and incorporating a Habitat Condition Assessment will be carried out annually during habitat creation to ensure habitats have established themselves successfully and prior to the onset of the aftercare period detailed in the LEMP. Species lists, incorporating a DAFOR assessment will be included. This approach will allow future biodiversity net gain assessments to be carried out to confirm the habitat is attaining its anticipated condition. Monitoring will be carried out by a suitably experienced ecologist appointed by Valencia.

5.2.4 After the habitat has been created and moved to the aftercare period it will be subject to further monitoring in years 1-3, 5,7 and 10 and every 5 years thereafter. Again this monitoring will use UKHab methodology.

5.2.5 Further botanical assessment of grassland habitats will be undertaken to monitor the success and development of the restoration project. This will follow standardised National Vegetation Classification (NVC) methodologies (JNCC, 2014[15]). This will be undertaken between every 4 and 5 years during the aftercare period. The NVC survey will record desirable and undesirable species and help inform management interventions such as enhanced cutting regimes, weed control or increases in grazing pressure. The data gathered from the NVC survey will support that obtained by the more frequent UKHab Survey and Condition Assessments.

5.2.6 Woodland, native scrub, ruderal vegetation and hedgerows will be monitored for survival, growth rate and weed control to inform replacement of failures, further weed control and devise an appropriate pruning / trimming strategy. Proposed interventions are provided in the Habitat Management Plans which support this RRMP.

5.2.7 Water levels will be monitored monthly throughout the year for all water bodies (Northern and Southern Lakes, Reedbed Lake) and wet grassland habitats. However, during summer (June – August) when drought conditions are more likely, then monitoring will be undertaken weekly. The supporting Water Resources Management Plan in **Appendix D** and Habitat Management Plan provide the basis for this timing being deemed sufficient.

5.2.8 Island habitats will be monitored annually to confirm availability of suitable nesting habitats, including gravel and pebble substrates remain weed free. Should these sites become overgrown with weeds then the installation of a weed membrane just below the substrate can be considered. This may also be a suitable alternative to weed control using spot treatments.

5.2.9 The need for any adaptive management throughout each and as far as the 5-year aftercare period will be discussed between the Client, Contractors, including ecological sub-contractors, Beddington Farmland Bird Group and the Site Restoration Manager. Interventions for each habitat type are included in the supporting Habitat Management Plan.

5.2.10 The presence / absence of invasive and noxious species will be recorded to inform management and control strategies.

Infrastructure

5.2.11 Pathways, cycle lanes, fence lines, bird hides and elements needed to support livestock will be monitored annually and repaired where defects are recorded. However, predator proof fencing should be checked monthly during the breeding season for signs of wear and tear and repairs put in place immediately.

Birds

5.2.12 Monitoring of bird populations will be undertaken to determine the success of the restoration plan with regards to target species.

5.2.13 All surveys should consider the Site as a whole, timed to occur in the appropriate season (breeding, passage and winter seasons) and include sufficient visits such that data collected is robust and comparable across years. The purpose, methodology and frequency of surveys adopted should be discussed between the Client, BFBG, CSG and Site Restoration Manager. Data collected should have a clear purpose and relate back to the restoration of the Site, including target species.

[15] JNCC (2006). *National Vegetation Classification: Users' handbook*. JNCC: Peterborough

Bats

5.2.14 To determine the bat assemblage using the Site, and confirm Objective 5 is being met, a series of bat surveys is recommended. Surveys may utilise bat transects, as has been done in previous years, or rely on remote monitoring using static bat detectors distributed across the Site. All surveys should comply with Bat Conservation Trust Guidelines[16].

5.2.15 Surveys for bats do not need to be annual and can be programmed every 2-3 years. Again the purpose of the data collection needs to be relatable to Objective 5 set out in the CMS and presented in this RRMP.

Public access

5.2.16 Public access will be monitored throughout the year to assess human impacts on infrastructure and habitats. Interventions such as closing footpaths to allow maintenance, to limit disturbance to breeding birds, to permit grazing and mowing or to address anti-social behaviour will be managed by the Site Restoration Manager.

[16] Collins (2023) Bat Surveys for Professional Ecologist: Good Practice Guidelines.

6 Future Document Revision

6.1.1 To confirm that the habitats on Site are developing in line with the RRMP and supporting documentation, in particular the LEMP, it is recommended that they are subject to a review. Indeed, it will also be necessary to revisit the supporting HMP and Biodiversity Net Gain Assessment.

6.1.2 Perhaps the most critical periods are: on completion of grassland habitats (meadowland and other neutral grassland), and successful establishment of the wet grasslands and reed beds, and; again after 4-5 years after the commencement of the aftercare period for each of these habitats.

6.1.3 As such it is recommended that all documents are reviewed and updated where necessary no more than 5 years after grassland habitats, wet grasslands and reed bed habitats have been created, and again 5 years into the aftercare period. All documents should be viewed as iterative and adaptable based on monitoring results so that habitats are modified and maintained to support target species.

6.1.4 It would also be appropriate to continue to review the CMS objectives in so far as including additional bird species which may be experiencing European and National declines. Changes in habitat types or management regimes should be adaptable so that Beddington Farmlands can support threatened or declining species throughout the year.

7 The "60 Year" Vision

7.1.1 It is anticipated that Beddington Farmlands will be a haven for wildlife making use of the wide diversity of fully restored habitats available on Site. The outcome for each of the habitats, accounting for the management prescriptions adopted until year 60, is provided in the supporting LEMP.

7.1.2 The Site will form part of a coherent ecological network linked to the wider Wandle Valley Regional Park and support fully functional ecological systems. The Site will host a significant assemblage of notable local and regional species of conservation value and be recognised for its significant contribution to conservation in the Greater London Area.

7.1.3 The creation and management of wet grassland will provide opportunities for foraging and breeding waders, including target species like lapwing. It is hoped that the long-term management of this habitat will encourage birds formerly known to be present to return to the Site and breed, in particular redshank, yellow wagtail and tree sparrow. By maintaining areas of standing water in association with these grasslands, and to include reedbeds, habitats will be available for a variety of passage and migrant wildfowl, passerines and reedbed species, including warblers and buntings.

7.1.4 Both the meadow grassland and neutral grasslands will offer foraging opportunities for a range of species, including waders, but also provide ideal habitat for ground nesting species such as skylark and meadow pipit. With the appropriate management of grasslands, it is envisaged that floristic diversity will increase which in turn will provide opportunities for invertebrate species, many of which will provide a food resource for birds, bats and small mammals, thus increasing the overall biodiversity of the Site.

7.1.5 Sympathetic management of woodland and scrub habitats, including the provision and monitoring of bird boxes will be crucial in supporting the tree sparrow population. Within 60 years it would be hoped that the Site supports a self-sustaining population of this target species.

7.1.6 On of the key objectives of this RRMP is to support the bat assemblage and enable Beddington to become a Site of Metropolitan Importance to bats. By improving the abundance and distribution of habitats which are of value for roosting, foraging and commuting bats, in particular mature woodland and hedgerows, and improving the available food resource, both bat assemblage and use of the Site will increase.

7.1.7 Enhancing the outdoor experience of the public at Beddington with numerous bird hides, suitable walkways and shared access routes and a viewpoint overseeing the Site and wider environment will be crucial to its long-term success. By encouraging the public on to the Site, whilst being mindful of the key objectives to support wildlife conservation, they will become personally invested in the Site and work towards its long-term maintenance for future generations.

7.1.8 Only through on-going public engagement and developing the passion for the Site and the species it hosts, will Beddington Farmlands be well placed to adapt to the challenges of climate change. The long-term management proposals set out for the next 60 years will allow an early indication of changes to be identified and adaptive management to be put in place.

8 Conclusions

8.1.1 This RRMP, which is based on that previously adopted since 2015, sets out an approach to create and manage a range of habitats necessary to meet seven key objectives originally set out in a CMS drafted in 2012. These objectives were based on those proposed in 1994 which related to only a small part of the Site. Further investigations, in particular an understanding of soil type, the availability of water to support wetted habitats, and opportunities to abstract water from the River Wandle have been undertaken.

8.1.2 Further, since the ERMP was drafted it has been confirmed that some habitats previously proposed were not viable or would be difficult to maintain (acid grassland and heathland / wet grasslands), while the inclusion of reedbeds in the desired Reedbed Lake may not have been subject to detailed investigation as to its suitability. The Site has also lost a number of target species, including redshank and yellow wagtail. Tree sparrow populations are also considered to have been lost from the Site in recent years.

8.1.3 Given the changes on Site and the availability of new information, there was a requirement to update the ERMP to ensure it was fit for purpose. This revision has relied on current data and as such has made changes to the type and distribution of habitats around the Site. Crucially it has intended not to deviate significantly from the ERMP and it is envisaged that it will still meet the original objectives.

8.1.4 Provided this RRMP and the supporting LEMP and HMP are followed, updated as required, and adaptive management is put in place to account for climate change, then the land at Beddington Farmlands should become an established Site of significant conservation value, demonstrate a biodiversity net gain, while facilitating its enjoyment by members of the public.

Appendix A Restoration Masterplan

LEGEND

- Red line boundary

Existing Soft Landscape

1. Waterbodies
2. Existing reed beds
3. Existing native scrub
4. Existing bramble scrub
5. Existing willow scrub
6. Existing marginal planting

Proposed Soft Landscape

7. Proposed reed beds
8. Proposed native scrub
9. Proposed meadow grassland
10. Proposed neutral grassland
11. Proposed wet grassland
12. Proposed riparian edge mix
13. Proposed amenity grass (mown)
14. Proposed winter seed crop
15. Proposed individual trees
16. Proposed broadleaf woodland
17. Proposed aquatic planting
18. Proposed marginal planting
19. Proposed native hedgerow

Existing Hard Landscape

20. Existing maintenance gate
21. Existing habitat protection fencing
22. Existing bird hide location

Proposed Hard Landscape

23. Proposed bird hide location
24. Proposed access routes
25. Proposed maintenance gate
26. Proposed shared ped/maintenance gate
27. Proposed pedestrian gate
28. Proposed habitat protection fencing
29. Proposed security fencing
30. Proposed boundary fencing
31. Proposed bench

Notes:

NOTES:

1. The position of any existing public or private sewers, utility services, plant or apparatus shown on this drawing is believed to be correct, but no warranty to this is expressed or implied. Other such plant or apparatus may also be present but not shown. The Contractor is therefore advised to undertake their own investigation where the presence of any existing sewers, services, plant or apparatus may affect their operations.
2. The intended purpose of this illustrative masterplan is for planning only. Further design work will be required at subsequent work stages.

P02 FOR PLANNING	CC	EH	2024.01.24
P01 FIRST ISSUE	CC	EH	12.09.2023
Issued/Revision	By	Appd	YYYY.MM.DD

Issue Status

FOR PLANNING

This document is suitable only for the purpose noted above.
Use of this document for any other purpose is not permitted.

Stantec

Stantec UK Limited
Caversham Bridge House, Waterman Place
Reading
RG1 8DN
Tel. +44 1189 500 761
www.stantec.com/uk

Client/Project Logo:

Valencia waste

Project:

Beddington Farmlands

Landscape Restoration Masterplan

	LYC	EH	EH	2024.01.24
	Dwn	Dsgn.	Chkd.	YYYY.MM.DD

Title

Landscape Restoration Masterplan

Project No.	A1 Scale
331201345	1:2000
Revision	**Drawing No.**
P02	**331201345_3001**

ORIGINAL SHEET - ISO A1 k:\331201345_beddington_landfill_phase_2\600 - landscape architecture\drawings (cad)\drawings\331201345_3001_restoration masterplan a1_1-2000
Plotted: 26.01.2024 2024.01.26 2:20:29 PM By: Cheung, Carol

Appendix B: Phasing Programme

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ACTIVITY	PHASE OF WORKS	ACTIVITY DETAIL	TIMELINE
			YEAR 0: Q4 2023 · YEAR 1: Q1 2024, Q2 2024, Q3 2024, Q4 2024, Q1 2025, Q2 2025, Q3 2025, Q4 2025 · YEAR 2: Q1 2026, Q2 2026, Q3 2026, Q4 2026 · YEAR 3: Q1 2027, Q2 2027, Q3 2027, Q4 2027 · YEAR 4: Q1 2028, Q2 2028, Q3 2028, Q4 2028 · YEAR 5: Q1 2029, Q2 2029, Q3 2029, Q4 2029 · YEAR 6 · YEAR 7 · YEAR 8 · YEAR 9 · YEAR 10 · YEAR 11 · YEAR 12 · YEAR 13 · YEAR 14 · YEAR 15 · YEAR 16 · YEAR 17
Application submission	Pre-Construction Activity	*Jan-24*	
Application determination		*Assumed Aug 2024*	
Survey's / licenses		*Included for further survey work to support detailed design phase (utilities, topo)*	
Detailed design		*1. storage cabin 2. access routes 3. wet grassland phases 1, 2 and 3 levels design. 4. full landscape plans including schedules and quantities for both hard and soft.*	
Consents		*Flood Risk Activities Permit for construction of hydraulic infrastructure to water the Phase 3 wet grassland. Revision to existing Recovery Permit to import soils for Northern flank. Any works on the Wandle Overflow Channel will potentially need a Main River Authorisation from the EA*	
Contractor procurement/mobilisation period		*Assume this is undertaken to appoint suitable contractors for the works described above. (storage cabin / hard and soft landscape / civils)*	
Habitat screening protection	Phasing figure yrs 0-1	*Erection of all screening fencing to protect priority habitats on-site. E.g. - northern lake eastern boundary*	
Installation of proposed bird hides	Phasing figure yrs 0-1	*4 new locations in total*	
Construction and widening of the permissive footpath north/south	Phasing figure yrs 0-1	*Construction of the permissive footpath to be undertaken in accordance with the Arboriculture Construction Methodology*	
Construction of all other footpath routes with the red line boundary	Phasing figure yrs 0-1	*Duration extended due to bird nesting season*	
Construction of all fencing and gates	Phasing figure yrs 1-2	*Duration extended due to bird nesting season*	
Opening of southern lake & reedbed footpath	Phasing figure yrs 1-2	*Gates to other routes around the site will remain closed until construction activity has been completed.* *Final opening times to be reviewed against ecological site conditions and will be moved if deemed the introduction of people around the site would have a negative impact on the site conservation.*	
Construction of storage cabin	Phasing figure yrs 1-2		
Northeastern access carriageway decommissioning and minor works to facilitate access links to the leachate tank	Phasing figure yrs 1-2		
Wet grassland 1 construction works	Phasing figure yrs 0-1	*Minor reprofiling and lining*	
Wet grassland 1	Phasing figure yrs 1-2	*Wet grassland seed mix and netural grassland seed mix to upper embankments*	→ Yr 1 - S · Yr 2 - S · Yr 3 - S · Yr 1 - M · Yr 2 - M · Yr 3 - M · Yr 5 - M · Yr 7 - M · Yr 10 - M
Wet grassland 2 construction works	Phasing figure yrs 1-2	*Earthworks and lining*	
Wet grassland 2	Phasing figure yrs 1-2	*Wet grassland seed mix and netural grassland seed mix to upper embankments*	→ Yr 1 - S · Yr 2 - S · Yr 3 - S · Yr 1 - M · Yr 2 - M · Yr 3 - M · Yr 5 - M · Yr 7 - M · Yr 10 - M
Wet grassland 3 construction works		*Minor reprofiling and lining*	
Wet grassland 3		*Wet grassland seed mix and netural grassland seed mix to upper embankments*	→ Yr 1 - S · Yr 2 - S · Yr 3 - S · Yr 1 - M · Yr 2 - M · Yr 3 - M · Yr 5 - M · Yr 7 - M · Yr 10 - M
Winter Seed Crop			→ Yr 1 - S · Yr 2 - S · Yr 3 - S · Yr 1 - M · Yr 2 - M · Yr 3 - M · Yr 5 - M · Yr 7 - M · Yr 10 - M
Neutral grassland	Phasing figure yrs 2-3	*Northern , southern , eedbed lakes and wet grassland 3 to upper embankments*	→ Yr 1 - S · Yr 2 - S · Yr 3 - S · Yr 1 - M · Yr 2 - M · Yr 3 - M · Yr 5 - M · Yr 7 - M · Yr 10 - M
Reed bed islands	Phasing figure yrs 2-3	*Bird breeding season will push this work into Autumn/Winter 2026*	→ Yr 1 - S · Yr 2 - S · Yr 1 - M · Yr 2 - M · Yr 3 - M · Yr 5 - M · Yr 7 - M · Yr 10 - M
Native hedgerows	Phasing figure yrs 2-3	*Implementation of hedgerow planting to commence alongside fencing installation*	→ Yr 1 - S · Yr 2 - S · Yr 3 - S · Yr 1 - M · Yr 2 - M · Yr 3 - M · Yr 5 - M · Yr 7 - M · Yr 10 - M
Meadow grassland - Parcel 1	Phasing figure yrs 0-1	*Cultivation of meadow grassland area to be split into 2 manageable parcels. Each will be worked on at the beginning of the growing season. Duration extended to allow for bird nesting seasons.*	→ Yr 1 - S · Yr 2 - S · Yr 3 - S · Yr 1 - M · Yr 2- M · Yr 5 - M · Yr 5 - M · Yr 7 - M · Yr 10 - M
Meadow grassland - Parcel 2	Phasing figure yrs 0-1	*Cultivation of meadow grassland area to be split into 2 manageable parcels. Each will be worked on at the beginning of the growing season. Duration extended to allow for bird nesting seasons.*	→ Yr 1 - S · Yr 2 - S · Yr 3 - S · Yr 1 - M · Yr 2- M · Yr 3 - M · Yr 5 - M · Yr 7 - M · Yr 10 - M
Native/bramble scrub	Phasing figure yrs 2-3		→ Yr 1 - S · Yr 2 - S · Yr 1 - M · Yr 2- M · Yr 3 - M · Yr 5 - M · Yr 7 - M · Yr 10 - M
Individual tree planting	Phasing figure yrs 2-3		→ Yr 1 - S · Yr 2 - S · Yr 3 - S · Yr 1 - M · Yr 2- M · Yr 3 - M · Yr 5 - M · Yr 7 - M · Yr 10 - M
Lake Islands	Phasing figure yrs 0-1	*Northern/Southern Lake vegetation management and sowing of marginal species mixes and habitat division of islands to ensure low/medium/gravel/bare ground proportions are created.*	→ Yr 1 - S · Yr 2 - S · Yr 3 - S · Yr 1 - M · Yr 2- M · Yr 3 - M · Yr 5 - M · Yr 7 - M · Yr 10 - M
Installation of site wide wayfinding and signage	Phasing figure yrs 2-3 & Phase figure yrs 3-4		Southern Lake Only to aid potential early opening · All other paths
Installation of livestock troughs	Phasing figure yrs 2-3		
Opening of northern lake and east/west link	Phase figure yrs 3-4	*Final opening times to be reviewed against ecological site conditions and will be moved if deemed the introduction of people around the site would have a negative impact on the site conservation.*	
Opening of footpath routes that access the former landfill	Phase figure yrs 3-4	*Final opening times to be reviewed against ecological site conditions and will be moved if deemed the introduction of people around the site would have a negative impact on the site conservation.*	
Infill of phase 10 earthworks	Phasing figure yrs 0-1	*Estimated 5 years due to soil availability*	
Phase 10 - swale and storage basin construction	Phase figure yrs 3-4	*Earthworks and lining*	→ Yr 1 - S · Yr 2 - S · Yr 1 - M · Yr 2- M · Yr 3 - M · Yr 5 - M · Yr 7 - M · Yr 10 - M
Phase 10 - swale and storage basin planting	Phase figure yrs 4-5	*Aquatic planting and hedgerows*	→ Yr 1 - S · Yr 2 - S · Yr 3 - S · Yr 1 - M · Yr 2 - M · Yr 3 - M · Yr 5 - M · Yr 7 - M · Yr 10 - M
Phase 10 - swale and strorage basin grassland establishment	Phase figure yrs 4-5	*Wet grassland seeding mix and netural grassland to the upper embankments*	
Phase 10 - meadow grassland	Phase figure yrs 3-4	*Phase 10 meadow grassland creation will be the final parcel to be sown following inportation of fill materials to restore proposed levels and the construction of the eastern swale and storage basin.*	→ Yr 1 - S · Yr 2 - S · Yr 3 - S · Yr 1 - M · Yr 2- M · Yr 3 - M · Yr 5 - M · Yr 7 - M · Yr 10 - M
Phase 10 - woodland and tree planting	Phase figure yrs 3-4		→ Yr 1 - S · Yr 2 - S · Yr 3 - S · Yr 1 - M · Yr 2- M · Yr 3 - M · Yr 5 - M · Yr 7 - M · Yr 10 - M

Each habitat long term management to continue beyon initial timeframe up to years 60 →

Each habitat long term management to continue beyon initial timeframe up to years 60 →

Each habitat long term management to continue beyon initial timeframe up to years 60 →

Start of the 5 year construction phase

End of the 5 year construction phase

KEY

- **Pre-construction Activity**
- → **Habitat creation** (Creation measures for each habitat are set out in the HMP)
- **Aftercare of Habitat Commences** (Aftercare maintenances percriptions are set out in the LEMP and Habitat management measures are defined within the HMP) Note: 5 year aftercare phase starts at the point each habitat is implimente
- **Long term management regimes** (Following the 5 year aftercare period up to years 60 for each habitat as defined within the HMP/LEMP)
- **Opening of specific site areas** (subject to review of ecological conditions)
- **Construction activity for hard landscape, built form and engineering works**

Yr 1 - S (etc) **Survey's to determin habitat creation success** (To align with aims of BNG outputs)

Yr 1 - M (etc) **Habitat monitoring for aftercare and longer management periods in accordance with the HMP/LEMP**

Appendix C Phasing Figures

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3 Corner Field

ERF Facility

WET GRASSLAND PHASE 1 STARTS

MEC Overflow

Fencing to protect gas infrastrucure and grazing cattle

MEADOW GRASSLAND PARCEL 2 STARTS

Proposed cattle station

Bird Hide 4

Bird Hide 3

MEADOW GRASSLAND

PHASE 10 INFILL STARTS Yr 0-5

MEADOW GRASSLAND PARCEL 1 STARTS

Bird Hide 2

WET GRASSLAND PHASE 1 STARTS

Hackbridge Station

Bird Hide 1

Beddington Park

CONSTRUCTION PHASING: Years 0-1

Beddington Farmlands

- Habitat protection fence line (construction mitigation)
- Implementation of proposed bird hides
- Cattle station installation

Routes, Fencing & Gates:

- All footpaths routes constructed
- Security fence installed
- Predator fencing installed
- Boundary stock fencing installed
- Shared vehicular gates installed
- Vehicular maintenance gates installed
- Pedestrian gates installed

Southern Lake Wayfinding

- Visitor welcome sign installation
- Unauthorised cycle access sign installation
- Bird hide interpretation board installation
- Directional fingerpost installation
- Storage cabin construction
- Northeastern access works

CONSTRUCTION PHASING: Years 2-3

Beddington Farmlands

Wayfinding (remaining site)

- Visitor welcome sign installation
- Unauthorised cycle access sign installation
- Bird hide interpretation board installation
- Vantage point interpretation board installation
- Directional fingerpost installation
- Prohibited public access sign installation

Hedgerow & Planting

- Planting of all native hedgerows
- Reed bed planting works
- Individual tree planting
- Native scrub planting works
- Neutral grassland seeding works (3 year duration)
- Winter bird seed mix

3 Corner Field

ERF Facility

NORTHERN LAKE

NORTHERN LAKE & ALL OTHER ROUTES OPEN TO THE PUBLIC (SUBJECT TO ECOLOGICAL CONDITIONS)

MEADOW GRASSLAND PARCEL 2 ONGOING

PHASE 10 INFILL ONGOING Yr 0-5

Beddington WwTW

MEADOW GRASSLAND PARCEL 1 ONGOING

Hackbridge Station

Beddington Park

CONSTRUCTION PHASING: Years 3-4

Beddington Farmlands

* **Northern Lake and all footpath routes open to the public (subject to ecological conditions)**

Open routes (Subject to ecological conditions)

CONSTRUCTION PHASING: Years 4-5

Beddington Farmlands

- Planting of native hedgerow
- Planting of broadleaf woodland
- Construction of swale and storage basin
- Individual tree planting
- Boundary stock fencing installed

Appendix D Water Resources Report

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Beddington Farmlands

Water Resources Report

On behalf of **Valencia Waste Management Ltd**

Project Ref: 331201345 | Rev: D | Date: February 2024

Registered Office: Buckingham Court Kingsmead Business Park, London Road, High Wycombe, Buckinghamshire, HP11 1JU
Office Address: Caversham Bridge House, Waterman Place, Reading RG1 8DN
T: +44 (0)1823 218 940 E: Reading.UK@stantec.com

Document Control Sheet

Project Name: **Beddington Landfill Phase 2**

Project Ref: **331201345**

Report Title: **Water Resources Report**

Doc Ref:

Date: **08 February 2024**

	Name	Position	Signature	Date
Prepared by:	Serena Grant Francess Haine	Assistant Engineer Geomorphologist		06/10/2023
Reviewed by:	Stephanie Dufour	Senior Associate		08/02/2024
Approved by:	Natalie Maletras	Director of Environmental Consulting		08/02/2024
For and on behalf of Stantec UK Limited				

Revision	Date	Description	Prepared	Reviewed	Approved
A	06/10/2023	First draft – for information	SG/FH	SD	
B	02/11/2023	Amended following Client review	SG/FH	NM	
C	17/11/2023	Amended following LPA review	SG/FH	SD	
D	08/02/2024	Issued for planning submission	SG/FH	SD	

Contents

Figures

Tables

1 Introduction

1.1 Purpose of Report

1.1.1 This report has been produced by Stantec UK Ltd ('Stantec') on behalf of Valencia Waste Management ('the Client') to support a planning application to revise the previously consented, extant Restoration Management Plan (ERMP) for Beddington Landfill site in Beddington, south London ('the Site').

1.1.2 This water resources report was produced to provide an assessment of the water needs of the wet grassland habitats and the suitability of the available water sources at the Site to meet these needs, providing part of the evidence base for the amended habitats presented within the revised RMP (RRMP).

1.2 Previous Studies

Restoration Management Plan

1.2.1 The ERMP (13 -1595 3204 D18 v 9.1) was prepared and accepted in relation to fulfilling condition 42 of Planning Permission D2012/66220/FUL. The document was prepared by Lockhart Garratt Ltd for the previous owners of the site Viridor Waste Management Ltd. ('Viridor') in 2015.

1.2.2 The ERMP stated that water for the wet grassland would be sourced from the existing site conditions.

> *"Suitable water levels will be achieved by a combination of factors including developing the habitat as close to water table as possible, modification of substrate, maximising use of rainfall through control of outflow and control of water inflow from designated water sources.*
>
> *Three principal sources of water will be available; ground water, direct rainfall, and indirect rainfall via the surface water drainage system. The grassland will be below the existing perched water table and there will therefore be a general flow of ground water into and through the system. Rainfall onto impermeable areas of the ERF and associated roads will fall directly into the wet grassland. Rainfall entering the ERF drainage system will undergo measures to ensure water quality and enter the three stage 'polishing pond' where outflow into the moats will be controlled by a level controlling weir directly into the wet grassland to the west of the ERF."*

1.2.3 To ensure the water level is maintained, and variable with the seasons, control structures have been included in the design of these habitats.

> *"The wet grasslands will require reliable and controllable water levels. This will be achieved by large channels or moats around each area of grassland which will both supply water to and drain water away from the habitat. The water levels around the moats will be controlled by a system of weirs which will maintain a consistent designated water level (upstream levels will be 500mm above downstream levels). Adjustable tilting weirs at either end of the creeks will allow the controlled movement of water between upstream moats and downstream moats. When flooding of the creeks is required the downstream weir will be raised and the upstream weir will be lowered."*

Thames Water Phase 1 Investigation

1.2.4 Consulting engineers Binnies were commissioned by Thames Water to review and investigate the hydrology within the Beddington Farmlands and Thames Water owned areas. Their January 2023 report was shared by Thames Water to further aid Stantec's understanding of the site water sources. The Phase 1 report established that:

- The Wandle Overflow channel transports flood flows approximately once or twice a year.
- Phase 1 Wet Grasslands are only fed by groundwater and rainwater and during their site visit, only the eastern half was wet.
- Phase 2 Wet Grasslands were not constructed but would be fed by perched groundwater, rainwater and surface water drainage from the ERF balancing pond.
- The Phase 3 wet grasslands were fed by groundwater, rainfall and an offtake from the River Wandle overflow channel.
- Only a few of the SAMs and 100 Acre Lagoons were still in operation and mechanically turned, with water pumped from Cemetery Drain or the area of the Phase 2 Wet Grasslands to support water levels in these habitats. The lagoons were noted to be above the Hackney Gravel Member and therefore water would be lost to the groundwater water table.
- Cemetery Drain and the Northern Drain both receive surface water runoff from the urban area drainage network. The MEC was noted as appearing to be connected into the surface water drainage network.
- Beddington STW discharge consent allows a maximum daily discharge volume of 234,000m3/day which exits the STW into the MEC.
- Downstream of the site, a significant portion of the River Wandle flows are derived from the STW MEC discharge.

1.2.5 The Thames Water report concluded that available water volumes were insufficient to meet the water needs of the lagoons, and further investigations were required to establish a sustainable management plan for the lagoon habitats and wet grassland areas, In particular, groundwater monitoring, ensuring that the habitats were interacting with perched groundwater and level data for the hydraulic structures (weirs) and constructed levels were noted as important for the next stage of the investigation. .

1.3 Sources of Information

1.3.1 The following sources of information have been used to inform this report and the water balance calculations associated with the report:

- Beddington STW weather station data – monthly rainfall data 1936-2017.
- Binnies/Thames Water 'Beddington Farmlands Phase 1 Investigation' report dated January 2023.
- British Geological Survey (BGS) Borehole Records.[1]
- Concept Site Investigations 'Ground Investigation Report – Factual. Beddington GI' dated December 2023, and associated GI testing and groundwater monitoring data.

[1] GeoIndex - British Geological Survey (bgs.ac.uk)

- Environment Agency (EA) 'CAMS: London abstraction licensing strategy: A strategy to manage water resources sustainably' dated January 2020.
- Golder Associates Ltd 'Beddington Farmlands Landfill Site: Hydrogeological Risk Assessment Review' (HRAR) dated October 2020.
- Met Office UK Climate Projections – Headline Findings[2] dated August 2022, and associated datasets.
- Mott Macdonald/Thames Water 'River Wandle Low Flow Investigation Phase 1 – Catchment Wide Review' dated September 2017.
- Mouchel 'South London Energy Recovery Facility [ERF] Flood Risk Assessment' dated July 2012, and associated drainage plan drawings.
- National River Flow Archive (NRFA) 'Wandle at Beddington Park' monitoring station data[3] (historic rainfall 1936-2017; river flow data 2013-2023).
- Site Visit in August 2023 to all on-site hydrological elements, other than those inaccessible due to vegetation growth, and a further visit with the EA in November 2023.
- SLR Consulting Ltd 'Beddington Farmlands Landfill: PPC Application Section A – Environmental Setting and Installation Design' dated October 2004.
- SLR Global Environmental Solutions 'Beddington Farm Landfill Conservation Management Scheme' (CMS) reference 404-0036-00549, dated July 2012.
- Stantec 'Beddington Landfill Phase 2 Ground Investigation Report' dated January 2024.
- Stantec 'Nutrient Assessment' dated February 2024.
- Terence O'Rourke Ltd 'South London ERF: Environmental Impact Assessment' (EIA) Chapter 8: Ground Conditions and Chapter 15: Water Environment dated July 2012.
- Terence O'Rourke Ltd 'South London ERF, Beddington Phase 9 Restoration Plan 2023', drawing 227701B/PL/111E, dated October 2014.
- Thames Water 'Drainage and Wastewater Management Plan [DWMP] 2025-2050', published May 2023.
- Thames Water 'Beddington and Hogsmill Catchment Strategic Plan' [part of the DWMP].
- Thames Water Main Effluent Carrier (MEC) flow data January 2017- December 2022.
- Thames Water UAV aerial photography of the Site.
- UK Centre for Ecology and Hydrology COSMOS-UK Potential Evapotranspiration (PE) data – Writtle site.[4]
- Valencia Topographical Survey 5m grid with contours, dated September 2023.
- Viridor Groundwater Monitoring data from existing on-site monitoring points, 1999-2023.

[2] ukcp18_headline_findings_v4_aug22.pdf (metoffice.gov.uk)

[3] NRFA Station Data for 39004 - Wandle at Beddington Park (ceh.ac.uk)

[4] Site | COSMOS-UK (ceh.ac.uk)

2 Wet Grassland Description

2.1 Wet Grassland Habitats

2.1.1 The three areas of wet grassland at the site (**Figure 2-1**) are referred to in previous reports and the ERMP as the Phase 1, 2 and 3 wet grasslands. For the RRMP and within this report, the three areas are hereafter known as:

- Wet Grassland 1 (north-west corner of Site, constructed)
- Wet Grassland 2 (north-central part of Site, part constructed)
- Wet Grassland 3 (south-east corner of Site, constructed).

Figure 2-1 Wet grassland locations within overall site

2.1.2 Wet grassland habitat is a key habitat for several of the target species described within the Conservation Management Scheme (CMS), in particular lapwing and redshank. The CMS specifies that '*the habitats should target a partly inundated state in winter with a high water level across the remaining area. Over wintering species, including passage migrant wildfowl and passerines, will benefit from food sources while islands created during periods of high water provide a safe refuge from predators. The water level should be allowed to recede from spring onwards to provide large areas of marginal habitat including open muddy edges that grade into shallow water, encouraging nest building and providing suitable food resources for adults and chicks*'.

2.1.3 A constant water source is therefore required throughout the year for the wet grassland habitats, with the ability to vary the water level throughout the seasons. The availability of water sources is discussed in **Section 3.**

2.2 Wet Grassland Description

2.2.1 Wet Grasslands 1 and 3 have been excavated to create a series of ponds, channels and ditches interspersed with vegetated 'island' areas to create suitable breeding and foraging habitat for the target bird species. 'As built' drawings for these habitats are not available. Topographic survey was conducted in September 2023 which determined the constructed size of these habitats. Wet Grassland 2 has been partly constructed but is incomplete at the time of writing this report.

2.2.2 As noted in **2.1.2**, varying water levels are required throughout the year to maintain the wet grassland habitats to the desired condition for the target species. The total volume of water required will be variable per month/season dependent on rainfall and ecological needs of the target species. **Section 3** assesses the potential water source for the wet grasslands, whilst the water requirements are discussed in **Section 4**.

3 Water Sources

3.1 Overview

3.1.1 The Site contains a number of constructed water bodies, ditches and channels which have been evaluated with respect to their potential to supply water to support the wet grassland habitats. The general direction of flow for all elements is from south to north or east to west. A location plan of the water sources is shown in **Figure 3-1**. Each hydrological element is described below.

Figure 3-1 Water Bodies and Channels

3.2 Surface Water Bodies

Northern Lake

3.2.1 The Northern Lake is located on the west side of the Site and occupies an area of approximately 5.2 ha. It was constructed in the 1990s and provided the first large area of permanent fresh water at the Site[5]. Water is supplied to the lake from the south via a culvert from the Southern Lake and the lake provides flood storage as part of the River Wandle Flood Alleviation Scheme (FAS), described in **Section 3.4**.

3.2.2 Additional water supply to the Northern Lake is provided by rainfall. Aerial imagery available via Google Earth (periodically updated between December 2003 - October 2022) shows a seasonal variation in water levels, with lower water levels and some drying out of the lake margins and island areas observable in the imagery during June-October, and the highest water levels observable during January-March. All available imagery shows some water retention in the lake even in the summer months. The available imagery indicates that the lake did not dry out fully during historic recorded drought periods (Google Earth image: July 2018).

3.2.3 Groundwater interaction with the lake is uncertain as as-built drawings were not available. However, other available site data indicates there may be groundwater input. Historic borehole records available via the British Geological Survey indicate that the groundwater level west of the site boundary, adjacent to the housing development west of the Northern Lake, varies from 24.70 – 25.0 mAOD (borehole reference TQ 26 NE/126, TQ 26 NE/132 and TQ 26 NE/137). Site groundwater monitoring data (discussed in **Section 3.7**) indicates that the average recorded groundwater level to the north-east and south-east of the lake is 24.74 mAOD. Water level monitoring data provided to Stantec by the LBS Site Warden indicates that the lake water level recorded during April - August 2023 varied between 24.55 to 24.61m AOD indicating a potential for groundwater interaction in the spring and summer months; therefore it can be assumed that there is likely to also be groundwater interaction in autumn and winter when groundwater levels generally start to rise.

3.2.4 The Main Effluent Carrier Overflow channel (see **Section 3.5**) discharges directly to the Northern Lake. There is the potential for storm overflows into the lake consist of screened but untreated effluent. Overflows occur when the stormwater tanks at Beddington STW are at capacity or during a flood event. The lake additionally receives indirect input from Wet Grasslands 1 and 2 which drain to the lake via the MEC Overflow Channel.

3.2.5 The outlet from the lake is a twin culvert structure with a controlled discharge rate. Water is discharged via a culverted channel alongside the western site boundary to join with flows from the MEC channel and Northern Drain in the north-west corner of the site, all converging into a single channel returning flows to the River Wandle.

3.2.6 The Environment Agency (EA) indicated at a meeting held on 8th September 2023 that any water abstracted from the Site should be taken from watercourses rather than surface water bodies. This is due to consented discharges limiting available water and the dependent ecology associated with the water levels within these habitats. The input of untreated effluent into the lake is also of concern in terms of water quality and transfer of water to other habitats. Therefore the Northern Lake has been excluded as a potential water source for the wet grasslands.

[5] History | Beddington Farmlands (bfnr.org.uk)

Southern Lake

3.2.7 The Southern Lake occupies an area of approximately 1.85 ha and is located to the immediate south of the Northern Lake. It was constructed in 2001 as mitigation for the loss of wetland habitat due to gravel extraction and landfill operations[6]. Water is designed to enter the lake via a tilting weir from the Southern Reedbeds.

3.2.8 The constructed bed level of the lake is unrecorded. Historic groundwater monitoring data at the site has been collected from 2 monitoring points adjacent to the west side of the Southern Lake (1BF028WM) and in the south-west corner of the site adjacent to the Southern Reedbeds (1BF024WM). The average groundwater level at 1BF024WM was 26.65m AOD, and at 1BF028WM it was 25.60m AOD. The recorded water level of the lake between April – August 2023 was 25.41 – 25.72m AOD, indicating that there is likely to be some groundwater interaction.

3.2.9 The Southern Lake outfalls to the Northern Lake. The outfall consists of a 300mm diameter culvert connected to the Northern Lake which conveys water during non-flood conditions. A flood relief culvert is situated on top of the culvert which remains dry in normal conditions and is operational only when water levels exceed 26.46m AOD in the Southern Lake.

3.2.10 As noted in paragraph **3.2.6**, the EA have specified that water should be abstracted from watercourses. The Southern Lake is also the most distant water body from habitats requiring water supply and at a lower elevation which would present challenges in terms of creation of the required infrastructure for water transfer. Therefore the Southern Lake has been excluded as a potential water source.

Southern Reedbeds

3.2.11 The Southern Reedbeds occupy an area of approximately 1.85 ha to the immediate south of the Southern Lake. Water enters the reedbeds from the feeder beds located immediately to the east. A tilting weir connects the southern reedbeds to the Southern Lake to allow for water levels in each respective water body to be controlled independently. At the time of writing this report, the embankment to the east of the weir has eroded such that water is able to overtop and is the preferential route for water to enter the Lake from the Reedbeds.

3.2.12 The southern reedbeds are partly reliant on excess water from Wet Grassland 3 for their water supply, together with flows from the River Wandle overflow channel, as described in Section 2.4 below. All required water has already been utilised within the wet grassland area before passing to this area. Therefore they are not a viable water source.

Feeder Beds for Southern Reedbeds

3.2.13 The feeder beds are wetland ponds located between the western edge of Wet Grassland 3 and the Southern Reedbeds. They are supplied with water via an overflow weir located at the western end of Wet Grassland 3, and by the River Wandle overflow channel which connects into the feeder beds just west of the wet grassland area. There is a continuous baseflow of groundwater in the Wandle overflow channel. The overflow weir was noted to be disconnected from Wet Grassland 3 with no through flows at the site visit in August 2023, but has recently been adjusted to enhance connectivity and it is now set at a level of 27.89m AOD. A level survey conducted by Valencia in January 2024 indicates that bed levels on the western side of the habitat reach a maximum level of 28.401m AOD, so further adjustments are required to ensure full connectivity of the weir structure. This is further discussed in paragraph **8.1.10**.

3.2.14 The feeder beds are partially supplied by surplus water from Wet Grassland 3 and all required water has already been utilised within the wet grassland area before passing through the weir

[6] History | Beddington Farmlands (bfnr.org.uk)

to this area. Groundwater flows within the Wandle overflow channel are also protected. Therefore is it not feasible to utilise the feeder beds as a water source.

ERF SuDS Pond

3.2.15 An irregularly shaped SuDS attenuation pond is located to the immediate west of the ERF. Previous reports[7] and design drawings indicate that the pond forms part of the surface water management strategy for the ERF and was originally intended to discharge into Wet Grassland 2, with the potential for surplus flows to be routed into the MEC channel 'or other suitable watercourse'. Observations during a site visit in November 2023 indicate that an outlet structure from the pond exists adjacent to the allocated area for Wet Grassland 2, but a formal connection has not yet been established as the wet grassland has not yet been constructed.

3.2.16 The water quality within the SuDS pond is understood to be poor, and not suitable as a water source for Wet Grassland 2, until the quality is improved to protect the integrity of the habitat. The pond is outside the red line boundary of the Site and is within the ownership and control of Viridor, as part of the ERF. The responsibility for the outlet and water quality lies with Viridor. Once the water quality of the SuDS pond is deemed appropriate, Viridor and Valencia will discuss plans for connectivity of the outlet to Wet Grassland 2.

3.2.17 The date for when this may occur is not known hence for the purposes of water balance calculations, the potential water input from the SuDS pond has not been considered.

3.3 Surface Water Drainage Channels

3.3.1 The site contains two drainage channels which convey surface water/runoff in a westerly direction from beyond the site boundary to the east.

Northern Drain

3.3.2 The Northern Drain (also referred to as the Oily Ditch or Cuckoo Brook) is a drainage ditch which flows from east to west in the north of the site, between Wet Grassland 2 and the Thames Water 100 Acre lagoons.

3.3.3 The catchment of the ditch is not known but data from the Thames Water i3 database and FEH indicates a potentially large catchment extending into the industrial and urban areas to the east of the site.

3.3.4 No water level, flow rate or water quality monitoring is undertaken within the Northern Drain. On-site observations by Thames Water staff and the Sutton Council Site Warden indicate that water levels are low, flow is sluggish, and the water is not clear (i.e. there may be water quality issues).

3.3.5 Due to the uncertainty of supply and reported low water levels and water quality concerns, this has been excluded as potential source of water supply.

Cemetery Drain

3.3.6 A short open section of Cemetery Drain is located within the eastern Site boundary, to the immediate north-west of the STW, south of Mile Road. The historic route and extent of Cemetery Drain to the east of the Site is unrecorded and likely to have been adapted alongside the urban development in this area. It is understood from Thames Water that Cemetery Drain used to extend westwards across the centre of the Site, but this part of the drain was cut off when the landfill was constructed. It was verified at a site visit in November 2023 that both ends of the

[7] South London Energy Recovery Facility Flood Risk Assessment (Mouchel, July 2012)

open section of the drain are now blocked off so there is no inflow or outflow from the short open section.

3.3.7 Thames Water drainage records indicate that Cemetery Drain has a large drainage catchment extending to the industrial and residential areas to the east of the Site. FEH data also indicates a large catchment shared with the Northern Drain.

3.3.8 No water level, flow rate or water quality monitoring data is undertaken within Cemetery Drain.

3.3.9 Thames Water have indicated that, as a temporary strategy until the future of the sludge lagoons has been confirmed, they are abstracting up to 20m^3/day of water from the section of Cemetery Drain on their land (which does not require an abstraction licence) to supply water to the former sludge lagoons located to the south. The longer-term water needs of the sludge lagoons require further evaluation by Thames Water.

3.3.10 Due to the existing abstraction and uncertainty of supply, this option has been excluded as a potential water source.

3.4 River Wandle Flood Alleviation Scheme (FAS)

3.4.1 The River Wandle has an offtake weir located to the east of Beddington Park which diverts flood flows northwards via an open channel flowing alongside the east boundary of Beddington Park. At the south-eastern corner of the Site the channel turns westwards and continues to flow just inside the southern site boundary into the feeder bed and onwards into the reedbeds and lakes at the Site, which provide flood storage capacity.

3.4.2 After passing northwards through the lake system, flood flows are discharged from the Northern Lake at a controlled rate via the twin culverts described in paragraph **3.2.5** to the northwest corner of the Site where they combine with flows from the MEC and Northern Drain and are returned to the River Wandle via a culverted channel.

3.4.3 The full route of the FAS between the offtake weir and discharge point back to the River Wandle is designated as a Main River by the EA.

3.4.4 No monitoring of water levels, flow rates or water quality is undertaken in the Wandle overflow channel, although a river level gauge (Wandle at Beddington Park) is located on the River Wandle itself immediately upstream of the offtake weir. Observations made by the Beddington Farmlands Site Warden, indicate that the channel contains a consistent baseflow outside of flood conditions, which is assumed to be groundwater.

3.4.5 Consultation with the EA confirmed it is possible to abstract flood flows from the Wandle overflow channel for use on Site. As the channel is part of a FAS, water overtopping the offtake weir from the River Wandle is classed as flood water and is available to abstract without a licence. The assumed groundwater baseflow is regionally protected and should not be abstracted.

3.4.6 The results of the EA River Wandle hydraulic model (2015) were assessed to understand the potential volume of water that may be available for abstraction. The hydraulic model results indicate that the weir overtops for return periods equal to and greater than the 1 in 5 year (20% chance of flooding in any given year) event. The volume of floodwater available in the 1 in 5 year return period is 11,288m^3 – calculated directly from the Hydraulic Model in Flood Modeller, utilising the model simulation.

3.4.7 Daily river level monitoring data for the Wandle at Beddington Park gauge is available from 2012-2023, providing a minimum, maximum and mean river level per day. The overflow weir is assumed to overtop when river depth levels are higher than 1.35m (i.e. the difference between the bed level and weir crest, as specified in the hydraulic model). The data indicates that water

levels higher than the weir crest level have occurred 0-3 times a year between November 2012 – December 2023, as summarised in **Table 3-1**.

Table 3-1: Frequency of overtopping of overflow weir level – Wandle at Beddington Park

Upstream Bed level		mAOD	26.50
Overflow Weir Crest		mAOD	30.85
Level difference		m	1.35
Frequency of recorded water depth in excess of 1.35m		Month(s) when higher water level occurred	Average water depth above weir level (m)
2012	1	November*	0.05
2013	0	-	-
2014	3	February, March	0.03
2015	1	August	0.11
2016	0	-	-
2017	1	June	0.005
2018	2	May	0.025
2019	1	June	0.072
2020	1	August	0.148
2021	2	June	0.048
2022	0	-	-
2023	0	-	-

* Records only available from 26/11/12 to end of year, therefore there may have been more than one exceedance in 2012.

3.4.8 The available data indicates that water levels have most frequently exceeded the weir crest level in the late spring and summer months, May to August. Future storm event predictions (e.g. Met Office[8]) indicate that summer storm events are expected to be more frequent with heavier and more intense rainfall than present day storm conditions.

3.4.9 Where more than one event occurred in a calendar year, an average level of exceedance has been calculated, which indicates the depth in metres that water exceeded the overflow weir height of 1.35m. This has varied from less than 10mm to 148mm above the weir level. By way of comparison, the Wandle hydraulic model indicates that during the 1 in 5 year event, the weir would be expected to have an exceedance level of 200mm. All recorded exceedances since November 2012 have been lower than the 1 in 5 year event.

3.4.10 The intensity and frequency of flood events, and therefore the volume of water available for abstraction, is challenging to predict and likely to be irregular. Based on the assessment in **Table 3-1**, the volume of water available is expected to be small and infrequent. This could be somewhat mitigated through the creation of a flood storage area, which can be topped up in times of flood and the water used in times of need. However, due to the anticipated low water volumes, this may not provide a sufficient water supply when most needed in summer.

3.4.11 Therefore, abstraction from the River Wandle overflow channel is not considered to be a viable source of water supply.

3.5 Artificial Water Sources

Main Effluent Carrier Channel

3.5.1 The Main Effluent Carrier (MEC) channel transports treated effluent discharged from Beddington Sewage Treatment Works (STW). It runs along the east boundary of the Site before turning to run north-westwards across the site to the north-western corner. The MEC is fully

[8] UK and Global extreme events – Heavy rainfall and floods - Met Office

contained within a concrete culvert within the site boundary other than a 150m section of open channel (concrete lined) between Wet Grasslands 1 and 2. It returns to culvert before it combines with the outflows from the Wandle FAS and Northern Drain, leaving the site and discharging to the River Wandle adjacent to Poulter Park, approximately 900m west of the north-west corner of the site.

3.5.2 The discharge permit for the STW (no. 382N/V001) specifies a maximum consented flow leaving the STW of 234,000 m^3/day. The MEC is in flow continuously, with daily and hourly variability in flow rates in accordance with peaks and troughs in household water use. Discharge flow rates and volumes are measured at the exit point from the STW (TQ 29521 66322) and Thames Water have provided records of monitored 15-minute, hourly and daily flows for the period January 2017 – December 2022.

3.5.3 Due to the seasonal consistency in flow (limited variation throughout the year) and the daily availability of water supply, this is considered a viable water source.

3.5.4 Extensive consultation with the EA, including a site visit, has taken place between October 2023 - January 2024. Letters and responses evidencing the discussion that has taken place are provided in **Appendix D** . This has included discussions and inputs with representatives from EA Planning, Groundwater and Abstraction, Fisheries, Water Quality and Flood Risk Teams.

3.5.5 Discussions have centred around the requirement for a permit should the proposals entail abstracting greater than 20m^3 per day from the MEC. Clarity on what restrictions would be in place should a permit be required was also discussed.

3.5.6 EA advice has stated that the MEC is not classed as a 'watercourse' and an abstraction licence would not be required if the following criteria were both met:

- The channel conveys treated effluent only and there are no connecting channels or watercourses. Downstream of a confluence with another channel/watercourse, abstraction becomes licensable by the EA; and
- The channel is concrete lined and there is no interaction with groundwater.

3.5.7 Thames Water have confirmed that the culverted sections of the MEC from its discharge point at the STW through the Beddington Farmlands Site has no known pipe connections. The open channel section of the MEC is concrete lined throughout its length and it does not interact with groundwater. There is one surface water outfall discharging into the open section of the MEC channel which is understood to convey surface water flows from the area north-east of the site boundary. This outfall is observable on site and visible in aerial images, at grid reference TQ 29063 66718.

3.5.8 Regardless of whether an abstraction permit is required, the EA have emphasised that it is important to ensure that any abstraction activities do not adversely impact downstream water bodies. Both regional and local constraints would need to be considered.

3.5.9 The constraint at the River Thames at Kingston is approximately Q50 (flows equalled or exceeded 50% of the time) which would only enable abstraction for roughly half of the year. Any reduction in flows along the Wandle has the potential to reduce water entering the Thames downstream of Teddington.

3.5.10 The EA have advised that local constraints for these site proposals are to be based around Q95 flows. It is recognised the proposed restoration of the Site is:

- Not significantly water consumptive;
- Demonstrates a gain to the environment; and

- Represent a positive scheme for the wider catchment through the creation of habitat.

3.5.11 Even without the need for a permit the EA would seek voluntary constraints to safeguard the local and regional environment. The EA have previously agreed with exempt abstractors prescribed abstraction limits, flow constraints and other conditions, in place of an abstraction licence.

3.5.12 The water resource strategy presented in this report therefore sets out to demonstrate abstraction from the MEC only when the flow is greater than the Q95 value. This then demonstrates the proposals have no detrimental impact on the local environment, and by extension, no impact on the regional environment.

Main Effluent Carrier Overflow Channel

3.5.13 An open, concrete-lined overflow channel diverts excess flows in times of flood from the main MEC channel into the Northern Lake. This channel also conveys a continuous baseflow of treated effluent from the MEC to the Northern Lake, and the outlet structure from Wet Grassland 1 connects to the MEC overflow channel.

3.5.14 The overflow channel may be operational during storm events if the water volume at the STW exceeds the capacity of the storm tanks and the main MEC channel, and untreated effluent may be discharged into the Northern Lake during such storm conditions. Thames Water provides publicly accessible Event Duration Monitoring (EDM)[9] data for the frequency and duration of storm discharges from Beddington STW between 2019-present.

3.5.15 Annual reports for the years 2019-2022 indicate that the total number and duration of recorded storm discharges were:

Table 3-2: Counted Spill for Beddington STW as reported by Thames Water

Year	Total Duration (hrs) all spills prior to processing through 12-24h count method	Counted spills using 12-24h count method
2019	76.78	23
2020	181.85	31
2021	101.50	18
2022	22.43	7

3.5.16 The overall storm discharge data for 2023 will be compiled and updated into an annual report by March 2024. One overflow event of one hour duration was recorded on 5th January 2024

3.5.17 The above data does not indicate if multiple events occurred on the same day or if each event occurred on a discrete date throughout the year. It is reasonable to conclude that storm conditions may impact on water quality in the main MEC channel as well as the MEC Overflow Channel on multiple days per year.

3.5.18 No flow data is available for the MEC overflow channel. However given that overflows may be irregular, of variable volume and duration and of poor water quality, potentially containing untreated effluent, this channel has been excluded as a potential water source.

[9] Storm discharge data | River health | Thames Water

3.6 Rainfall

3.6.1 Daily rainfall monitoring data is available from Beddington STW rainfall monitoring station, and catchment rainfall data for the Beddington area is available via the National River Flow Archive (NRFA) dataset from 1936-2017.

3.6.2 The NRFA dataset has been utilised to inform water balance calculations as it covers a wider date range (81 years) providing a more accurate long-term average. A catchment-wide rainfall average also removes any localised rainfall anomalies which may be recorded by the rainfall gauge at the STW.

3.6.3 Standardised Average Annual Rainfall (SAAR) is the catchment average rainfall total across a 1km grid square for the years 1991-2020. This figure is used to calculate runoff and drainage requirements. The SAAR value of 764 mm for the catchment containing the Site is consistent with other data used for the water balance e.g. runoff calculations. To provide consistency with other datasets used for comparison, which are based on 1991-2020 average rainfall data, the longer-term average NRFA rainfall data has been fitted to SAAR as summarised in **Table 3-3**.

Table 3-3: Average catchment monthly rainfall 1936-2017

Average catchment monthly rainfall 1936-2017		
Month	Average rainfall (mm)	Fitted to SAAR
January	82.8	79.3
February	57.0	54.6
March	54.5	52.2
April	53.7	51.4
May	57.4	55.0
June	55.0	52.7
July	57.2	54.8
August	63.3	60.7
September	66.6	63.8
October	81.9	78.5
November	86.4	82.8
December	81.7	78.3
Annual	797.6	764.0

3.6.4 There is a relatively consistent pattern of monthly rainfall within the catchment which provides a valid water source for the Site, both from direct rainfall and from runoff, which is discussed in **Section 5.3**.

3.7 Groundwater

3.7.1 Groundwater level (GWL) monitoring has historically been undertaken by Viridor between January 1999 to February 2023 at locations around the Site (shown in **Figure 3-2**) and the full GWL dataset for this time period has been provided. The exact time period over which groundwater data was collected at each monitoring point varies by location.

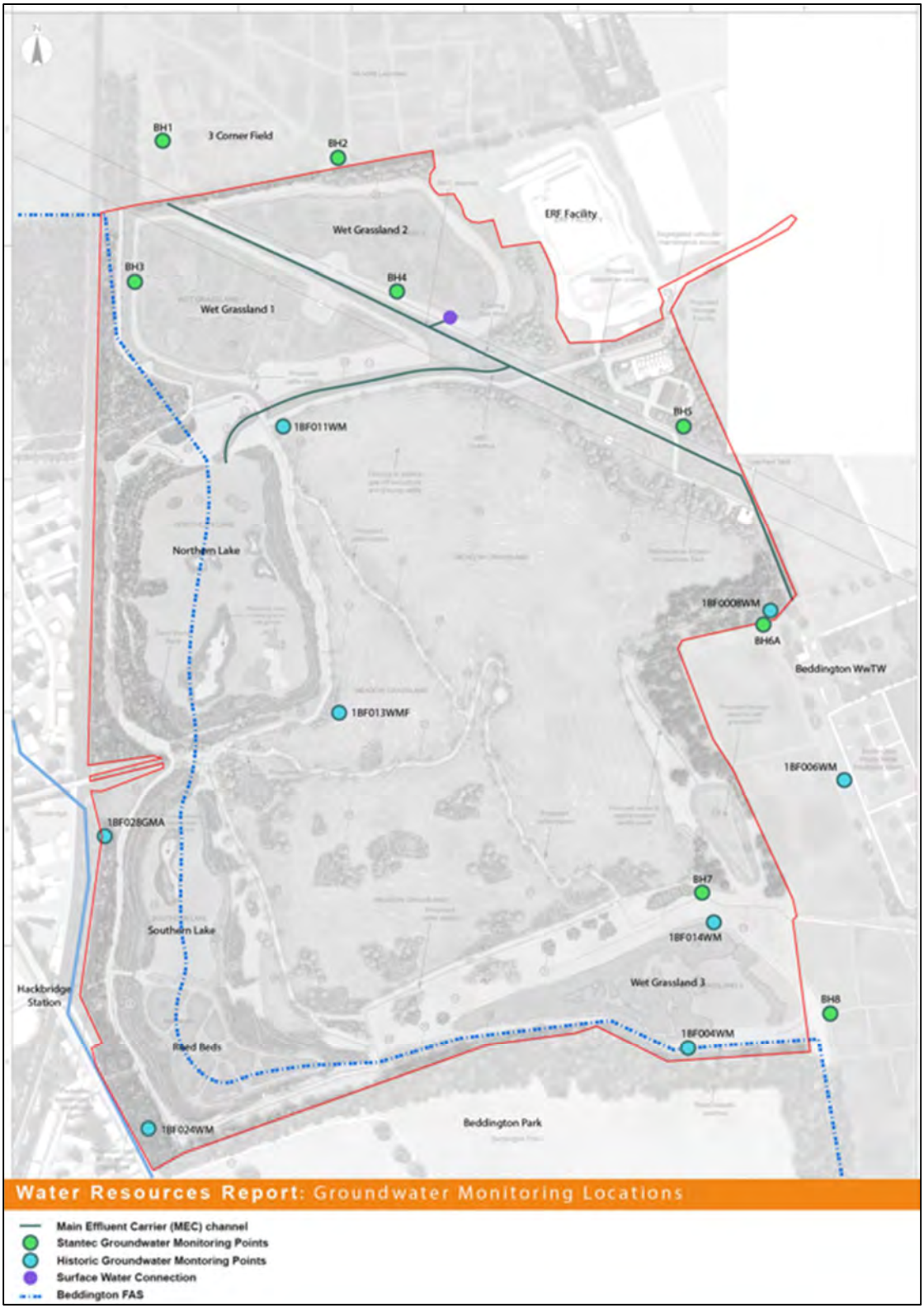


Figure 3-2 Groundwater monitoring points at site

3.7.2 It is noted that the recorded ground level elevations at monitoring points 1BF006WM, 1BF011WM and 1BF013WMR (marked with *) have changed over time, assumed to be linked to changes related to construction and subsequent restoration of the landfill, or changes at the STW. This affects the interpretation of long-term groundwater trends at these locations. Most significantly, the recorded ground level at 1BF013WMF has risen from 28.57m AOD in 2000-2001 to 31.83m AOD from 2013-2022. For all three locations, the most recent recorded ground level elevation has been listed in **Table 3-4**.

Table 3-4: Summary of On-Site groundwater monitoring dataset, 1999-2023

Monitoring point	Ground level* (mAOD)	Average GWL (mAOD)	Maximum recorded GWL (mAOD)	Minimum recorded GWL (mAOD)	GWL average (m bgl)	GWL maximum (m bgl)
1BF004WM	30.78	28.49	29.67	27.85	2.29	1.11
1BF006WM	32.75*	30.49	31.19	27.63	2.26	1.56
1BF008WM	31.57	29.19	30.70	27.26	2.38	0.87
1BF011WM	31.83*	24.74	26.21	23.22	7.09	5.62
1BF013WMF	30.42*	24.74	27.52	23.62	5.68	2.90
1BF014WM	31.81	28.78	31.43	5.20	3.03	0.38
1BF024WM	28.90	26.65	27.72	25.50	2.25	1.18
1BF028GMA	28.06	25.60	26.17	23.79	2.46	1.89

3.7.3 Average groundwater levels across the site have been calculated between 1999-2023 and compared to the ground level of the monitoring points, summarised in **Table 3-4**. The average level of the groundwater table varied by location, between 2.25 – 7.09m below ground level. At the maximum recorded groundwater elevations during this time period, groundwater was closest to surface level on the eastern side of the site (monitoring points 1BF008WM and 1BF014WM) and furthest below ground level adjacent to the Northern Lake (monitoring points 1BF011WM and 1BF013WMF). Seasonal variation in groundwater levels was reflected in the difference between the maximum and minimum recorded groundwater elevations at each monitoring point, which varied from 1.82 – 4.43m. The highest variation was recorded at 1BF014WM, just north of wet grassland 3. This indicates a potential for significant seasonal variation in groundwater levels across the site.

3.7.4 To attempt to ascertain if any notable patterns in groundwater levels can be observed over time, all available recorded groundwater levels from the closest monitoring points to Wet Grassland 3 - 1BF004WM, 1BF004WMB (a supplementary borehole sometimes used as an alternative to 1BF004WM), and 1BF014WM - were plotted and are shown in **Figure 3-3**. Data was collected between 1999-2015 at these locations. There appears to be some anomalous data from 2005/6 where some of the recorded levels are considerably lower than the long term trend. Overall, groundwater levels show a consistent pattern across time, varying between 26.19 – 31.41m AOD, and seasonal variations in groundwater levels can be observed with generally higher groundwater levels in winter/early spring and lower levels in late summer/autumn, as would be expected in a Chalk aquifer.

3.7.5 The most recently available groundwater levels recorded in BH7 and BH8 in November and December 2023 are also plotted in **Figure 3-3** to provide a comparison to historic groundwater levels. The location of these boreholes is also shown in **Figure 3-2.** Recent groundwater levels have varied from 29.60 – 30.85m AOD, which is consistent with the longer term trend in the south-east corner of the site.

3.7.6 There is no historic data from the vicinity of Wet Grasslands 1 and 2 but it can be assumed that similar trends would be observed in the groundwater levels due to the underlying geology.

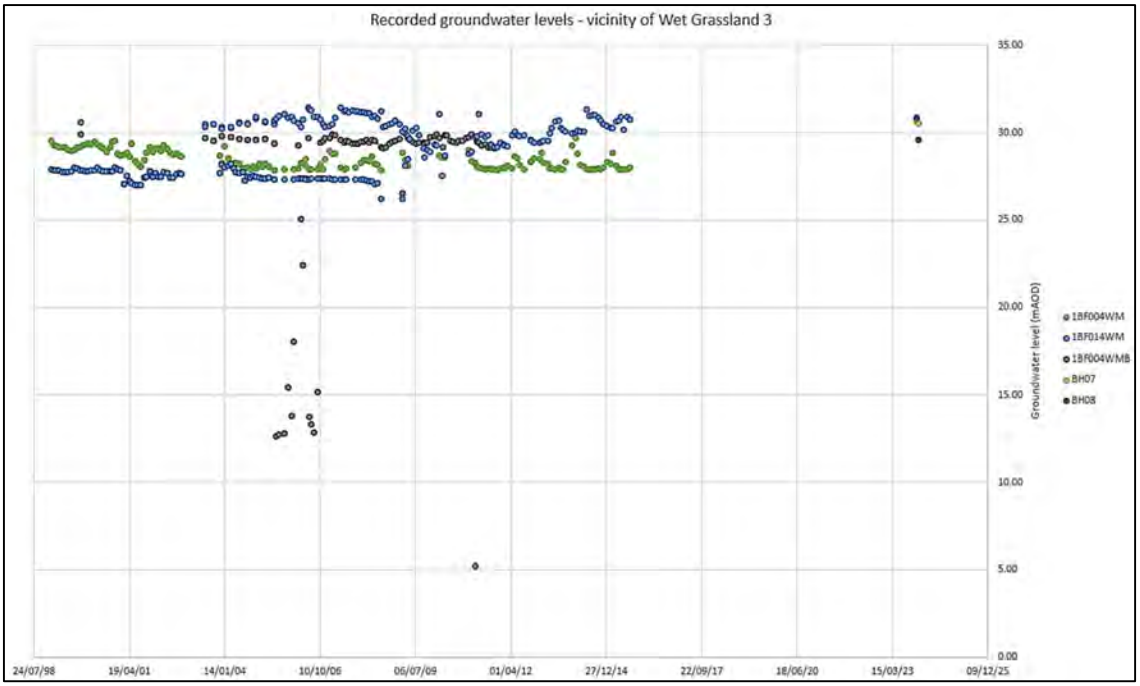


Figure 3-3 Recorded groundwater levels in vicinity of Wet Grassland 3

Wet Grasslands 1 and 2

3.7.7 The northernmost point at which groundwater data has historically been collected is 1BF011WM at the north-eastern corner of the Northern Lake. No historic monitoring points or groundwater data was available further north of the Site including the Wet Grassland 1 and 2 areas. Previous reports (e.g. the Binnies/Thames Water Phase 1 report) have indicated that a perched groundwater table underlies both of these areas within the Hackney Gravel stratum, and the presence of perched groundwater has been assumed to be available to support these habitats. However, anecdotal reports from site-based staff and aerial/drone photography of the Site in different seasons indicates that Wet Grassland 1 as constructed does not remain consistently wet, in particular on the western side. This indicates that the groundwater table may not be in contact with the bed level of the habitat as previously assumed.

3.7.8 There is a lack of historic monitoring points in this area, and therefore no supporting evidence as to whether there is a perched groundwater table in this location. Ground investigations to support this planning application were commenced in October 2023 and two boreholes were drilled. These are located at the western edge of Wet Grassland 1 (BH3) and within the yet to be constructed area set aside for Wet Grassland 2 (BH4). The locations selected were the most suitable to allow for safe access for the borehole drilling rigs.

3.7.9 Full details of the stratigraphy at these locations can be found in the Ground Investigation Report. The Hackney Gravel stratum was proven to be present below the Made Ground in the Wet Grassland 2 area, but was absent from the Wet Grassland 1 area where Reworked Clay was proven beneath the Made Ground, over London Clay. The historical use of this area for gravel extraction may have led to variable, unrecorded materials being used for infill after the cessation of quarrying operations. This may have led to a lack of consistency in the underlying soils, which may help to explain why the western side of Wet Grassland 1 (underlain by reworked Clay, which might be acting as a relatively impermeable barrier to any underlying groundwater) may be drier than the eastern side.

3.7.10 Groundwater level monitoring data at BH3 and BH4 is summarised in **Table 3-5**. The observed groundwater elevation in late 2023 (24.59 – 24.75mAOD) indicates that it is at, or below the bed level of Wet Grassland 1 (24.6mAOD – 25.2mAOD) and therefore, minimal groundwater interaction would be expected.

3.7.11 Wet Grassland 2 would need to be constructed at levels below 26.00m AOD to interact with the groundwater table, whilst still being sufficiently elevated above Wet Grassland 1 to allow for gravity flow between the habitats. Note that the bed levels of Wet Grassland 1 and 2 are also constrained by the water level of the Northern Lake. The Wet Grasslands must be constructed at a higher elevation, to prevent backflow from the Lake via the syphon.

Table 3-5: Summary of recent groundwater monitoring in the Wet Grassland 1 and 2 areas

Borehole	Borehole elevation (m AOD)	GW level during drilling (m bgl) Late October 2023	GW level (m bgl) 29/11/2023	GW level (m bgl) 12/12/2023	Groundwater elevation (m AOD)
BH3 [WG1]	27.10	1.90	2.51	2.35	24.59 – 24.75
BH4 [WG2]	27.46	2.20	0.80	1.40	26.06 – 26.66

Wet Grassland 3

3.7.12 The closest historic monitoring points to Wet Grassland 3 are located to the south and north of the constructed area. As shown in **Figure 3-4**, the average groundwater level at monitoring point 1BF 014WM (to the immediate north of the wet grassland) across the monitoring period was 3.00m below ground level, reaching 2.49m below ground level in May and dropping to 4.32m below ground level in October. At monitoring point 1BF004WM[10] (immediate south of the wet grassland area), the average level was 1.98m below ground level, reaching a maximum of 1.65m below ground level in March and dropping to 3.41m below ground level in August. Both boreholes showed a variation of around 1.8m between the lowest and highest recorded groundwater levels.

[10] Monitoring point 1BF004WM has groundwater level data recorded between 1999-2015.

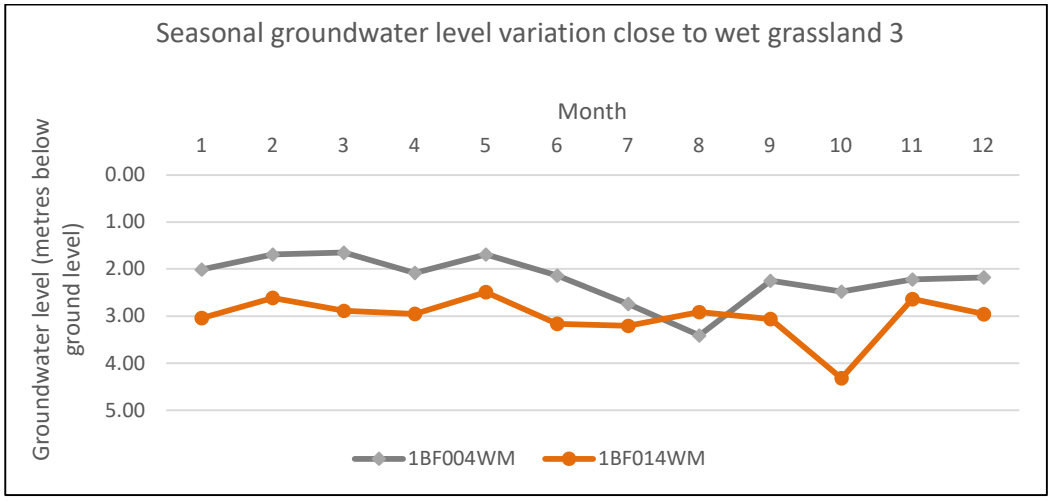


Figure 3-4 On-site monthly groundwater variation at monitoring points 1BF004WM and 1BF014WM

3.7.13 Recent ground investigations in the Wet Grassland 3 area undertaken in October 2023 have comprised 2 boreholes (BH7 and BH8) on the eastern fringe of the area. The boreholes have been sunk as close as suitable access has allowed to Wet Grassland 3. Made ground was present to a thickness in excess of 5m below ground level at the location of BH7 (north-east of West Grassland 3) and Hackney Gravels were not proven in this location. In BH8, the Hackney Gravel stratum was proven beneath the Made Ground to a thickness of 2.7m. Full details of the stratigraphy are available in the GCA report.

3.7.14 A summary of groundwater levels captured is shown in **Table 3-6**.

Table 3-6: Summary of recent groundwater monitoring in the Wet Grassland 3 area

Borehole	Borehole elevation (m AOD)	GW level during drilling (m bgl) Late October 2023	GW level (m bgl) 29/11/2023	GW level (m bgl) 12/12/2023	Groundwater elevation (m AOD)
BH7	32.42	Dry	1.78	2.55	28.07 – 30.64
BH8	32.00	0.30	1.15	2.40	29.60 – 30.85

3.7.15 A recent level survey conducted by Valencia in January 2024 indicates that the bed level of Wet Grassland 3 varies between 28.09 to 28.40 m AOD, which is below the recently recorded groundwater levels in the adjacent access path and therefore indicates a potential for groundwater interaction within Wet Grassland 3.

Groundwater Summary

3.7.16 Historic groundwater level data shows considerable seasonal and spatial variations. If groundwater was to be relied upon as a primary water source to support the habitats, the management of the habitats would need to be more flexible and a greater onus placed on monitoring to react to the observed conditions.

3.7.17 In drier years, another water source would be required to maintain the water level in the wet grasslands. If the groundwater table was particularly low, this could potentially amount to a large volume of water being transferred into the habitat. Regular filling would also likely be required as the infiltration potential of the underlying soil type is good.

3.7.18 The historic and recently captured groundwater level data shows the potential for groundwater interaction in the Wet Grassland 2 and 3 locations. It is however, determined to be a less reliable source with no certainty due to seasonal fluctuations and potential inconsistency between years, and may also be influenced by external water management strategies outside of the site boundary. Groundwater is therefore ruled out in favour of more robust water sources.

3.8 Water Supply Summary

3.8.1 In summary, feasible sources of regular water supply for Wet Grasslands 1 and 2 are:

- Rainfall; and
- Abstraction from the MEC.

3.8.2 Feasible sources of regular water supply for Wet Grassland 3 are:

- Rainfall;
- Runoff from the eastern and southern sides of the landfill mound; and
- Abstraction from the MEC.

4 Water Requirements

4.1 Wet Grassland Water Levels

4.1.1 The wet grassland areas will be managed on an annual cycle to achieve specific seasonal water levels, as follows:

- October - March: High water table across the habitat. Some shallow flooding (10-300mm) across no more than 30% of the area.
- March – May: High water table at ground level across 30% of the field. Some shallow flooding covering between 5% to 10%.
- May – July: Water table to within 200mm of ground level with shallow pools and ditches to create muddy edges.
- July - September: Water table dropping to its lowest level, up to 400 mm below ground level to facilitate management across the wet grassland habitat.

4.2 Water Volume

4.2.1 Water volume requirements have been undertaken assessing the maximum volume of water that could potentially be required for each wet grassland based on the differing desired conditions throughout the year, and is shown in **Table 4-1**. The assumed water depth is based on a simplification of the above requirements, as follows:

(i) 'Muddy' habitats between June to September – 50mm water depth across the wet grassland area.

(ii) Shallow pools of water with some drier areas between March to May – 150mm water depth.

(iii) Flooded or 'splashy' conditions between October to February– 300mm water depth.

4.2.2 The required maximum volume is based on the entire area of each wet grassland, assuming that no water is already present. Each habitat will contain several islands which reduces the water volume requirements. These islands have not been taken into account within the calculation, hence the volumes presented in **Table 4-1** are considered to be conservative.

Table 4-1 Wet Grassland Water Volume Requirements

Month	Target Condition	Average Water Depth (m)	Water Volume Required (m^3)		
			Wet Grassland 1	Wet Grassland 2	Wet Grassland 3
January	wet/flooded	0.3	11,921	7,487	10,637
February	wet/flooded	0.3	11,921	7,487	10,637
March	shallow	0.15	5,960	3,743	5,318
April	shallow	0.15	5,960	3,743	5,318
May	shallow	0.15	5,960	3,743	5,318
June	muddy	0.05	1,987	1,248	1,773
July	muddy	0.05	1,987	1,248	1,773
August	muddy	0.05	1,987	1,248	1,773
September	muddy	0.05	1,987	1,248	1,773
October	wet/flooded	0.3	11,921	7,487	10,637
November	wet/flooded	0.3	11,921	7,487	10,637
December	wet/flooded	0.3	11,921	7,487	10,637

4.3 Water Usage

4.3.1 Actual water requirements will vary throughout the year and across the internal topography of each habitat to suit the target species. Based on historic averages, rainfall will supply a significant proportion of the water volumes specified in **Table 4-1**, particularly in the period between late autumn and early spring. It is however expected there will be situations in which an alternative water source is required to achieve the target condition in the habitat.

4.3.2 Three key scenarios are described in this section of the report in which the wet grasslands may require water input at variable volumes.

Initial Filling

4.3.3 Each of the wet grassland habitats are currently in differing stages of establishment. All will require some degree of construction work and these works are proposed to be staggered across the overall five year construction programme. Appendices B and C in the RRMP show the construction phasing programme and accompanying figures.

- **Wet Grassland 1:** Construction activity to Wet Grassland 1 (minor re-profiling of levels and lining) is phased to commence Q3 2024 (year 0).
- **Wet Grassland 2:** Construction activity to Wet Grassland 2 (excavation to create bed levels of and lining) is phased to commence Q3 2025 (year 1).
- **Wet Grassland 3:** The minor re-profiling works to Wet Grassland 3 will commence Q3 2024 and end in Q1 2025 (year 0).

4.3.4 The construction works for each of the wet grassland is targeted for Autumn, after the breeding bird season has finished, and in preparation for the subsequent breeding season. The initial filling of each wet grassland is planned during the winter period when there is typically a greater chance of rainfall and therefore a reduced risk of downstream impacts if water is abstracted from the MEC channel.

4.3.5 **Table 4-2** shows the area of each wet grassland, and the calculated volume which would be required to fill the habitat from a dry state to the target wet/flooded level in winter. A 0.3m water

depth has been assumed for this purpose to provide sufficient water to fill the internal scrapes/channels and create the required 'flooding' of c.30% of the habitat, rounded up to the nearest 100m^3.

Table 4-2 Water Volumes Required for Initial Fill

	Wet Grassland 1	Wet Grassland 2	Wet Grassland 3
Total area of habitat (m^2)	39,735	24,956	35,456
Water volume required for initial fill (m^3)	12,000	7,500	10,700

4.3.6 The initial filling of each habitat would not need to be continuous and could be achieved at a slower rate over a 1-2 week period, with breaks in pumping to suit daily flow conditions in the MEC.

Water Level Management

4.3.7 On an ongoing basis, water requirements for each wet grassland area will vary from day to day according to antecedent rainfall, evaporation and available volumes of stored runoff from the landfill mound (for the Phase 3 area). All habitats are proposed to be lined with impermeable material to ensure water retention, hence the impact of infiltration has been excluded.

4.3.8 Water level boards have been installed in each of the wet grassland areas. Management of the habitat requires regular monitoring of the water level to ensure the desired condition is reached. There is currently a full-time warden for the site and water level monitoring is included as part of their responsibilities. The appointment of the warden will continue as part of long-term management of the site. The Habitat Management Plan describes the recommended frequency of monitoring.

4.3.9 If water levels have dropped below target level, and no rainfall was forecast, a volume of water would be abstracted to return the habitat to the required water level. Calculations have been undertaken to estimate the potential volume lost to evaporation, and the rate at which this occurs. **Table 4-3** shows the total target volume across all three wet grasslands and the calculated volume lost to evaporation on a weekly basis. The resultant volume remaining, is based on the assumption that no rainfall is available to refill the habitat, hence represents a conservative value. During extended periods of dry weather, the frequency of monitoring would be increased (minimum weekly) to prevent the habitats from drying out.

Table 4-3 Evaporation Loss

Month	Total Target Volume (m^3)	Evaporation Loss per week (m^3)	Volume Remaining (%)
January	30,044	590	98%
February	30,044	446	99%
March	15,022	777	95%
April	15,022	1,227	92%
May	15,022	1,680	89%
June	5,007	2,001	60%
July	5,007	2,026	60%
August	5,007	1,692	66%
September	5,007	1,170	77%
October	30,044	673	98%
November	30,044	349	99%
December	30,044	227	99%

4.3.10 The findings show that assuming there is an absence of rainfall, evaporation may reduce the volume of water within the wet grasslands to below 70% of the target in the summer months.

Autumn Refilling

4.3.11 Following the end of the breeding bird season, the wet grassland habitats would be prepared to welcome wintering birds. The water levels will be managed to gradually increase from the end of summer to achieve the desired wetter flooded conditions by October/November. This process would be reliant on rainfall in the first instance to achieve these desired conditions.

4.3.12 In the absence of rainfall, the volumes and indicative pump durations presented in **Table 4-2** are relevant to demonstrate the potential maximum amount to be abstracted from the MEC, assuming a (worst case) dry starting condition.

5 Proposed Water Supply Strategy

5.1 Water Balance Calculations

5.1.1 Water balance calculations for each wet grassland area have been undertaken with key outcomes summarised in this section. Detailed calculations are presented in **Appendix A** .

5.1.2 For each wet grassland habitat, a water balance calculation was derived by deducting potential evapotranspiration from average annual rainfall, multiplied by the area of each of the three wet grassland habitats, to provide a total water input per month from direct rainfall. Infiltration losses for the wet grassland habitats is not considered as it is proposed to line the habitats.

5.1.3 Additional calculations were undertaken to assess the potential volume of runoff per month from the eastern and southern slopes of the landfill, based on rainfall to the runoff catchment area with potential evapotranspiration (PE) deducted (the slopes will be vegetated). The landfill is capped with a relatively impermeable clay layer, but some infiltration into the capping/topsoil layers has been accounted for in the calculations using an indicative infiltration rate for clay soils.

Rainfall Data

5.1.4 Average monthly rainfall for the Beddington catchment between 1936-2022 was calculated from the NRFA dataset of historic daily rainfall to Beddington catchment, and was fitted to SAAR for each month, as described in **Section 3.6**. The average annual rainfall at the site over an 81 year period was 797mm per year, and when fitted to SAAR is 764mm per year.

5.1.5 Sensitivity testing was undertaken using years identified by the Met Office as especially wet or dry, within the current SAAR period of 1991-2020. The year 1996 was the driest year on record within this period, with 631mm of rainfall recorded in the NFRA dataset for Beddington catchment, and 2000 was the wettest year with 1140mm of rainfall recorded.

5.1.6 The Met Office supplies projected rainfall datasets considering the future impact of climate change on anticipated rainfall, based on 12km grid squares. The grid square including the Site has a projected future annual rainfall of 809mm.

Potential Evapotranspiration Data

5.1.7 PE accounts for water losses from evaporation from hard and soft surfaces, and water uptake by plants for transpiration. The rate of PE is dependent on many meteorological factors including quantity of daily rainfall, air temperature, wind speed and current level of soil wetness. In warmer months or in periods of dry weather, it is possible for PE and/or infiltration to exceed rainfall (shown as a negative monthly total in the water balance calculations). During such periods, no water from rainfall is expected to be retained in the wet grassland areas and surface level drying out of the soil may occur.

5.1.8 Two PE datasets were examined.

(i) UKCEH provides a historic PET dataset from 2000-2015 [as used in the previous Binnies/Thames water hydrology report (2023), data calibrated for the UK] which falls within the current SAAR period.

(ii) The COSMOS_UK project monitors daily PE at selected sites in England intended to represent different land use types and underlying geology. The most analogous site to Beddington included in the COSMOS project is Writtle, near Chelmsford, Essex, which is an improved grassland site located over London Clay and Chalk strata. Daily PE monitoring data is available from this site for the period July 2017-August 2023. Analysis

of monthly PE totals over this recent time period indicate very similar monthly PE totals to the UKCEH historic data, with slightly higher PE values than the UKCEH dataset during the summer months.

5.1.9 Given the similarities between the older and more recent datasets, the UKCEH data was selected for use in the water balance as it covers a longer time period and provides consistency of data comparison with previous reports.

Infiltration Data

5.1.10 Additional water losses occur from infiltration of rainfall into the upper soil layers and/or deeper infiltration to groundwater. The actual rate of infiltration is dependent on multiple factors including soil type and the existing level of soil wetness.

5.1.11 Soakaway testing (a standard geotechnical test, conducted in-situ) was undertaken at three locations as part of the ground investigation in October 2023, adjacent to the three wet grassland locations. Test pit SA1 was located in the Wet Grassland 2 area, and test pits SA2 and SA3 were located to the immediate north and east of Wet Grassland 3, respectively. Three tests were conducted in each soakaway pit. The average infiltration rate was 1.37 x 10^{-5} m/s from SA1, representing infiltration into the Wet Grassland 1 and 2 area, and 4.14 x 10^{-5} m/s from SA3, representing assumed infiltration in the Wet Grassland 3 area.

5.1.12 These rates are indicative of potentially significant water losses to infiltration and the Ground Investigation Report provides further detail. Consequently, lining of the Wet Grassland areas to improve water retention is recommended and infiltration has been excluded from the water balance calculations.

5.2 Wet Grasslands 1 and 2

Water Sources

5.2.1 The strategy for water supply for each wet grassland is discussed in turn, describing the water sources and the transfer of water from the source to each habitat. For the purposes of water needs, Wet Grasslands 1 and 2 have been considered together as one linked habitat.

5.2.2 The water requirements for Wet Grasslands 1 and 2 will be met by a combination of direct rainfall and abstraction from the MEC. Water balance calculations are provided in **Appendix B**

5.2.3 Direct rainfall will supply a percentage of the total water needs of these wet grassland areas. Based on long-term average rainfall, rainfall alone will be unable to meet the full water needs of the habitats throughout the year. Water balance calculations indicate that expected losses from evapotranspiration would be expected to exceed rainfall volumes between April-September in an average rainfall year (**Appendix B** An additional water source will be required. The MEC is the preferred water source due to consistency and predictability of supply.

5.2.4 As noted in paragraph **3.5.2**, a consistent daily supply of treated wastewater is available within the MEC. Thames Water have supplied a dataset with recorded volumes of water passing through the MEC discharge point for the period January 2017 to December 2022, which shows that the overall average daily maximum flow is **123,452 m^3/day**.

5.2.5 To provide an estimate of potential flow limitations, the Thames Water daily flow volume dataset was ranked by lowest to highest recorded volume per annum, and the Q95 flow volume (the volume exceeded 95% of the time) was established as the 18th value in each 365 day period (365 x 0.05, rounded down to nearest integer). The six Q95 flow values for the years 2017-2022 were averaged to provide an overall Q95 flow volume of **101,457 m^3/day**. The EA have indicated that Q95 flow volumes will be a primary consideration when reviewing the need for an abstraction licence and any obligatory or voluntary conditions required. Broadly speaking, this could mean that water is unavailable for abstraction approximately 18 days per year, but in

reality this would be variable dependent upon actual flow volumes within the MEC. The water supply strategy has therefore focused on demonstrating feasibility by abstracting only when flows exceed the Q95 value.

5.2.6 Dry weather flows have also been considered in relation to known periods of drought which have occurred during the period for which MEC flow data is available. The summers of 2018 and 2022 were classified as drought periods by the Met Office. The number of individual and consecutive days during these periods where the average MEC flow was lower than the Q95 flow was considered. During August 2018, MEC flows fell below the Q95 volume for 2 consecutive days. During the hottest, driest period recorded in August 2022, MEC flows fell below the Q95 value for 11 days of the month in total, with a maximum 5 consecutive days of <Q95 flow volume. Commentary on drought management has been considered within the Habitat Management Plan.

5.2.7 **Table 5-1** summarises the flow volumes and rates described above.

Table 5-1: Average, Q95 and dry weather MEC flow summary

MEC flow	Flow by volume (m^3/day)	Flow rate (l/s)
Overall daily average flow	123,494	1,429
Q95 average flow	101,457	1,174
Dry weather average flow	91,606	1,060

5.2.8 The average volume of water passing through the MEC on a monthly basis vastly exceeds the maximum volumes of water likely to be required to supply all three Wet Grassland areas even if the starting condition of the wet grassland areas was fully dry (e.g. in the summer months). **Table 5-2** shows the potential maximum volumes required for abstraction a per month basis, which amount to 0.6% or less of monthly flow volumes. This provides assurance that the quantity of water is available even if Q95 flow restrictions are applied.

Table 5-2: Summary of required monthly water volume from MEC abstraction

Month	Total water volume across time period 2017-2022 (m3)	No of days included in total volume	Average flow (m3/day)	Average flow (m3/month)	Total volume required to support all 3 wet grassland areas (m^3)	% of average monthly flow required
January	22,125,629	173	127,894	3,964,708	17646	0.4
February	22,571,320	169	133,558	3,773,017	23364	0.6
March	24,676,803	182	135,587	4,203,192	11917	0.3
April	22,635,760	180	125,754	3,772,627	15525	0.4
May	23,420,736	186	125,918	3,903,456	19018	0.5
June	22,057,454	180	122,541	3,676,242	11595	0.3
July	19,631,459	172	114,136	3,538,228	11953	0.3
August	17,569,844	156	112,627	3,491,443	8058	0.2
September	19,714,574	180	109,525	3,285,762	2759	0.1
October	22,856,239	186	122,883	3,809,373	21200	0.6
November	18,875,082	157	120,223	3,606,704	17570	0.5
December	21,261,712	164	129,645	4,018,982	17471	0.4

5.2.9 To protect the habitats from low water quality, water will not be abstracted from the MEC when storm discharges are occurring from the STW. Water quality is further considered in **Section 7.2**.

Wet Grassland Operation

5.2.10 The primary water source for the northern wet grassland areas is rainfall and water will only be abstracted from the MEC when rainfall volumes are insufficient to meet the required water needs within the habitats.

5.2.11 Water from the MEC will be abstracted via a pump placed into the MEC at grid reference TQ 29096 66698, within the open channel section of the MEC. The pump will convey water to the south-eastern corner of Wet Grassland 2. It will only be in operation when water is required and personnel are available on site to oversee the abstraction.

5.2.12 Water will be transferred around the habitat via gravity, through the constructed ditches and channels. The required water levels within Wet Grassland 2 will be controlled by a tilting weir. Water from Wet Grassland 2 will discharge via the existing 560mm diameter syphon into the drainage channel running through Wet Grassland 1. Water from the drainage channel is able to enter Wet Grassland 1 through tilting weirs. At the southern edge of Wet Grassland 1, an inverted syphon drains any surplus flows from the area into the MEC overflow channel and onwards to the Northern Lake. The existing syphon structure (560mm diameter) is proposed to be retained.

5.2.13 The Habitat Management Plan describes in further detail the proposed water level management of these habitats, including

5.3 Wet Grassland 3

Water Sources

5.3.1 The water requirements for Wet Grassland 3 will be met by a combination of direct rainfall, runoff from the landfill mound, and abstraction from the MEC. Water balance calculations are provided in **Appendix B**

5.3.2 In an average rainfall year, direct rainfall (including runoff from the landfill) could supply around 90% of total water needs from November to January; and 40-60% of total water needs in February, March and October. However, from April to August, the calculations show rainfall and stored runoff in an average year would be insufficient to sustain the habitat and a supplementary source of water is required.

5.3.3 The artificial mound created by the landfill provides potential to capture surface runoff and utilise this as an additional water source. The majority of the runoff from the southern side of the landfill will fall naturally towards Wet Grassland 3, and provides an additional source of water supply over and above direct rainfall.

5.3.4 The intended final contours of the landfill have been used to identify a catchment area for the runoff and to calculate the potential runoff volumes which might be available in an average rainfall year (based on the 1991-2020 average) as shown in **Figure 5-1.** An allowance has been deducted from the calculated volumes to account for losses during transfer from the swale to the wet grassland area, with 20% losses included in the calculation as a conservative estimate.

5.3.5 Runoff from the eastern face of the landfill will be collected via a proposed swale that runs along the toe of the landfill. Water balance calculations indicate that potential volumes of around 2200m^3 per month could run off the eastern side of the landfill in the wetter months of the year (November to January), with lesser volumes of between 300 – 1500m^3 available in February/March and September/October.

5.3.6 For both the southern and eastern faces of the landfill, there is not expected to be any runoff volume available between April to August. During these months infiltration and PE is expected to exceed rainfall and no runoff will be available.

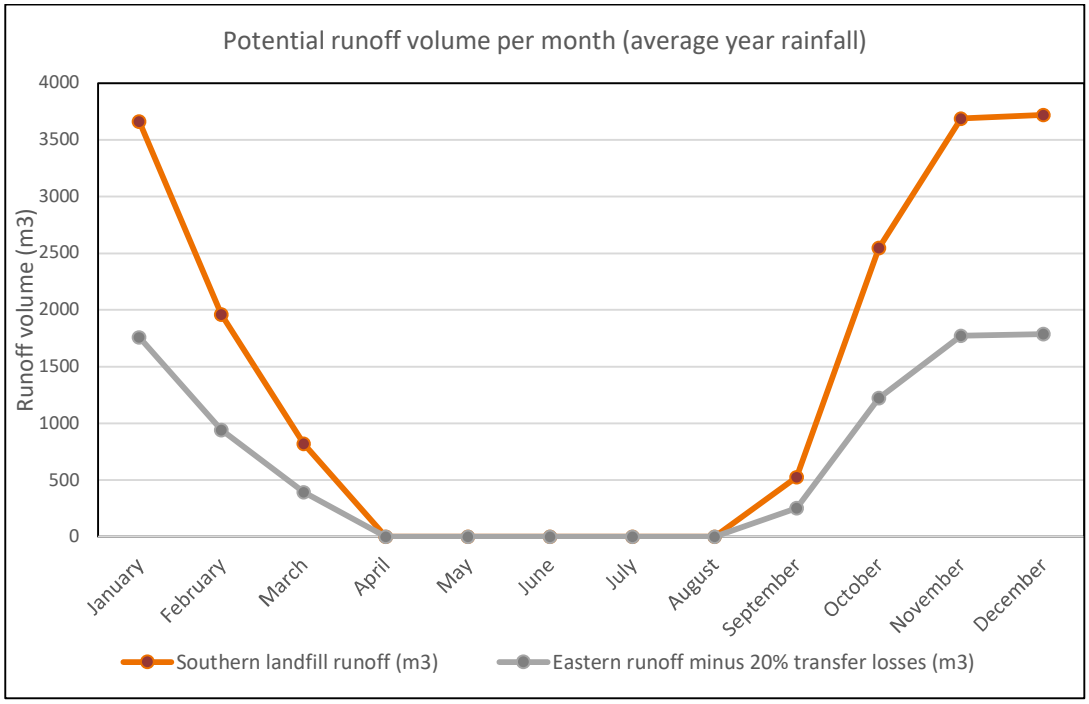


Figure 5-1 Potential volume of runoff from south and east sides of landfill (m^3)

5.3.7 The swale will flow via gravity towards a storage basin area located to the north of wet grassland 3. A tilting weir will be constructed at its downstream end to allow for water to retained within the basin, and discharged as required. A culvert will convey stored water from the basin into Wet Grassland 3.

5.3.8 The swale and the storage basin will be lined with impermeable material to minimise losses to infiltration and protect groundwater. An illustrative layout for the swale and storage basin is shown in **Figure 5-2**. The approximate area of the basin is 3000m^2 (including side slopes) to accommodate calculated runoff volumes. Runoff from the area to the north (formerly a sludge lagoon) will also be directed into the basin.

5.3.9 The primary purpose of the basin is water provision to support the Wet Grassland 3 habitat. It is not intended that the basin is maintained in a wet state year round, and there is the potential for the basin to run dry following extended periods of dry weather.

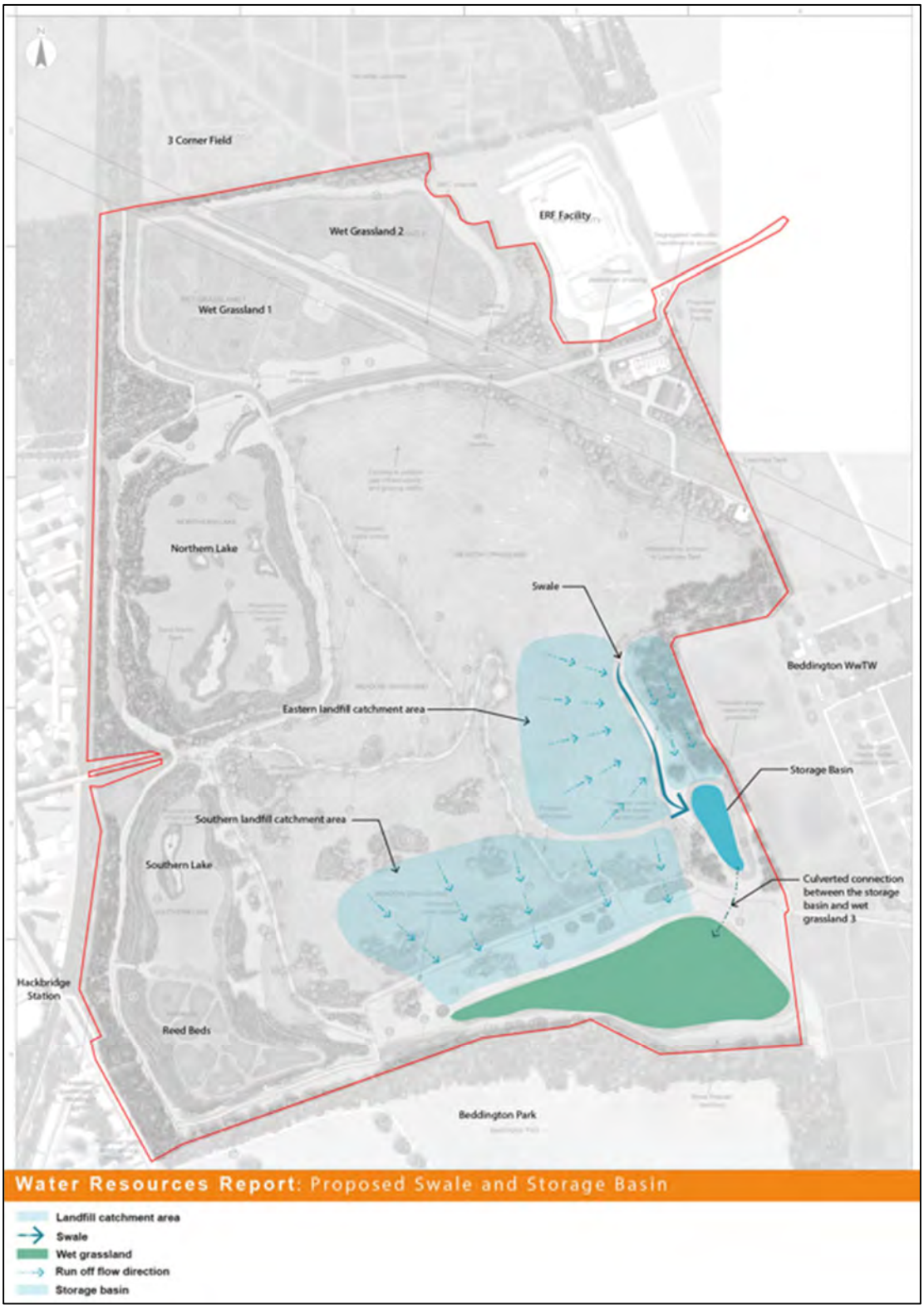


Figure 5-2 Proposed swale and storage basin location and runoff catchment areas

5.3.10 The extant Phase 3 wet grassland management plan indicates that Wet Grassland 3 was due to be constructed with a bed level of 28.5m AOD, into which pools and channels varying in depth up to 300mm below bed level were excavated, and island areas were created which extend 100mm above the bed level. This would have provided bed levels of between 28.20 – 28.60m AOD across the habitat. However, no as-built records exist so it had previously not been possible to verify if the habitat was constructed as it was designed.

5.3.11 A spot level survey was undertaken by Valencia in January 2024 of selected, accessible parts of Wet Grassland 3 to ascertain the constructed bed levels. Recorded bed levels vary from a minimum of 27.89 m AOD on the eastern side of the habitat, to a maximum of 28.40m AOD on the western side of the habitat – a rise of 0.51m from east to west, which will inhibit gravity flow. Reprofiling of Wet Grassland 3 will be required to enhance water flow from west to east and connectivity of the tilting weir at the western end of the wet grassland.

5.3.12 Historic and recently obtained groundwater levels in the vicinity of Wet Grassland 3 are inconclusive as to the potential for groundwater interaction. Anecdotally, seepage has also been reported from the SAMS lagoons on adjacent Thames Water land through to the Wet Grassland 3 area. However, the future plans for the lagoons are unknown so this cannot be guaranteed to continue, if still present. Therefore, groundwater has been excluded as a reliable source of water and lining of Wet Grassland 3 is recommended to reduce infiltration losses.

Wet Grassland Operation

5.3.13 Surface runoff from the southern side of the landfill will flow naturally towards Wet Grassland 3 and will not be formally collected. Runoff from the eastern side of the landfill will be collected via the open swale and transported via gravity into the storage area located north of Wet Grassland 3. The outfall for the storage area will consist of a tilting weir to allow for water to be retained and discharged as required. A culvert will convey water from the storage area into Wet Grassland 3. An existing tilting weir is located at the downstream (western) end of Wet Grassland 3 which discharges water from the habitat into the Wandle Overflow Channel. The weir was previously installed at an inappropriate level such that discharge via gravity was not possible. The weir is understood to have been reinstalled in December 2023/January 2024. Reprofiling works of Wet Grassland 3 may be required to allow for efficient movement and draining of water.

5.3.14 Water from the MEC will be abstracted from the proposed pump location described above at grid reference TQ 29096 66698, within the open channel section of the MEC. Water will only be abstracted if there is insufficient water from all other sources described in the preceding section. The pump will convey water via a network of pipes to the northern end of the proposed swale, and into the storage pond and Wet Grassland 3. It will only be in operation when water is required and personnel are available on site to oversee the abstraction.

6 Proposed Pumping Infrastructure

6.1 Eel Regulation Compliance

6.1.1 As of January 2024, the Eels Regulation 2009 applies when any abstraction meets the following criteria:

- The abstracted volume equals to or is greater than 20 m^3/day.
- The abstraction location is within 100km from the head of tide and less than 150m above sea level.

6.1.2 Local advice should always be sought from the EA Fisheries team as there can be evidence of eels (albeit low populations), or an absence of eels outside of the second parameter listed above.

6.1.3 Consultation with the local EA Fisheries officer and a representative from the EA's National Eel Screening Helpdesk (NESH) was held on 16th January 2024. The EA confirmed that eels and elver are present within the vicinity of the Beddington Site. The outfall to the STW provides good habitat for eels and elver due to the significant volumes of suitable food that is present in the final effluent and storm discharges from a wastewater treatment plant. Reports dated as recently as 2022[11] and 2023[12] indicated that elvers down to 90mm in size have been trapped locally along with adult eels up to and in excess of 300mm.

6.1.4 Any abstraction in Beddington would be required to provide an eel screen sufficient to meet the requirements of the EA manual LIT 60516 – Screening at intakes: measures to protect eel and elvers.

6.2 Screening Options

6.2.1 There are a number of screen styles that are accepted by the EA, notably:

- Mesh Panel Screens
- Bar Rack Screens
- Drop Type Intake Screens
- Wedge Wire Screens (active or passive, cylinder or panel)
- Self-Cleaning Travelling Screens

6.2.2 The pump flows required for the proposed watering strategy will be low (<100 L/s, see **Section 6.3**), as such a small-scale package plant system is likely to represent the best cost efficiency. Therefore, only Wedge Wire Screens and Self-Cleaning Travelling Screens have been investigated. There are six manufacturers typically available for these screens:

- Passive Wedge Wire Cylinder: Rotorflush, Andritz
- Active Wedge Wire Cylinder: ISI
- Active Wedge Wire Panel: Ecoscreens

[11] The Thames European Eel Project Report (Zoological Society of London, November 2022)

[12] The Thames European Eel Project Report (Zoological Society of London, December 2023)

- Self-Cleaning Travelling Screens: Hydrolox, Go Flo

6.2.3 Different screening systems require different auxiliary systems and are suited to different installations styles. An optioneering assessment for abstractions at Beddington reviewed two possible locations, including the MEC channel and from a manhole closer to the WWTP outlet. This assessment concluded that the existing MEC channel provides good installation parameters for a wedge wire cylinder as cross flows are available. Additionally, a flow rate of less than 150 L/s means Rotorflush can supply a coupled screen / pump system reducing the equipment footprint and amount of auxiliary systems. Therefore, a Rotorflush passive wedge wire cylinder screen installed in the MEC channel is recommended for abstractions at Beddington.

6.2.4 The Rotorflush system uses part of the abstracted flows to backflush the screen mesh and can be coupled to a pump directly, thereby removing the need for a separate pump. These are ideal for in channel installations and make the most from cross flows. Where a Rotorflush screen is coupled with a pump, flows shouldn't exceed approximately 150 L/s. Any flows beyond this would require an uncoupled Rotorflush screen with an independent pump.

6.3 Pump Rate

6.3.1 The selection of a maximum pump rate has considered:

- **The flow rate within the MEC:** A pump rate substantially less than the flow rate within the MEC was targeted to safeguard the ecology downstream. **Table 5-1** summarises the daily average flow, the calculated Q95 flow, and the dry weather flow within the MEC.
- **Operational management:** The use of the pump is intended to be undertaken supervised during Site opening hours. The selection of pump rate has factored in the time taken to fill the wet grasslands aiming appropriate time frames.
- **Available pump products:** Consideration has been given to the available products on the market such that a cost effective solution can be selected.

6.3.2 **Section 4.3** describes the three scenarios in which abstraction may be required. These are:

- The filling of each habitat at the initial establishment stage;
- Ongoing water level management in line with maintaining the desired condition. Periodic water loss may be experienced due to evaporation exceeding the volume of rainfall; and
- Water levels in each habitat will be gradually increased from the end of summer to reach inundated conditions in October/November. Water may be required if the volume of rainfall is insufficient.

6.3.3 For the initial filling, and autumn refilling of the habitats, abstraction is proposed to take place in autumn/winter when drought conditions are less likely. Several options for pump rate have been considered in the event that rainfall is insufficient to fill each of the habitats to the desired level. **Table 6-1** illustrates the duration of pumping required based on several options of maximum pump rate. The durations presented assume a dry starting position and no rainfall input.

6.3.4 These rates have been selected in consideration of the daily average flow rate (1,429 l/s (**Table 5-1**)) within the MEC. All of these options are no more than 10% of the daily average MEC flow. The initial filling of each habitat would not need to be continuous and could be achieved at a slower rate over a 1-2 week period, with breaks in pumping to suit daily flow conditions in the MEC. Alternatively, a higher (temporary) rate could be considered to reduce the overall pump duration.

Table 6-1 Water Volumes Required for Initial Fill

	Wet Grassland 1	Wet Grassland 2	Wet Grassland 3
Total area of habitat (m^2)	39,735	24,956	35,456
Water volume required for initial fill (m^3)	12,000	7,500	10,700
	Pump Duration (Days)		
pump rate of 40 l/s* (3% of MEC avg daily rate)	3.4	2.2	3.1
pump rate of 80 l/s (6% of MEC avg daily rate)	1.7	1.1	1.5
pump rate of 120 l/s (9% of MEC avg daily rate)	1.1	0.7	1.0

* 40l/s represents the maximum rate of a single pump (see description under 'pump specification'). The overall pump rate can be scaled up by operating multiple units in tandem.

6.3.5 For water level management purposes, the summer months represent the greatest volume in which water may need to be topped up in the event of drought conditions. Summer is the period in which downstream ecological conditions in the River Wandle/River Thames are most likely to be at their most sensitive. The proposed strategy is to abstract from the MEC only when the flow is above the dry weather average flow (1,060l/s (**Table 5-1**)), and for this to be undertaken at the lower rate of 40l/s. This flow can be correlated to a water level within the channel at the abstraction point, and the pump configured to automatically switch on/off.

6.3.6 The Habitat Management Plan recommends more frequent water level monitoring of the wet grasslands during extended dry periods. Therefore, topping up of water, can be undertaken as more frequent, smaller volumes over a short duration.

6.4 Proposed Abstraction Layout

6.4.1 The proposed abstraction location is within an open channel section of the MEC. The channel is constantly flowing, crossflows would always be present during abstraction periods allowing for the channel flows to carry any debris washed off the screen. The channel is 1.295m wide and 2.44m from channel floor to top of concrete; however, the water depth in the screen is variable depending on the discharge flows from the STW.

6.4.2 The cross flow and channel width indicate that a wedge wire cylinder would suit an install in this location. As the flows are approximately 40 L/s, a Rotorflush screen coupled directly to a pump meets the criteria for an install at this location and would represent an ideal solution. The combined pump and screen reduce the number of auxiliary equipment and the overall equipment footprint. Additionally, the existing infrastructure could be used to reduce any additional civil infrastructure other than any electrical associated infrastructure.

6.4.3 Rotorflush combined systems have a minimum submergence allowance. As the channel depth is not yet known, there is a risk that there may not be sufficient submergence. However, this is true for all screening options, and a small weir could be installed to maintain sufficient water depth around the screening infrastructure. The proposed layout is provided in **Figure 6-1**.

6.4.4 The proposed location for the Rotorflush pump is slightly upstream of where the storm drain discharges into the MEC. Therefore, the only anticipated debris would be direct discharges from the STW. In general, any flows from the STW will be treated prior to entering the MEC; however, in a storm event there may be unscreened sewage. In which case, a Rotorflush installed within a channel is a suitable solution as the crossflows will carry any debris blown off of the screens. However, an operator should lift and check the equipment after such an event to confirm no debris remains stuck on the screen.

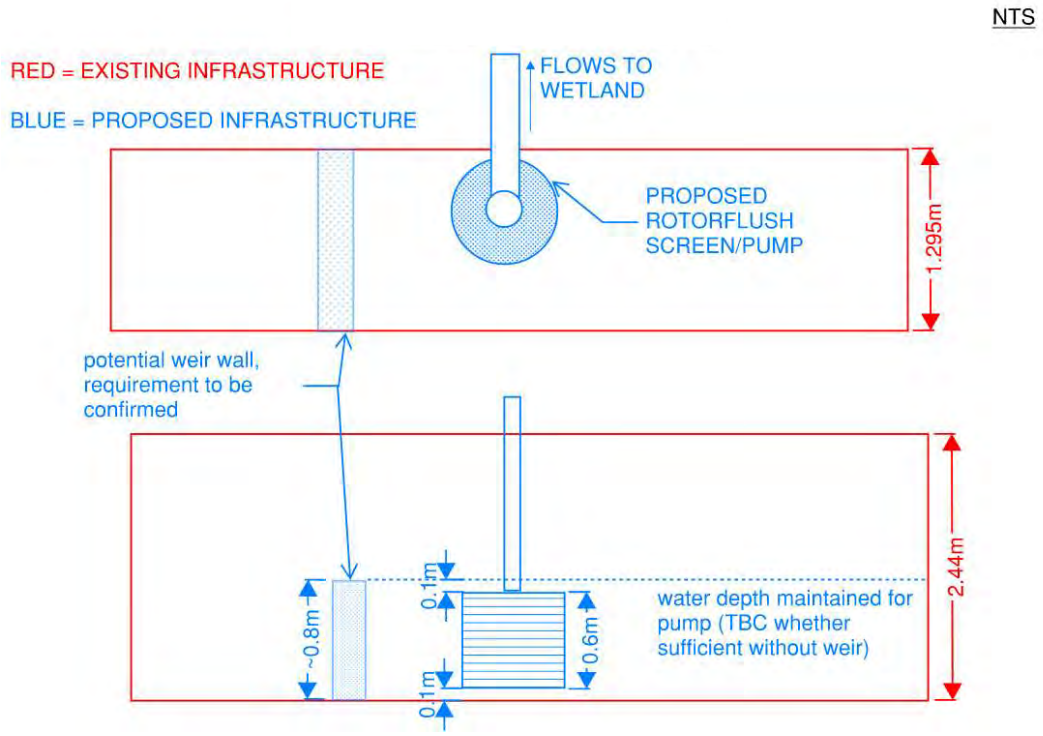


Figure 6-1 Proposed Abstraction Layout

6.5 Approach Velocities and Mesh Sizes

6.5.1 The abstraction layout was presented to the EA Fisheries team and deemed to meet Best Available Eel Protection (BAEP), and confirmation was obtained that any equipment in the proposed layout (**Figure 6-1**) would be required to meet the following parameters:

- Mesh size = 2mm
- Maximum approach velocity = 0.25m/s

7 Further Considerations

7.1 Climate Change

7.1.1 Climate change may impact on water supply to the Site in several ways which are summarised below.

Rainfall

7.1.2 Climate change is expected to change rainfall patterns, which are predicted to reduce in summer and increase in winter. There is a wide consensus about the likely impacts of climate change on rainfall (e.g. Met Office UK Climate Projections[13]). The Met Office have projected changes to rainfall for the period 2050-2079. **Figure 7-1** displays this data for the area relevant to the Site, plotted against the historic long-term average. This shows a decrease in rainfall from May to November, but an increase in rainfall from December to March, resulting in an overall annual increase of around 22mm above long-term average annual rainfall.

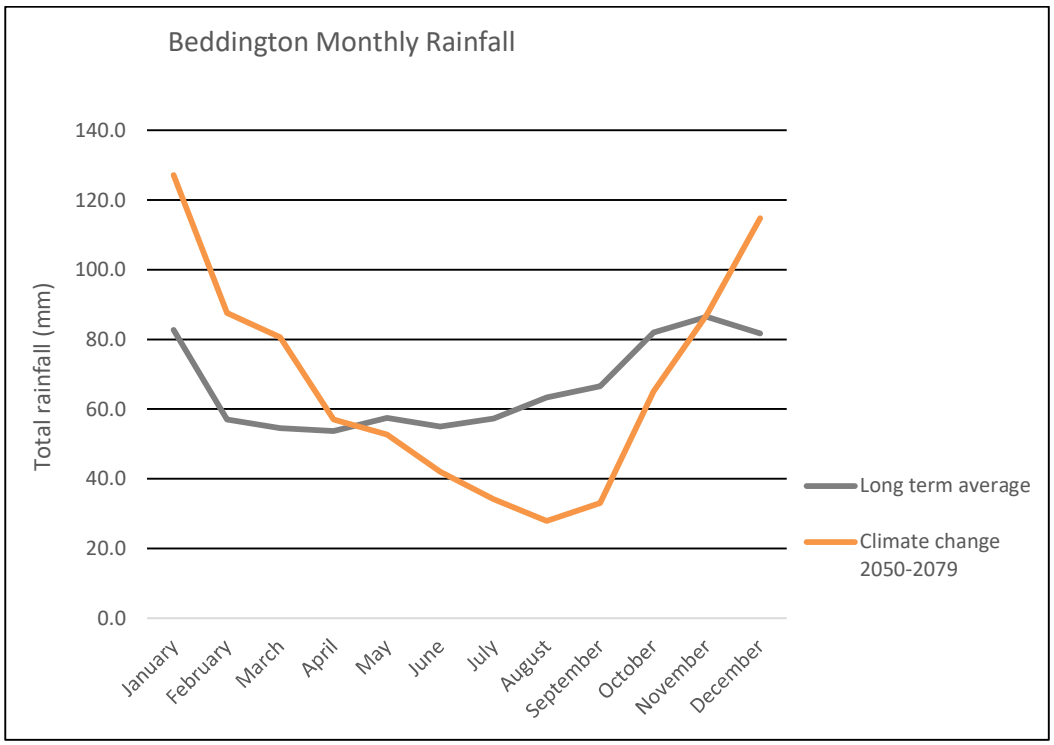


Figure 7-1 Long term average and climate change monthly rainfall comparison

7.1.3 Water supply is already limited in the summer months for the wet grasslands. The impacts of climate change increase the chances of these habitats experiencing dry periods during the warmer months where wet or muddy ground conditions may be challenging to sustain, dependent on frequency and volume of available rainfall.

7.1.4 Sensitivity testing of the water balance calculations for a dry year (where rainfall was 21% lower than the long term annual average) indicates that infiltration and PE are likely to exceed rainfall between March-September i.e. there would be insufficient rainfall to prevent soil drying in all 3 wet grassland areas (**Appendix C**). In a wet year (where rainfall was 42% higher than the long

[13] UKCP headline findings - Met Office

term average) the dry period is shown to reduce to May-August (March is also shown to be dry, but this may be an anomaly in the data of the particular year selected to represent a 'wet year').

7.1.5 The proposed design for Wet Grassland 3 includes the creation of a storage area which assists with mitigating the impacts of uncertainty in weather patterns. It allows for any excess water from landfill runoff to be stored and used in drier periods.

7.1.6 Wet Grasslands 1 and 2 are less susceptible to changes in rainfall patterns. Anticipated wetter winters in future will mean there is less reliance on abstraction from the MEC to maintain water levels within the habitat. Drier summers or increased periods of drought in future may lead to an increase in the frequency of abstraction from the MEC or increased limitations on when water can be abstracted (if flows fall below the Q95 flow volume).

7.1.7 The Habitat Management Plan describes how the wet grasslands can be managed to reduce the impacts of climate change.

Groundwater

7.1.8 Changes to future rainfall patterns will also impact on groundwater levels and the ability of aquifers to recharge, which may in turn impact on the assumed groundwater connectivity of the lakes and reedbeds, and the baseflow in the Wandle FAS channel. There is less of a consensus view about potential changes to groundwater linked to climate change because this is complex to predict and model. Projects exploring potential impacts are ongoing (e.g. British Geological Survey's 'Future Flows 2' Project) but outputs are not yet available, so possible future changes to groundwater levels cannot be quantified.

Frequency-Intensity-Duration of Storm Events

7.1.9 Extreme storm events are predicted to occur more frequently in future and this could potentially occur at any time of the year, but in particular is expected to occur more frequently in winter. This will impact on the frequency and volume of flood flows entering the Wandle FAS, but also entering the Northern Lake from the MEC overflow. The Wandle FAS plays an important role in mitigating the impacts of flooding to downstream communities, and therefore the operation of the Northern Lake outfall must not be altered.

7.1.10 The creation of a storage basin to capture runoff from the former landfill mound provides some potential flood risk benefit primarily to Wet Grassland 3.

7.1.11 The Habitat Management Plan describes how the wet grasslands can be managed to reduce the impacts of flooding.

Impacts of Water Stress

7.1.12 The south-east is located in an area of serious water stress (i.e. future water demand is likely to outstrip the ability of water companies to supply sufficient water to meet all needs).

7.1.13 Changes to water use by households and commercial/industrial premises, either mandatory or voluntary, are likely to be introduced to manage water stress. Water use reductions are being actively promoted and worked towards by many water companies as part of their Water Resources Management Plans (WRMPs) to provide sustainable future water supplies. This may reduce future flows in the MEC, however, the most recent updates to WRMPs are still ongoing and may not have been finalised.

7.1.14 The Thames Water Drainage and Wastewater Management Plan published in May 2023, covering the period 2025-2050, outlines proposals to make changes to Beddington STW in the period 2030-2040 to provide increased capacity to accommodate future population growth and

ensure compliance with environmental targets. This will involve increasing capacity at the STW and consequently, it is assumed that flows into the MEC will not reduce in future.

7.1.15 The MEC discharge will be relied upon for water supply to the wet grassland areas, particularly in the summer months. The downstream environment is also reliant on discharge from the MEC, and hence water use on site must be cognisant of the knock on impacts of increased abstraction.

7.1.16 It is vital that Valencia and Thames Water actively work together to plan for any future changes to the MEC discharge volumes. As Thames Water are the landowners of the site, and active members of the Conservation Science Group (CSG) and Conservation and Access Management Committee (CAMC), these forums will help to facilitate these discussions.

7.1.17 The Habitat Management Plan describes how the wet grasslands can be managed to reduce the impacts of drought.

7.2 Water Quality

7.2.1 The Beddington STW discharge permit specifies water quality standards set by the EA for the discharged effluent. The MEC flows eventually discharge into the River Wandle, and therefore have a potential impact on the water quality, ecology and Water Framework Directive objectives associated with the watercourse, as well as potential localised impacts on the wet grassland habitat. The discharge permit specifies limits for Biochemical Oxygen Demand (BOD), Ammoniacal Nitrogen, suspended solids, Iron, oil and grease, Chemical Oxygen Demand (COD), and Phosphorous. As these inputs are limited to levels which prevent impact to the sensitive Chalk stream of the River Wandle and the underlying Chalk catchment, then the water quality is assumed to be high enough not to negatively influence the restored habitats within the RMP.

7.2.2 To further assess potential impacts to the habitats, an outline assessment of water quality and potential nutrient inputs has been undertaken and is summarised in the Nutrient Assessment report (appended to the RRMP). The report considers potential nitrogen loading resulting from the additional input of treated effluent from the MEC into the Northern Lake when excess water needs to be discharged from Wet Grasslands 1 and 2.

7.2.3 A ‘single discharge event’ would occur when water levels in the habitats need to be lowered, and a volume of water is discharged from Wet Grassland 1 via the existing connection to the MEC overflow channel and into the Northern Lake. This would be expected to occur twice a year when water levels are lowered in spring and summer to meet the requirements of the target species. A discharge of water may also be required in anticipation of a flood event into the River Wandle overflow channel, to create additional flood storage capacity within the wet grassland areas. Discharge of excess water may also need to occur following periods of heavy rainfall when water levels in the habitat exceed the requirements of the target species.

7.2.4 The key findings of the Nutrient Assessment were:

- The proposals do not alter the discharge location of treated effluent from site as the Northern Lake and MEC overflow channel discharge into the River Wandle at the same location
- It is estimated the proposed watering strategy will result in a 4% increase in the concentration of ammoniacal nitrogen in the Northern Lake.
- Such events are expected to occur infrequently (twice a year in line with management strategy and in anticipation of a flood event). As the existing concentration of nitrogen within the Northern Lake already varies seasonally, a 4% increase in concentration is considered unlikely to have a significant long-term effect on water quality within the Northern Lake and wider environment.

7.2.5 The Thames Water Beddington and Hogsmill Catchment Strategic Plan[14] notes an intention to invest in the STW to achieve 100% permit compliance between 2030-2035, which in turn will improve water quality abstracted from the MEC to support the wet grassland habitats.

7.2.6 The Habitat Management Plan describes how the wet grasslands can be managed to reduce the potential for poor quality treated effluent to enter the habitats.

7.3 Future abstraction by Thames Water to support lagoon habitats

7.3.1 Discussions with Thames Water have been opened regarding future plans for the former sludge lagoons known as the SAMS lagoons (located to the south of the STW) and 100 Acre lagoons (located just beyond the north boundary of the Site). The lagoons have been identified as providing suitable habitat for the target bird species.

7.3.2 Phase 1 of the investigations relating to the future of the lagoons has been completed and is summarised in the Binnies/Thames Water 'Beddington Farmlands Phase 1 Investigation' report dated January 2023. The report included water balance calculations for some of the lagoons concluding that a water source would need to be found to maintain the lagoon habitat year-round. The report also made recommendations for the next phase of investigations however a timescale for these investigations to occur is not known at the time of writing.

7.3.3 Many of the recommendations within the report such as groundwater monitoring and survey of hydraulic structures has been undertaken as part of the investigations underpinning this planning application. Moreover, the proposed water resource strategy has furthered the Phase 1 investigations and identified a viable water source that may also be relevant for the Thames Water sites.

[14] beddington-and-hogsmill-catchment-strategic-plan.pdf (thameswater.co.uk)

8 Summary

8.1 Report Overview

8.1.1 This report has assessed the water needs of wet grassland habitats at the Beddington Landfill restoration site and evaluated all available sources of water to meet the water needs, to support the development of a revised Restoration Management Plan for the site by Stantec, on behalf of Valencia Waste Management.

8.1.2 All water sources within the site boundary have been evaluated for their potential to support the Wet Grassland habitats. All surface water bodies (ERF SuDS pond, Northern and Southern lakes and Southern Reedbeds/Feeder Beds) have been excluded as potential sources of water supply due to land ownership/water quality issues, EA advice and engineering feasibility issues, respectively. The MEC Overflow channel has also been excluded due to water quality/potential contamination issues and lack of information about flow rates/volumes.

8.1.3 There is an identified potential for groundwater interaction in Wet Grasslands 2 and 3. Groundwater has been determined to be an unreliable source due to seasonal fluctuations and variation in levels over longer time periods. Soakaway testing has established that infiltration losses may exceed rainfall, and overall losses to infiltration are likely to outweigh any potential gains from groundwater input due to the underlying soil conditions. Therefore, all three wet grassland areas will be lined with suitable impermeable material to improve water retention.

8.1.4 Direct rainfall to the wet grassland areas, runoff from the landfill mound and treated effluent from the MEC are considered to be the most reliable and feasible sources of water supply in the long term.

8.1.5 The primary source of water supply to Wet Grasslands 1 and 2 will be direct rainfall, supported as required by abstraction from the MEC.

8.1.6 The primary source of water supply to Wet Grassland 3 will be a combination of direct rainfall, supplemented with stored runoff from the landfill mound, and abstraction from the MEC when insufficient water is available from storage.

8.1.7 The continuous daily flow rate within the MEC above Q95 flow volumes is sufficient to sustain the water needs of all three wet grassland areas in all seasons when insufficient water is available from rainfall and runoff capture. Q95 flow volumes have been used in line with EA advice as a guideline to the minimum required flow volume to support the River Wandle. On average, this would mean that insufficient water was available for abstraction for 18 days per year, which is unlikely to be consecutive.

8.1.8 No water would be abstracted from the MEC during declared drought conditions or extended periods without rainfall, to protect River Wandle baseflows. The Habitat Management Plan outlines the procedure for management of the habitats during dry and drought conditions.

8.1.9 A swale and storage area will be created at the base of the south-eastern side of the landfill to capture and store runoff from the eastern side of landfill and the former lagoon area to the immediate north of the storage area. This creates a new habitat as well as providing some flood risk benefit.

8.1.10 Excavation of the western side of Wet Grassland 3 to a lower level is required to improve gravity flows through the wet grassland area and restore connectivity to the tilting weir located at the western edge which serves as an outlet structure. The weir is currently set at a level of 27.89m AOD. The required bed and weir levels will be further evaluated and confirmed during the ongoing detailed design process.

Appendix A Water Balance Calculations

Appendix A

Beddington Farmlands: Water Balance Calculation

Average monthly rainfall 1936-2017			Water inputs - average rainfall year				
			Eastern part of landfill	Southern part of landfill	Wet Grassland 1	Wet Grassland 2	Wet Grassland 3
Month	Average rainfall (mm)	Fitted to SAAR	Rainfall (m^3)	Rainfall (m^3)	Rainfall (m^3)	Rainfall (m^3)	Rainfall (m^3)
January	82.8	79.3	2858	4759	3150	1978	2811
February	57.0	54.6	1970	3279	2170	1363	1937
March	54.5	52.2	1882	3133	2074	1302	1850
April	53.7	51.4	1854	3086	2043	1283	1823
May	57.4	55.0	1983	3302	2186	1373	1950
June	55.0	52.7	1900	3164	2094	1315	1869
July	57.2	54.8	1977	3291	2179	1368	1944
August	63.3	60.7	2187	3641	2410	1514	2151
September	66.6	63.8	2299	3827	2533	1591	2261
October	81.9	78.5	2830	4711	3118	1959	2783
November	86.4	82.8	2985	4970	3290	2066	2935
December	81.7	78.3	2823	4699	3111	1954	2776
Annual total	797.6	764.0					

	Total area (m^2)
Rainfall catchment area: Eastern part of landfill	36057
Rainfall catchment area: Southern part of landfill	60027
Wet Grassland 1	39735
Wet Grassland 2	24956
Wet Grassland 3	35456

Water losses - average rainfall year																
Potential Evapotranspiration (PE)						Infiltration						Totals				
PE* (mm/month)	Eastern PET* (m^3)	Southern PET* (m^3)	Wet Grassland 1 (m^3)	Wet Grassland 2 (m^3)	Wet Grassland 3 (m^3)	Infiltration Rate CLAY (m/month)	Eastern Infiltration (m^3)	Southern Infiltration (m^3)	Wet Grassland 1 Infiltration (m^3)	Wet Grassland 2 Infiltration (m^3)	Wet Grassland 3 Infiltration (m^3)	Total Eastern losses (m^3)	Total Southern losses (m^3)	Total Wet Grassland 1 losses (m^3)	Total Wet Grassland 2 losses (m^3)	Total Wet Grassland 3 losses (m^3)
11.91	429	715	473	297	422	0.080	230	382	0	0	0	659	1097	473	297	422
17.97	648	1079	714	448	637	0.073	144	240	0	0	0	792	1319	714	448	637
34.35	1238	2062	1365	857	1218	0.080	151	252	0	0	0	1390	2313	1365	857	1218
52.50	1893	3151	2086	1310	1861	0.078	144	240	0	0	0	2037	3391	2086	1310	1861
74.29	2679	4460	2952	1854	2634	0.080	159	265	0	0	0	2838	4725	2952	1854	2634
85.64	3088	5141	3403	2137	3037	0.078	148	246	0	0	0	3236	5387	3403	2137	3037
89.58	3230	5377	3559	2236	3176	0.080	159	264	0	0	0	3389	5642	3559	2236	3176
74.82	2698	4491	2973	1867	2653	0.080	176	293	0	0	0	2873	4784	2973	1867	2653
50.06	1805	3005	1989	1249	1775	0.078	179	298	0	0	0	1984	3302	1989	1249	1775
29.77	1073	1787	1183	743	1055	0.080	227	379	0	0	0	1301	2165	1183	743	1055
14.92	538	896	593	372	529	0.078	232	386	0	0	0	770	1282	593	372	529
10.03	362	602	399	250	356	0.080	227	378	0	0	0	589	980	399	250	356

Water balance: Inputs - losses Average rainfall year				
Eastern part of landfill (m^3)	Southern part of landfill (m^3)	Wet Grassland 1 (m^3)	Wet Grassland 2 (m^3)	Wet Grassland 3 (m^3)
2199	3661	2677	1681	2388
1177	1960	1456	915	1300
492	819	709	445	633
-183	-305	-43	-27	-39
-855	-1423	-766	-481	-684
-1335	-2223	-1309	-822	-1168
-1412	-2350	-1381	-867	-1232
-686	-1143	-563	-353	-502
315	525	544	342	486
1529	2546	1936	1216	1727
2215	3687	2697	1694	2406
2234	3719	2712	1703	2420
5690	9473	8669	5445	7735

Cumulative Water Balance Average rainfall year				
Eastern part of landfill (m^3)	Southern part of landfill (m^3)	Wet Grassland 1 (m^3)	Wet Grassland 2 (m^3)	Wet Grassland 3 (m^3)
2199	3661	2677	1681	2388
3377	5621	4133	2596	3688
3869	6441	4842	3041	4321
3685	6135	4799	3014	4282
2831	4712	4033	2533	3598
1495	2489	2724	1711	2430
83	139	1343	843	1198
-603	-1004	780	490	696
-288	-479	1325	832	1182
1241	2067	3260	2048	2909
3456	5754	5957	3741	5315
5690	9473	8669	5445	7735

Appendix B Wet Grassland Water Requirement Calculations

Appendix B

Beddington Farmlands Water Balance: Additional Water Needs

Wet Grassland 1 Water Needs						
Month	Water available - direct rainfall (m^3)	Target Condition	Average Water Depth (m)	Water Volume Required (m^3)	Sufficient volume available from direct rainfall?	Additional volume required from MEC abstraction (m^3)
January	2677	wet/flooded	0.3	11921	No	9244
February	4133	wet/flooded	0.3	11921	No	7787
March	4842	shallow	0.15	5960	No	1118
April	4799	shallow	0.15	5960	No	1161
May	4033	shallow	0.15	5960	No	1928
June	2724	muddy	0.05	1987	Yes	0
July	1343	muddy	0.05	1987	No	644
August	780	muddy	0.05	1987	No	1207
September	1325	muddy	0.05	1987	No	662
October	3260	wet/flooded	0.3	11921	No	8660
November	5957	wet/flooded	0.3	11921	No	5964
December	8669	wet/flooded	0.3	11921	No	3252
Annual total				85430		41627

Wet Grassland 2 Water Needs						
Month	Water available - direct rainfall (m^3)	Target Condition	Average Water Depth (m)	Water Volume Required (m^3)	Sufficient volume available from direct rainfall?	Additional volume required from MEC abstraction (m^3)
January	1681	wet/flooded	0.3	7487	No	5806
February	2596	wet/flooded	0.3	7487	No	4891
March	3041	shallow	0.15	3743	No	702
April	3014	shallow	0.15	3743	No	729
May	2533	shallow	0.15	3743	No	1211
June	1711	muddy	0.05	1248	Yes	0
July	843	muddy	0.05	1248	No	404
August	490	muddy	0.05	1248	No	758
September	832	muddy	0.05	1248	No	416
October	2048	wet/flooded	0.3	7487	No	5439
November	3741	wet/flooded	0.3	7487	No	3745
December	5445	wet/flooded	0.3	7487	No	2042
Annual total				14974		26144

Wet Grassland 3 Water Needs						
Month	Water available - direct rainfall (m^3)	Target Condition	Average Water Depth (m)	Water Volume Required (m^3)	Sufficient volume available from direct rainfall?	Additional volume required from MEC abstraction (m^3)
January	2388	wet/flooded	0.3	10637	No	8248
February	3688	wet/flooded	0.3	10637	No	6949
March	4321	shallow	0.15	5318	No	998
April	4282	shallow	0.15	5318	No	1036
May	3598	shallow	0.15	5318	No	1720
June	2430	muddy	0.05	1773	Yes	0
July	1198	muddy	0.05	1773	No	575
August	696	muddy	0.05	1773	No	1077
September	1182	muddy	0.05	1773	No	591
October	2909	wet/flooded	0.3	10637	No	7728
November	5315	wet/flooded	0.3	10637	No	5321
December	7735	wet/flooded	0.3	10637	No	2901
Annual total				21274		37144

Appendix C Sensitivity Analysis

Appendix C
Beddington Farmlands: Water Balance Calculation Sensitivity Test

Wet year scenario (based on 2000 rainfall)

		Water inputs - wet year				
Average monthly rainfall 2000		Eastern part of landfill	Southern part of landfill	Wet Grassland 1	Wet Grassland 2	Wet Grassland 3
Month	Average rainfall (mm)	Rainfall (m^3)	Rainfall (m^3)	Rainfall (m^3)	Rainfall (m^3)	Rainfall (m^3)
January	27.0	974	1621	1073	674	957
February	80.4	2899	4826	3195	2006	2851
March	23.0	829	1381	914	574	815
April	140.1	5052	8410	5567	3496	4967
May	96.9	3494	5817	3850	2418	3436
June	21.4	772	1285	850	534	759
July	78.8	2841	4730	3131	1967	2794
August	25.9	934	1555	1029	646	918
September	140.6	5070	8440	5587	3509	4985
October	209.4	7550	12570	8321	5226	7424
November	171.1	6169	10271	6799	4270	6067
December	125.0	4507	7503	4967	3120	4432
Annual total	1139.6					

Water losses - wet year																
Potential Evapotranspiration (PE)						Infiltration						Totals				
PE* (mm/month)	Eastern PET* (m^3)	Southern PET* (m^3)	Wet Grassland 1	Wet Grassland 2	Wet Grassland 3	Infiltration Rate CLAY (m/month)	Eastern Infiltration (m^3)	Southern Infiltration (m^3)	Wet Grassland 1 Infiltration (m^3)	Wet Grassland 2 Infiltration (m^3)	Wet Grassland 3 Infiltration (m^3)	Total Eastern losses (m^3)	Total Southern losses (m^3)	Total Wet Grassland 1 losses (m^3)	Total Wet Grassland 2 losses (m^3)	Total Wet Grassland 3 losses (m^3)
11.91	429	715	473	297	422	0.080	78	130	0	0	0	508	845	473	297	422
17.97	648	1079	714	448	637	0.073	212	353	0	0	0	860	1432	714	448	637
34.35	1238	2062	1365	857	1218	0.080	67	111	0	0	0	1305	2173	1365	857	1218
52.50	1893	3151	2086	1310	1861	0.078	393	654	0	0	0	2286	3805	2086	1310	1861
74.29	2679	4460	2952	1854	2634	0.080	281	467	0	0	0	2960	4927	2952	1854	2634
85.64	3088	5141	3403	2137	3037	0.078	60	100	0	0	0	3148	5241	3403	2137	3037
89.58	3230	5377	3559	2236	3176	0.080	228	380	0	0	0	3458	5757	3559	2236	3176
74.82	2698	4491	2973	1867	2653	0.080	75	125	0	0	0	2773	4616	2973	1867	2653
50.06	1805	3005	1989	1249	1775	0.078	394	656	0	0	0	2199	3661	1989	1249	1775
29.77	1073	1787	1183	743	1055	0.080	607	1010	0	0	0	1680	2797	1183	743	1055
14.92	538	896	593	372	529	0.078	480	799	0	0	0	1018	1694	593	372	529
10.03	362	602	399	250	356	0.080	362	603	0	0	0	724	1205	399	250	356

Water balance: Inputs - losses Wet year				
Eastern part of landfill (m^3)	Southern part of landfill (m^3)	Wet Grassland 1	Wet Grassland 2	Wet Grassland 3
466	776	600	377	535
2039	3394	2481	1558	2214
-476	-792	-451	-283	-402
2766	4605	3481	2186	3106
534	890	898	564	802
-2376	-3956	-2553	-1603	-2278
-617	-1027	-428	-269	-382
-1839	-3061	-1944	-1221	-1734
2870	4779	3598	2260	3210
5870	9773	7138	4483	6369
5152	8576	6206	3898	5537
3783	6298	4568	2869	4076

Cumulative Water Balance Wet year				
Eastern part of landfill (m^3)	Southern part of landfill (m^3)	Wet Grassland 1	Wet Grassland 2	Wet Grassland 3
466	776	600	377	535
2505	4170	3080	1935	2749
2029	3378	2629	1651	2346
4795	7982	6110	3838	5452
5329	8872	7009	4402	6254
2953	4916	4456	2799	3976
2336	3889	4028	2530	3594
497	827	2084	1309	1859
3367	5606	5682	3568	5070
9238	15379	12819	8051	11439
14389	23955	19025	11949	16976
18173	30253	23593	14818	21053

Dry year scenario (based on 1996 rainfall)

Average monthly rainfall 2000		Water inputs - dry year				
		Eastern part of landfill	Southern part of landfill	Wet Grassland 1	Wet Grassland 2	Wet Grassland 3
Month	Average rainfall (mm)	Rainfall (m^3)	Rainfall (m^3)	Rainfall (m^3)	Rainfall (m^3)	Rainfall (m^3)
January	68.1	2455	4088	2706	1700	2415
February	66.1	2383	3968	2626	1650	2344
March	45.0	1623	2701	1788	1123	1596
April	24.4	880	1465	970	609	865
May	41.3	1489	2479	1641	1031	1464
June	8.3	299	498	330	207	294
July	44.6	1608	2677	1772	1113	1581
August	76.0	2740	4562	3020	1897	2695
September	31.1	1121	1867	1236	776	1103
October	60.4	2178	3626	2400	1507	2142
November	139.1	5016	8350	5527	3471	4932
December	26.6	959	1597	1057	664	943
Annual total	631.0					

Water losses - dry year																
Potential Evapotranspiration (PE)						Infiltration						Totals				
PE* (mm/month)	Eastern PET* (m^3)	Southern PET* (m^3)	Wet Grassland 1	Wet Grassland 2	Wet Grassland 3	Infiltration Rate CLAY (m/month)	Eastern Infiltration (m^3)	Southern Infiltration (m^3)	Wet Grassland 1 Infiltration (m^3)	Wet Grassland 2 Infiltration (m^3)	Wet Grassland 3 Infiltration (m^3)	Total Eastern losses (m^3)	Total Southern losses (m^3)	Total Wet Grassland 1 losses (m^3)	Total Wet Grassland 2 losses (m^3)	Total Wet Grassland 3 losses (m^3)
11.91	429	715	473	297	422	0.080	197	328	0	0	0	627	1043	473	297	422
17.97	648	1079	714	448	637	0.073	175	291	0	0	0	822	1369	714	448	637
34.35	1238	2062	1365	857	1218	0.080	130	217	0	0	0	1369	2279	1365	857	1218
52.50	1893	3151	2086	1310	1861	0.078	68	114	0	0	0	1961	3265	2086	1310	1861
74.29	2679	4460	2952	1854	2634	0.080	120	199	0	0	0	2798	4659	2952	1854	2634
85.64	3088	5141	3403	2137	3037	0.078	23	39	0	0	0	3111	5180	3403	2137	3037
89.58	3230	5377	3559	2236	3176	0.080	129	215	0	0	0	3359	5592	3559	2236	3176
74.82	2698	4491	2973	1867	2653	0.080	220	367	0	0	0	2918	4858	2973	1867	2653
50.06	1805	3005	1989	1249	1775	0.078	87	145	0	0	0	1892	3150	1989	1249	1775
29.77	1073	1787	1183	743	1055	0.080	175	291	0	0	0	1248	2078	1183	743	1055
14.92	538	896	593	372	529	0.078	390	649	0	0	0	928	1545	593	372	529
10.03	362	602	399	250	356	0.080	77	128	0	0	0	439	731	399	250	356

Water balance: Inputs - losses Dry year				
Eastern part of landfill (m^3)	Southern part of landfill (m^3)	Wet Grassland 1	Wet Grassland 2	Wet Grassland 3
1829	3044	2233	1402	1992
1561	2599	1912	1201	1706
254	423	423	266	378
-1082	-1800	-1116	-701	-996
-1309	-2180	-1311	-823	-1170
-2812	-4681	-3073	-1930	-2742
-1751	-2915	-1787	-1122	-1595
-178	-296	47	30	42
-771	-1283	-753	-473	-672
930	1548	1217	765	1086
4087	6805	4934	3099	4403
520	866	658	413	587

Cumulative Water Balance Dry year				
Eastern part of landfill (m^3)	Southern part of landfill (m^3)	Wet Grassland 1	Wet Grassland 2	Wet Grassland 3
1829	3044	2233	1402	1992
3390	5643	4145	2603	3699
3643	6065	4568	2869	4077
2562	4265	3452	2168	3080
1253	2085	2141	1345	1911
-1559	-2596	-932	-585	-832
-3310	-5511	-2719	-1708	-2427
-3488	-5807	-2672	-1678	-2385
-4259	-7090	-3426	-2152	-3057
-3329	-5542	-2208	-1387	-1971
758	1263	2726	1712	2432
1279	2129	3384	2125	3020

Climate change scenario

Average monthly rainfall 2050-2079		Water inputs - climate change scenario				
		Eastern part of landfill	Southern part of landfill	Wet Grassland 1	Wet Grassland 2	Wet Grassland 3
Month	Average rainfall (mm)	Rainfall (m^3)	Rainfall (m^3)	Rainfall (m^3)	Rainfall (m^3)	Rainfall (m^3)
January	127.1	4583	7629	5050	3172	4506
February	87.6	3158	5257	3480	2186	3105
March	80.6	2906	4838	3203	2011	2858
April	57.0	2055	3422	2265	1422	2021
May	52.7	1900	3163	2094	1315	1869
June	42.0	1514	2521	1669	1048	1489
July	34.1	1230	2047	1355	851	1209
August	27.9	1006	1675	1109	696	989
September	33.0	1190	1981	1311	824	1170
October	65.1	2347	3908	2587	1625	2308
November	87.0	3137	5222	3457	2171	3085
December	114.7	4136	6885	4558	2862	4067
Annual total	808.8					

Water losses - climate change scenario																
Potential Evapotranspiration (PE)						Infiltration						Totals				
PE* (mm/month)	Eastern PET* (m^3)	Southern PET* (m^3)	Wet Grassland 1	Wet Grassland 2	Wet Grassland 3	Infiltration Rate CLAY (m/month)	Eastern Infiltration (m^3)	Southern Infiltration (m^3)	Wet Grassland 1 Infiltration (m^3)	Wet Grassland 2 Infiltration (m^3)	Wet Grassland 3 Infiltration (m^3)	Total Eastern losses (m^3)	Total Southern losses (m^3)	Total Wet Grassland 1 losses (m^3)	Total Wet Grassland 2 losses (m^3)	Total Wet Grassland 3 losses (m^3)
11.91	429	715	473	297	422	0.080	368	613	0	0	0	798	1328	473	297	422
17.97	648	1079	714	448	637	0.073	231	385	0	0	0	879	1464	714	448	637
34.35	1238	2062	1365	857	1218	0.080	234	389	0	0	0	1472	2450	1365	857	1218
52.50	1893	3151	2086	1310	1861	0.078	160	266	0	0	0	2053	3417	2086	1310	1861
74.29	2679	4460	2952	1854	2634	0.080	153	254	0	0	0	2831	4714	2952	1854	2634
85.64	3088	5141	3403	2137	3037	0.078	118	196	0	0	0	3206	5337	3403	2137	3037
89.58	3230	5377	3559	2236	3176	0.080	99	164	0	0	0	3329	5542	3559	2236	3176
74.82	2698	4491	2973	1867	2653	0.080	81	135	0	0	0	2779	4626	2973	1867	2653
50.06	1805	3005	1989	1249	1775	0.078	93	154	0	0	0	1897	3159	1989	1249	1775
29.77	1073	1787	1183	743	1055	0.080	189	314	0	0	0	1262	2101	1183	743	1055
14.92	538	896	593	372	529	0.078	244	406	0	0	0	782	1302	593	372	529
10.03	362	602	399	250	356	0.080	332	553	0	0	0	694	1155	399	250	356

Water balance: Inputs - losses Climate change scenario				
Eastern part of landfill (m^3)	Southern part of landfill (m^3)	Wet Grassland 1	Wet Grassland 2	Wet Grassland 3
3785	6301	4577	2875	4084
2279	3793	2766	1737	2468
1434	2388	1838	1154	1640
3	4	179	112	160
-931	-1550	-858	-539	-766
-1691	-2816	-1734	-1089	-1547
-2099	-3495	-2204	-1385	-1967
-1773	-2951	-1864	-1171	-1663
-708	-1178	-678	-426	-605
1085	1807	1404	882	1253
2355	3921	2864	1799	2556
3442	5730	4159	2612	3711

Cumulative Water Balance Climate change scenario				
Eastern part of landfill (m^3)	Southern part of landfill (m^3)	Wet Grassland 1	Wet Grassland 2	Wet Grassland 3
3785	6301	4577	2875	4084
6064	10095	7343	4612	6552
7498	12482	9181	5766	8192
7501	12487	9360	5878	8352
6569	10936	8502	5340	7586
4878	8120	6767	4250	6039
2779	4626	4563	2866	4072
1006	1675	2699	1695	2408
299	497	2021	1269	1803
1384	2304	3425	2151	3056
3739	6225	6289	3950	5612
7181	11954	10448	6562	9323

Wet year rainfall mm/month - 2000	
Month	Rainfall (mm)
January	27.0
February	80.4
March	23.0
April	140.1
May	96.9
June	21.4
July	78.8
August	25.9
September	140.6
October	209.4
November	171.1
December	125.0
Total	1139.6

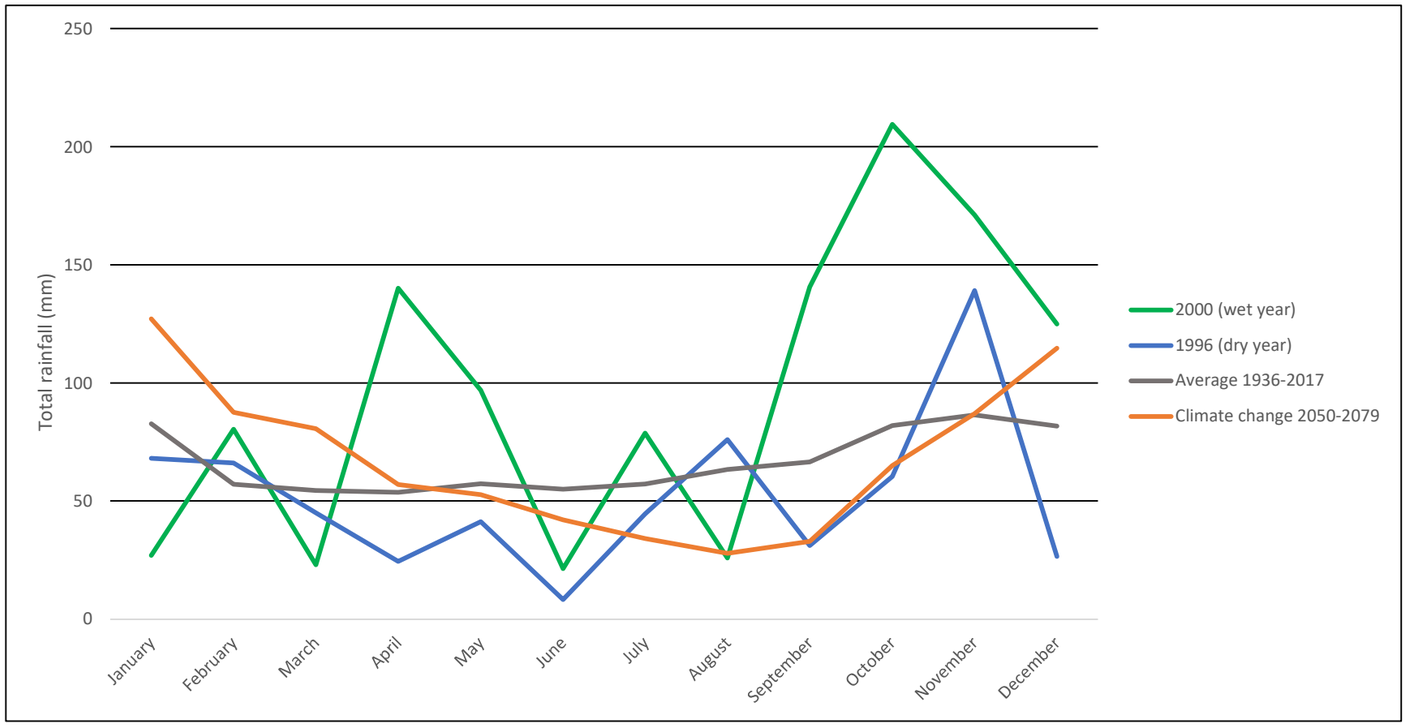
43% higher than average year

Dry year rainfall mm/month - 1996	
Month	Rainfall (mm)
January	68.1
February	66.1
March	45.0
April	24.4
May	41.3
June	8.3
July	44.6
August	76.0
September	31.1
October	60.4
November	139.1
December	26.6
Total	631.0

21% lower than average year

Monthly climate projections (rainfall) 2050-2079			
Month	Projected rainfall (mm)	Variance from average (mm)	Variance from average (%)
January	127.1	44.3	154%
February	87.6	30.6	154%
March	80.6	26.1	148%
April	57.0	3.3	106%
May	52.7	-4.7	92%
June	42.0	-13.0	76%
July	34.1	-23.1	60%
August	27.9	-35.4	44%
September	33.0	-33.6	50%
October	65.1	-16.8	79%
November	87.0	0.6	101%
December	114.7	33.0	140%
Total	808.8		

Average monthly rainfall 1936-2017	
Month	Rainfall (mm)
January	82.8
February	57.0
March	54.5
April	53.7
May	57.4
June	55.0
July	57.2
August	63.3
September	66.6
October	81.9
November	86.4
December	81.7
Total	797.6



Appendix D Meeting Minutes: Environment Agency

Your Ref:
Our Ref: 331201345

25th October, 2023

Environment Agency
3rd Floor, Seacole Building
2 Marsham Street
London
SW1P 4DF

Attn: Layla Stevens, Environment Agency Abstraction License Officer

Dear Layla,

Re: Abstraction Strategy for Beddington Farmlands (DRAFT)

INTRODUCTION

Stantec have undertaken pre-application consultation with the Environment Agency (EA) on behalf of our client Valencia Waste Management Ltd ('Valencia') to discuss the proposed restoration plans for Beddington Farmlands. This letter summarises the key points from these consultations and provides further details of the proposals and strategy for watering of the site.

PROJECT BACKGROUND

The Beddington Farmlands site is approximately 91.5 ha, and located in Beddington within the London Borough of Sutton (approximate centre grid reference: TQ 290 663). The site is designated as Metropolitan Open Land and Site of Importance for Nature Conservation. The Site also forms part of the Wandle Valley Regional Park.

The site has previously been granted Planning Permission (D2015/72989/FUL), with conditions attached requiring compliance with the Restoration Management Plan (RMP) and final restoration of the Site before 31 December 2023.

- Condition 41 and 43 on the decision notice state the following:
  "The development shall be constructed in accordance with the approved RAMP as detailed in Version 5 (13-1595 3204 D18 v5, dated 23/06/14) submitted under condition 40 of planning permission D2005/54794."

- Condition 42 Part c of 2015 consent states the following:
  "Final restoration of the site is to be completed on or before 31st December 2023".

These conditions control the form of the restoration that needs to be take place.

Restoration of the site began on 2015 by Viridor Waste Management Ltd. The site was acquired by Valencia in April 2022 and it is now incumbent on Valencia to restore the landfilled area as part of the existing planning consent. Prior to the acquisition of the site, it was considered that parts of the previously approved RMP were undeliverable. To independently assess the scheme against these parameters, Valencia appointed Stantec in Autumn 2022.

Caversham Bridge House
Waterman Place
Reading
Berkshire RG1 8DN

Telephone: +44 (0)118 950 0761
email: reading.uk@stantec.com

Registered Office:
Stantec UK Ltd
Buckingham Court
Kingsmead Business Park
Frederick Place, London Road
High Wycombe HP11 1JU
Registered in England No. 01188070

One key finding of the assessment identified concerns around water availability to sustain proposed wet grassland habitats located in the north and south of the site (**Figure 1**) which are critical for the conservation of target bird species. These bird species include the lapwing which is currently red listed on the RSPB Birds of Conservation Concern List.

Figure 1: Site Masterplan
(NB. Extracted from Work In Progress drawing – subject to revision/amendment)

This letter outlines our proposed approach to water provision for the proposed habitats as part of a revised site restoration plan and is a continuation of the discussions held with the EA on 8th September and 6th October 2023.

Two abstractions are proposed for the site and described in the following sections of this letter.

PROPOSED ABSTRACTION FROM THE WANDLE OVERFLOW CHANNEL

The Wandle overflow channel flows in a northerly and westerly direction through the Beddington site. The watercourse is understood to form part of a formal flood alleviation scheme of the River Wandle and is a designated Main River. The upstream end of the overflow channel is located 350m south of the south-eastern corner of the site. An offtake weir is located along the northern bank of the River Wandle. Once water levels in the River Wandle exceed the crest level of the weir (30.85mAOD), water is able to flow into the overflow channel and be stored within the Northern and Southern lakes (flood storage areas) on the Beddington site, before discharging through a culvert into the River Wandle.
A river level gauge is located along the River Wandle at Beddington Park approximately 50m upstream of the offtake weir. The weir height is recorded as 1.35m in the River Wandle Hydraulic Model provided by the EA. Our assessment has shown that the maximum recorded water level in the Wandle has exceeded the weir crest level in eight of the last 12 years, on average once or twice per year (**Table 1**).

Table 1: Beddington Park Overflow Weir Level Exceedance 2012-2023

Year	Frequency of exceedance of weir crest level	Month(s) in which exceedance occurred	Average level of exceedance (m)
2012 *	1	December	0.050
2013	0	-	-
2014	3	February, March	0.030
2015	1	August	0.110
2016	0	-	-
2017	1	June	0.005
2018	2	May	0.025
2019	1	June	0.072
2020	1	August	0.148
2021	2	June	0.048
2022	0	-	-
2023 **	0	-	-

* Gauge data only available from November 2012-December 2012. More than one exceedance may have occurred in this year.
** Gauge data available to end September 2023. No exceedances have occurred in the YTD.

The proposal is to abstract water from the Wandle overflow channel in times when the weir is overtopped. It has been discussed with the EA that this water would be classed as flood water owing to the overflow channel forming part of a flood alleviation scheme. Once abstracted, the water will be transferred into a storage area to the north of the Phase 3 wet grassland. The downstream end of the Phase 3 wet grasslands is located at the western end of the habitat. An existing weir allows for water level management of the wet grasslands with water being returned to the Wandle overflow channel. (**Figure 2**).

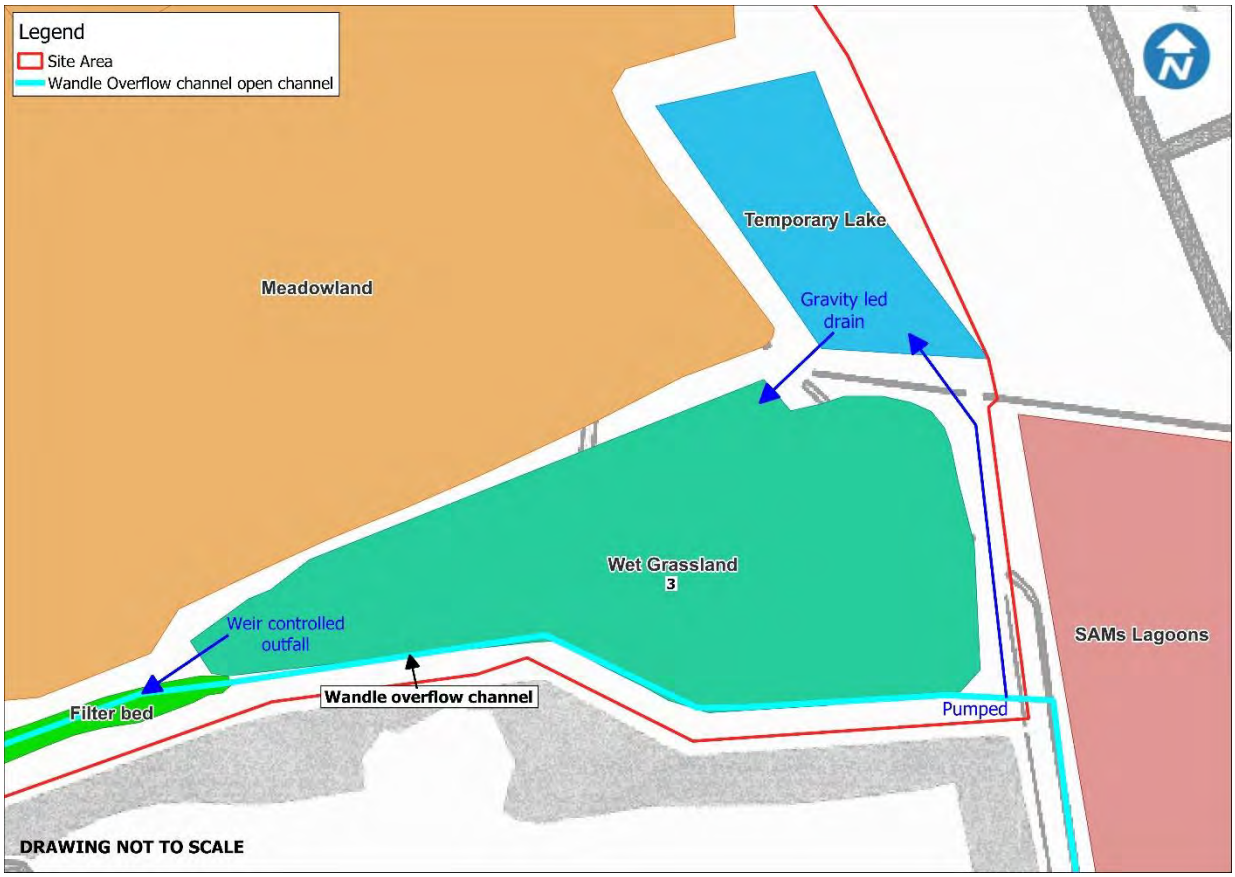


Figure 2: Proposed Wandle Overflow Abstraction Schematic

The frequency, severity and time of year in which flooding (overtopping of the weir) may occur is challenging to predict. The creation of a storage area therefore allows for excess water to be stored in wetter months for use in drier time periods. It also provides additional flood storage resulting in a flood risk benefit to areas downstream. The storage area will be lined to prevent loss of water through infiltration, and ensure no groundwater interaction.

It should be noted that observations from the site warden have identified a baseflow within the Wandle overflow channel. This is suspected to be linked to the local groundwater levels and is not available for abstraction according to the EA and the published Abstraction Licensing Strategy.

Abstraction from the Wandle overflow is one of several sources of water proposed for the Phase 3 wet grasslands. Other sources of water include:

- Direct rainfall over the wet grasslands and storage area;
- Surface water runoff from the clay capped landfill in the centre of the site; and
- Interaction with the perched groundwater table.

As only flood flows will be abstracted and the proposal could help improve flood risk by providing additional storage areas, it is proposed that the abstraction of water at these times and for these purposes does not require a formal abstraction license from the EA.
It is also our understanding that a discharge permit will not be required. The stored water and water from the grassland will be uncontaminated and therefore will be exempt from needing a permit.

A Flood Risk Activity Permit will be required for any activity within 8 metres of the bank of a main river.

PROPOSED ABSTRACTION FROM THE MAIN EFFLUENT CARRIER

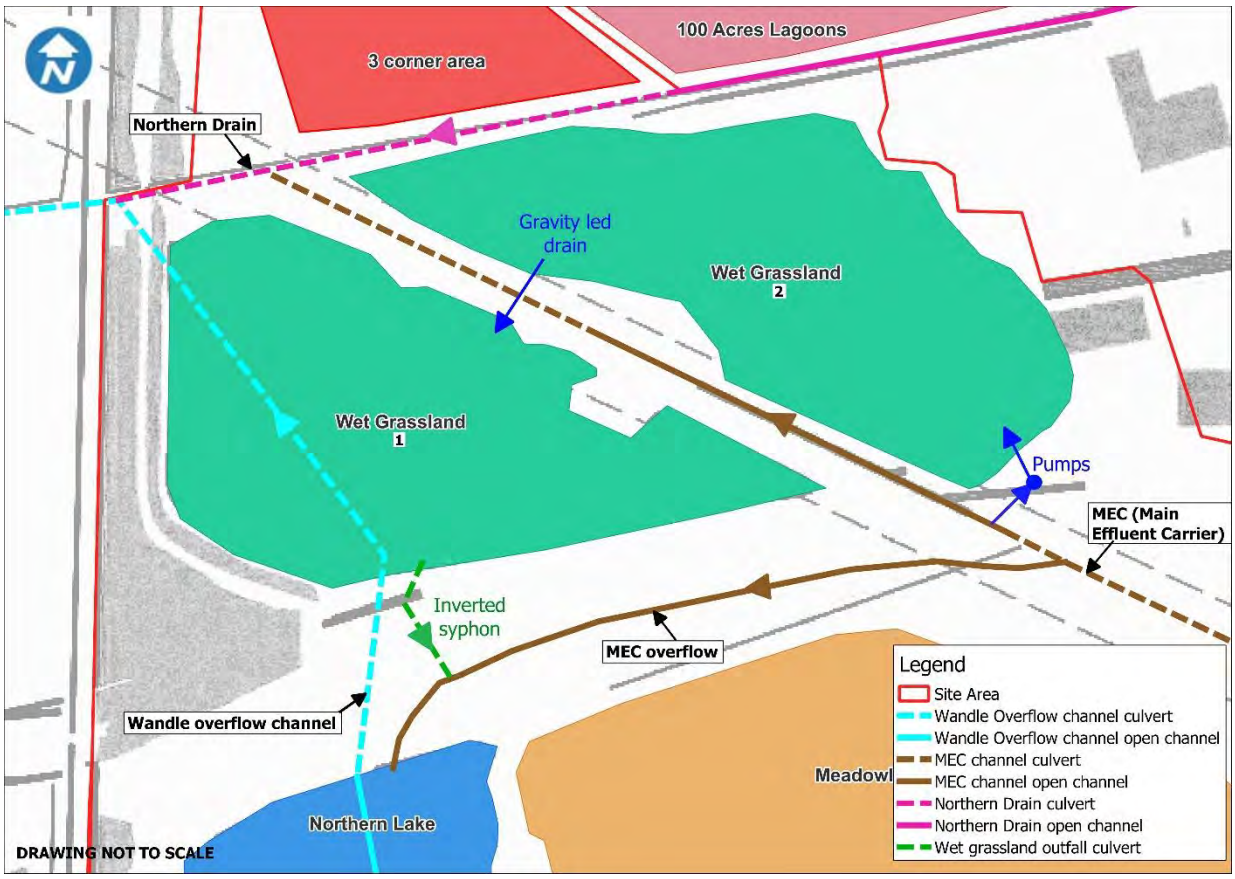


Figure 3: Proposed Main Effluent Carrier Abstraction Schematic

The Main Effluent Carrier (MEC) channel transfers treated effluent from Beddington Sewage Treatment Works (STW), located to the east of Beddington Farmlands. The channel is culverted when it enters the site and leaves the site, and is open channel (concrete lined) for a 150m stretch within the site boundary. A concrete lined overflow channel conveys flood water from the MEC outfalling into the Northern Lake. The outflow from the Northern Lake flows through a culvert, joining the culverted section MEC outside of the site boundary before discharging into the River Wandle.

From the discharge point at the STW to the outfall of the Northern Lake, there are no connecting watercourses or channels into the MEC (**Figure 4**). The open channel stretch of Cemetery Drain flows away from the MEC in the east of the site, before flowing in culvert beneath the site. Consultation with the EA on 6th October 2023 confirmed that were this criteria to be met and evidenced, then abstraction of this water would not require an abstraction license.

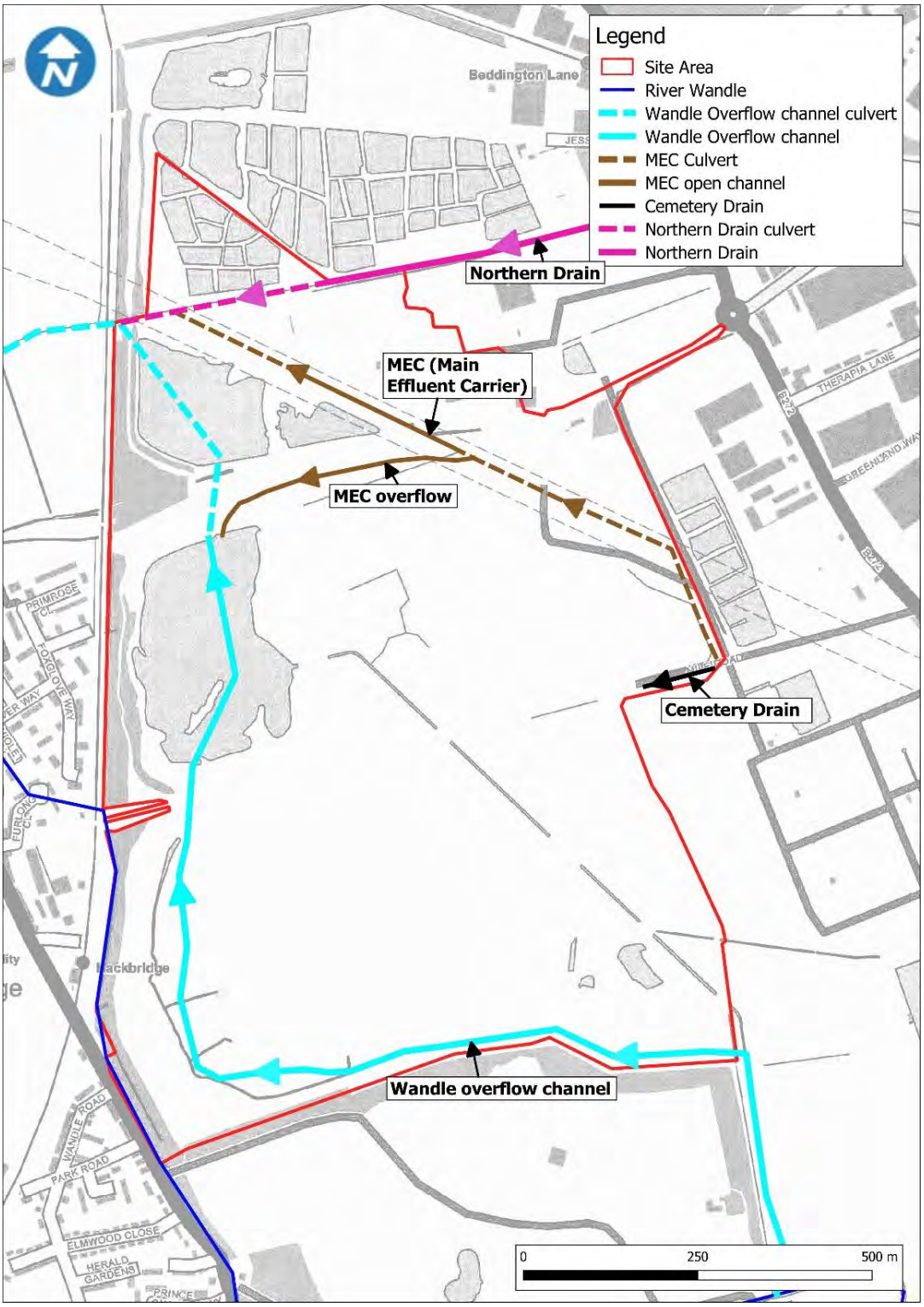


Figure 4: Beddington Watercourses and Flow Direction

Figure 8 within The Beddington Farmlands Thames Water report[1] (reproduced in **Figure 5** below) shows the surface water drainage network in the vicinity of the site. The figure shows that a large part of the urban area to the east of the site discharges into the northern drain, bypassing the MEC. The remainder

[1] Beddington Farmlands: Phase 1 Investigation (Thames Water, January 2023)

of this eastern urban area is suspected to flow into Cemetery Drain. We have sought, and are awaiting further confirmation from Thames Water. A surface water culvert is shown to discharge into the open channel section of the MEC within the site boundary. This culvert is shown to collect the surface water runoff from the road forming the site entrance.

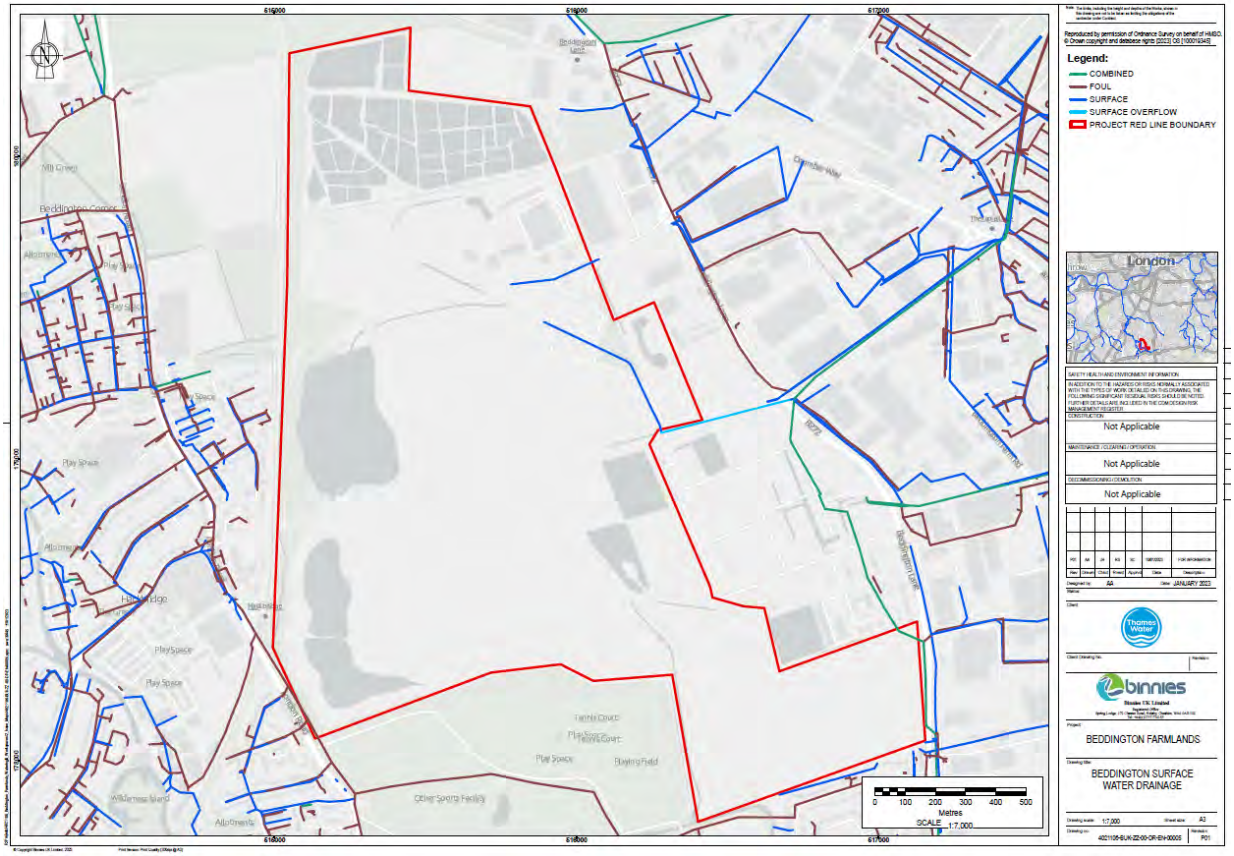


Figure 5: Beddington Surface Water Connections

It is proposed to abstract the treated effluent from the MEC and convey the water to the Phase 2 wet grassland. From here it will flow via gravity to the Phase 1 wet grassland. The outfall from the Phase 1 wet grassland discharges into the Northern Lake, which then flows into a culvert that joins the culverted MEC before discharging into the River Wandle.

The maximum permitted discharge from the STW (permit 382N, issued 5th March 2018) is 234,000 m^3/day. Thames Water have provided Stantec with monitored discharge volumes for the period January 2017-November 2022. The average recorded discharge is 123,358m^3/day over the period for which Thames Water have provided data.

The water needs of the Phase 1 and Phase 2 wet grassland areas will vary seasonally to suit the target bird species. The habitat aims to be partially inundated (up to 30% of the area) in winter progressing to a shallow water level with open muddy areas in in summer.

The water volumes calculated have been based on three water levels which represent muddy/partly dry conditions (0.05m water depth), partly wet conditions (0.15m water depth) and flooded conditions (0.5m water depth) to represent the varying target conditions throughout the year. The volumes of water that would be required for each condition (after the contribution of average rainfall has been deducted) per month are summarised in Table 2 below. Note that in the summer months, as a lower depth of water is targeted, a lower water volume is required when compared to winter months.

Table 2: Phase 1 and 2 Wet Grassland Water Balance Calculations

Month	Phase 1 + Phase 2 total water volume required (m^3)			MEC average monthly volume (m^3)
	0.05m Water Depth	0.15m Water Depth	0.5m Water Depth	
January	234	6,702	29,345	3,964,708
February	1747	8,215	30,858	3,773,017
March	2973	9,442	32,085	4,203,192
April	4167	10,635	33,278	3,772,627
May	5424	11,892	34,535	3,903,456
June	6249	12,718	35,361	3,676,242
July	6421	12,889	35,532	3,538,228
August	5189	11,657	34,300	3,491,443
September	3417	9,886	32,529	3,285,762
October	1426	7,895	30,538	3,809,373
November	233	6,701	29,344	3,606,704
December	159	6,627	29,270	4,018,982

The required maximum monthly volume for abstraction (if this is taken as the highest figure presented above) represents less than 1% of average monthly flow volumes in the MEC.

We propose that this transfer of water will not happen when storm overflow discharges are occurring from the Beddington STW due to potential poor water quality. The locations for abstraction and discharge are proposed to be within the current treated effluent flow system to ensure that only treated effluent is used. As only treated effluent is proposed to be abstracted it is considered that this part of the scheme does not require an abstraction license as discussed previously with the EA.

The River Wandle is currently classed as “Compliant” based on the Environment Flow Indicator (EFI) for the Water Framework Directive Cycle 2, indicating the current flow regime supports Good Ecological status. We request from the EA the EFI values for the River Wandle such that we can undertake an assessment to confirm whether the proposed abstraction from the MEC at times of low flow may impact on the Wandle and the WFD status.

CONCLUSION

This letter outlines the proposed strategy to abstract water at the site of Beddington Farmlands to use in the restoration scheme. The water is to be used to sustain new and existing water environment habitats with the objective of supporting target bird species for conservation purposes. Due to the nature of these abstractions the current understanding is that neither of these abstractions will require applying for an abstraction license with the EA. We kindly request feedback on our proposals.

Yours faithfully/sincerely,

Stephanie Dufour
Senior Associate
on behalf of Stantec UK Ltd

creating a better place
for people and wildlife

Environment Agency

Stephanie Dufour
Stantec
7 Soho Square
London
W1D 3QB

Our ref: SL/2023/122885/03-L01

Date: 22 November 2023

Dear Stephanie,

Beddington Farmlands Restoration, Beddington Landfill, CR0 4TD

Thank you for consulting the Environment Agency with respect to the Beddington Farmlands Restoration. We have reviewed the following document:

- Abstraction Strategy for Beddington Farmlands (DRAFT) by Stantec dated 25th October Ref: 331201345

Proposed flow from the wetlands
For the proposed abstraction from the Main Affluent Carrier we would request information on the indicative flow from wetlands 1 & 2 through the inverted syphon (Figure 3 of the letter No 331201345 from 25 October 2023) during flood events. Ideally, it should not be any flow through this structure during flood events: wet grasslands 1 & 2 should work as flood storages and keep all excessive water until the end of a flood event. However, reasonably small flow can be considered, but it should not be higher than a flow from a greenfield of the same area.

Potential nutrient build-up
We have concerns regarding the use of final effluent (FE) to provide feedwater to the lakes at the increased levels suggested. This potentially will reduce flows to the Wandle during the summertime when final effluent contributes a significant proportion of the overall flow.

In addition, the use of FE could result in nutrient build-up in the lakes and, consequently, the Wandle downstream. There is no detail regarding the control measures which would prevent FE of poor quality (ie if there was an issue/outage at Beddington Sewage Treatment Works) being taken, nor how storm discharges, which also pass down the Main Effluent Carrier, would be isolated.

Exempt activity
It has not been determined that the abstraction proposal meets an exemption, further evidence is still required, some of which may be confirmed during the upcoming site visit. Once further evidence has been collated and submitted, this will be presented to the Water Resources Regulation Team within the agency to provide confirmation on the status of the exemption. If the proposal does meet the criteria for an exemption, an assessment of impacts will still take place for the MEC abstraction to understand the potential for damage or deterioration without any form of constraint. This assessment of potential damage/deterioration would form part of the feedback

via the planning consultation, although options could be explored such as a voluntary constraint. We have had previous examples of exempt abstractors where an agreement was used to prescribe abstraction limits, flow constraints and other conditions, in place of an abstraction licence.

As discussed on a previous meeting between Stantec and the Environment Agency, we would need to capture any connecting channels and inflows/outflows. This may be confirmed during the site visit but we would still require a map clearly showing the abstraction intake point relative to all of these to present to the Water Resources Regulation Team at the Environment Agency.

Proposed abstraction point/outflow to the river Wandle
It was stated that surface water runoff is routed to enter the MEC, please can you confirm the grid reference of that and please could this be plotted alongside your abstraction points. In addition, it appears that the proposed abstraction point is after a divergence in the channel i.e. there is a separate branch that forms the MEC overflow channel towards the lake. It is unclear from the plans on how Cemetery Drain links in. It appears to be a short black line on the plan but it is not clear of it's full route which isn't plotted on the map or how it interacts with the carrier. It is not shown on our standard mapping systems. Is there no interaction/linkage between the Cemetery Drain and the MEC?

From the map it appears that the MEC and the outflow channel from the Northern Lake join the river Wandle at the same point. We need further detail on whether there is any control on that outflow to the river Wandle to understand how/if operations would need to be managed in alignment. We understand there is a fixed flow structure in the north west of the site which allows the slow release of water into the Wandle to ensure flood risks are managed. Is this structure on the outflow from the Northern Lake rather than at the confluence with the Wandle? Or does the structure control the MEC flow into the Wandle as well? It is not an EA owned/operated structure. If it may not be possible to visit the structure during the site visit then could you provide the details of how it operates and where it is located at the Farmlands site?

There are a number of additional requests for information below:

- We request the intended maximum hourly, daily and annual abstraction volumes for each of the abstraction intake points, including the flood storage abstraction. Would the abstraction operations be manually controlled? Would the intakes be compliant with eel regulations? Safe passage for eels - GOV.UK (www.gov.uk)

- Please could you provide the grid references for each of your proposed abstraction points across the site.

- It was very useful to see flow data for the MEC, please provide the daily timeseries for the full record you are referring to. This would be required as part

- of any licence application and sustainability assessment as it helps provide an indication of the variability and lowest points relative to the proposed daily maximum abstraction.

- Please could you confirm the figures relate to a gauge tracking flows as they immediately exit the treatment works? We assume the MEC overflow on your map is only for exceptional circumstances and therefore the flow data you are presenting primarily represents what is flowing through the MEC and the abstraction point, with the exception of the overflow events. Hopefully the overflow events will be clear when the daily data is examined but at present it is unclear the extent the monthly average figures may be skewed by infrequent storm overflow events.

Local constraint/River Thames

As mentioned on a previous call, the critical waterbody which needs to be considered for any proposal to abstract water from the River Wandle, is downstream on the River Thames. This is likely the most restrictive of all constraints that would be placed upon a licence in this patch and therefore needs to factored into any proposal. The abstraction licensing strategies for London and the Thames explains this CAMS-London-abstraction-licensing-strategy.pdf (publishing.service.gov.uk) and Thames Abstraction Licensing Strategy (publishing.service.gov.uk).

The constraint at the River Thames at Kingston is approximately Q50 (flows equalled or exceeded 50% of the time) which would only enable abstraction for roughly half of the year and is tightly managed. Any reduction in flows along the Wandle is considered to reduce water entering the Thames downstream of Teddington and would therefore be linked to potential damage and concerns at that location.

The EFI at the assessment point AP3 (shown on the licensing strategy and located much further downstream than Beddington) is 80Ml/d at Q95 (flows equalled or exceeded 95% of the time) or 58Ml/d at Q99.9. During low flow conditions the treated effluent forms a large proportion of these flows. This is effectively overridden by the constraint on the more restrictive downstream critical waterbody on the Thames as flagged in the previous bullet point. However, these constraints do not represent flows locally and certain areas of the Wandle can struggle with low flows. Therefore, we may need to consider a more local constraint to prevent damage or deterioration. We would require further internal consultation to identify what a local constraint would look like to protect the immediate environment. The site visit will be useful in assisting with this. Local constraints are also mentioned within the abstraction licensing strategy.

It looks like the lower segment of the MEC overflow channel would become permanently in use as the water from the grasslands would be routed to enter there. Are details available that confirm the proposals are within tolerance for the channel and it can accommodate both the flows running off from the grassland during a storm event and a potential storm discharge from the treatment works?

There are a number of additional requests for information below:

- What amount of sweetening flow is passing through the flood relief channel that you mention? Is it possible to view? What mechanisms would you have in place to ensure you only abstract during flood events?

- Are any impounding structures being created as part of the wet grassland design or is it all free flow through the site?

- What are is the size of the wet grassland areas? This is to assist with verifying water use calculations.

- The report mentions that during the summer months a lower depth is targeted and therefore a lower water volume is required compared to the winter months. However, the table appears to indicate higher volumes being used during the summer compared to the winter. Please could you clarify?

- For features such as this we encourage storage to be considered and we also expect the plans for abstraction to accommodate windows of low flows and drought. There could be certain years where constraints are in force and some parts of a reserve could dry. We have seen that some site owners opt to deal with this by creation of storage and prioritise certain features while letting others periodically go dry. Other sites specifically aim to support ecology which will cope with the variation in water availability that may occur.

- We take the table of proposed abstraction volumes to represent different depth scenarios, rather than proposing to abstract all 3 volumes at the same time. i.e. you would only be taking a total from one column at any one time. Is that interpretation correct?

- What is the size of the reservoir/storage area that you are planning for the south of the site? We assume it is relatively small and therefore unlikely to fall into the remit of the reservoir owner and operator requirements. We attach a link to the requirements in any case: Reservoirs: owner and operator requirements - GOV.UK (www.gov.uk)

Also attach a link related to flood risk activities which may be required if you are proposing works close to a main river: Flood risk activities: environmental permits - GOV.UK (www.gov.uk)

Yours sincerely

Mr Ajit Gill
Planning Specialist

Direct e-mail Ajit.Gill@environment-agency.gov.uk

customer service line 03708 506 506
gov.uk/environment-agency

Your Ref:
Our Ref: 331201345

05 January 2024

Environment Agency
3rd Floor, Seacole Building
2 Marsham Street
London
SW1P 4DF

Attn: Layla Stevens, Environment Agency Abstraction License Officer

Dear Layla,

Re: Abstraction Strategy for Beddington Farmlands

INTRODUCTION

Stantec have undertaken pre-application consultation with the Environment Agency (EA) on behalf of our client Valencia Waste Management Ltd ('Valencia') to discuss the proposed restoration plans for Beddington Farmlands (the Site).

Stantec issued a letter on 26th October 2023 outlining the water resource strategy proposed for the establishment of wet grassland habitats as part of the restoration of the Site. A response from the EA was received on 22nd November 2023 along with a request for a site visit. A site visit was conducted on 24th November 2023 with members from the EA, officers from the London Borough of Sutton, Valencia, and Stantec. A follow-up consultation was held on 1st December 2023.

This letter aims to provide the additional information requested and responses to the key points raised in the EA letter and during the latest consultation. We have appended to this letter, a copy of the latest draft masterplan of the proposed restoration and data provided to Stantec from Thames Water showing monitored flows within the MEC channel.

SITE HYDROLOGY OVERVIEW

The Site contains a number of interconnected water bodies, ditches and channels. The general direction of flow for all elements is from south to north or east to west. A plan of the water sources with flow directions is shown in Figure 1.

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Caversham Bridge House
Waterman Place
Reading
Berkshire RG1 8DN

Telephone: +44 (0)118 950 0761
email: reading.uk@stantec.com

Registered Office:
Stantec UK Ltd
Buckingham Court
Kingsmead Business Park
Frederick Place, London Road
High Wycombe HP11 1JU
Registered in England No. 01188070

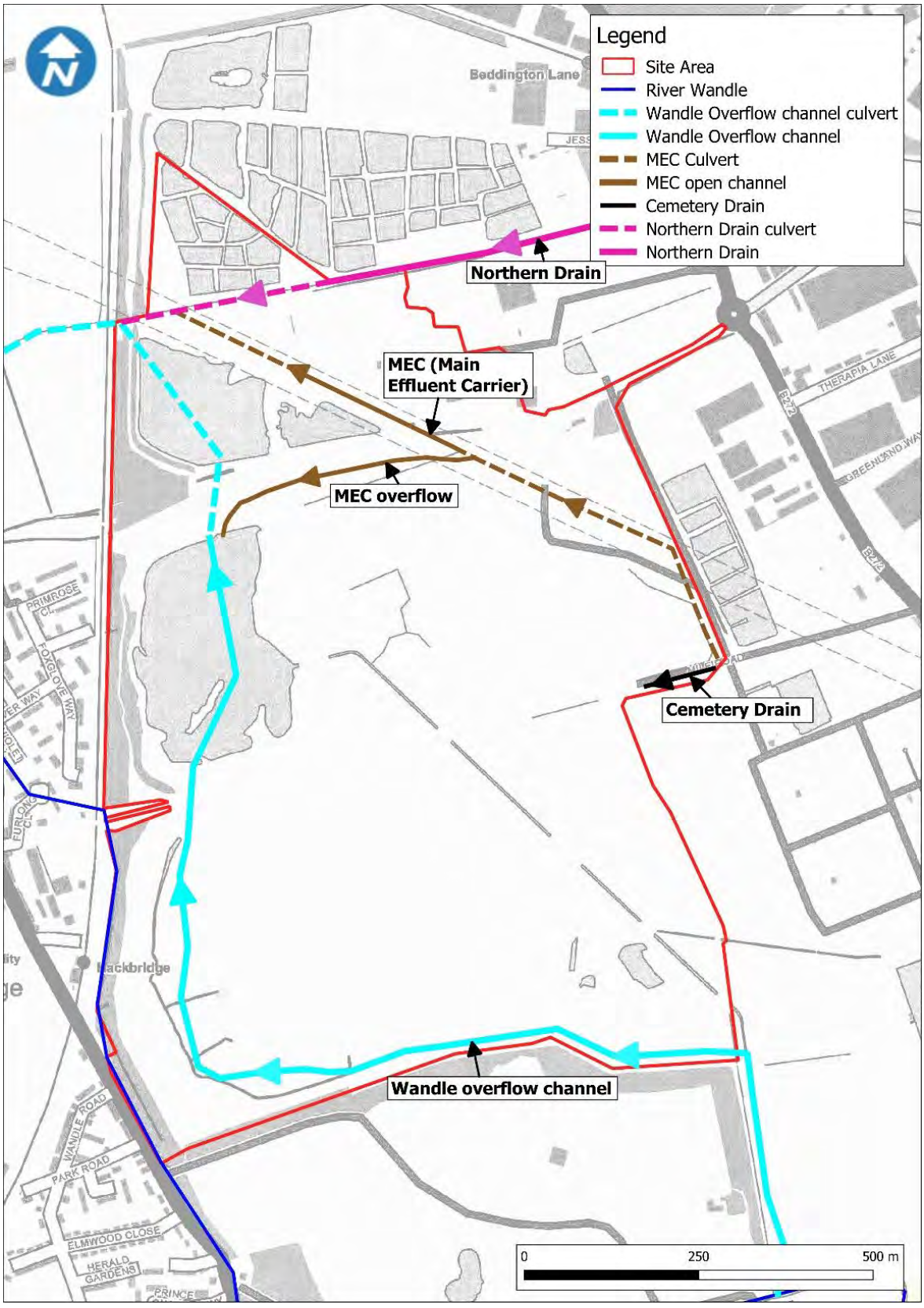

Figure 1 Beddington Watercourses and Flow Direction

The River Wandle flows to the south and west of the Site, outside of the application red line boundary. The River Wandle has an offtake weir to the south of the site, east of Beddington Park, which diverts flood flows northwards into the Wandle Overflow Channel, an open channel flowing alongside the east boundary of Beddington Park. At the south-eastern corner of the Site the channel turns westwards and continues to flow just inside the southern site boundary. It passes through the Southern Reedbeds, Southern Lake and the Northern Lake. The Overflow Channel and aforementioned waterbodies are all designated Main River and together form the Wandle Flood Alleviation Scheme. The outfall from the Northern Lake is a culverted structure which eventually discharges back into the River Wandle via Beddington Corner.

The Main Effluent Carrier (MEC) channel transports treated effluent discharged from the Beddington Sewage Treatment Works (STW). It runs along the east boundary of the Site via a culverted channel, turning to run north-westwards across the site to the north-western corner. The MEC is open channel (concrete lined) for a brief stretch as it passes through the Site.

A surface water culvert outfall was observed on site which discharges into the open channel section of the MEC, approximately 45m downstream of where the culvert daylights. Data from a Thames Water Report[1] indicates this outfall is connected to a surface water drainage system from the industrial/urban area to the east of the site.

The MEC returns to culvert within the Site boundary before it combines with the outflow for the Wandle FAS, leaving the site and discharging to the River Wandle adjacent to Poulter Park, approximately 900m west of the north-west corner of the site.

The MEC Overflow Channel is a concrete-lined overflow channel. It is fed from an offtake weir of the MEC, immediately upstream of where it is open channel. The MEC Overflow Channel has a constant baseflow which is suspected to be due to wave action within the culverted MEC. Its primary purpose is to divert excess flows from the main MEC channel into the Northern Lake. The channel may be operational during storm events if the water volume at the STW exceeds the capacity of the storm tanks and the main MEC channel, and untreated effluent may be discharged into the Northern Lake during such storm conditions.

The Northern Drain is a drainage ditch which flows from east to west along the northern boundary of the Site. The Northern Drain is an ordinary watercourse and collects runoff from the Prologis development area and associated hardstanding to the east of the Site. It discharges into the culverted outflow from the Northern Lake and eventually into the River Wandle.

A short open section of Cemetery Drain is located within the eastern Site boundary, to the immediate north-west of the STW, south of Mile Road. The drain was observed on the site visit to be permanently blocked at both upstream and downstream ends. Representatives from both Valencia and the London Borough of Sutton (the current Site Warden) stated that the drain is not known to be hydrologically linked to any other watercourses/water bodies, including the MEC Channel.

PROPOSED ABSTRACTION POINTS

The following locations are being considered for water abstraction to sustain the proposed wet grassland habitats. This section of the letter outlines the range of locations being considered. We request from the EA comment on each location and an understanding as to whether an abstraction permit is required for each location.

Grid references are provided for each proposed location. We have also illustrated each proposed location overlaid on drone imagery provided courtesy of Thames Water.

[1] Beddington Farmlands: Phase 1 Investigation (Thames Water, January 2023)

ABSTRACTION POINT 1

Location: TQ 29096 66698
Water Source: Treated effluent from MEC channel

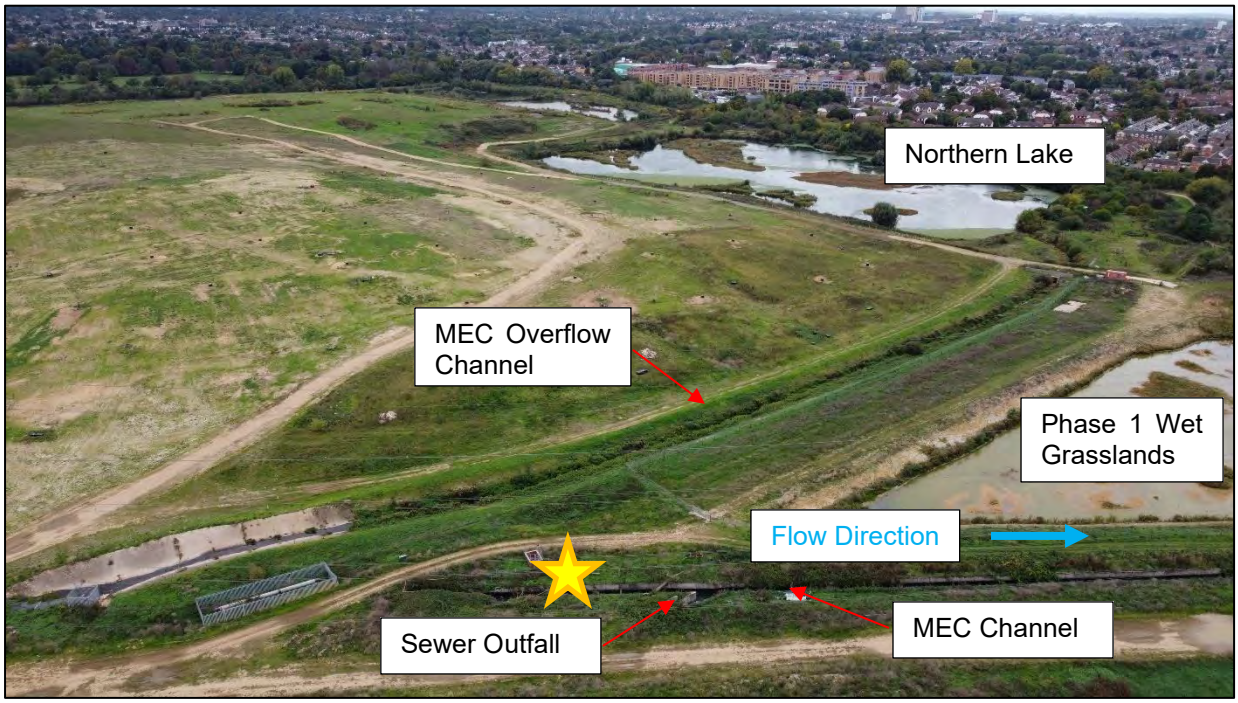

Figure 2 Abstraction Point 1: View Looking South-West

This proposed abstraction location is within the open channel section of the MEC, and immediately adjacent to the Phase 1 and 2 wet grassland areas. Water abstracted at this location would be predominately used to support the Phase 1 and 2 wet grassland habitats. Due to distance and ground elevation, it may be challenging to convey water to the south of the site to be used for the Phae 3 wet grasslands, and hence is not the preferred option for this location.

From the abstraction point, a pump would be used to convey water to the Phase 2 wet grassland. From here it will flow via gravity to the Phase 1 wet grassland, through an existing syphon which connects the two habitats. The existing outfall from the Phase 1 wet grassland discharges into the downstream end of the MEC overflow channel before flowing into the Northern Lake.

ABSTRACTION POINT 2

Location: TQ 29489 66432
Water Source: Treated effluent from MEC channel

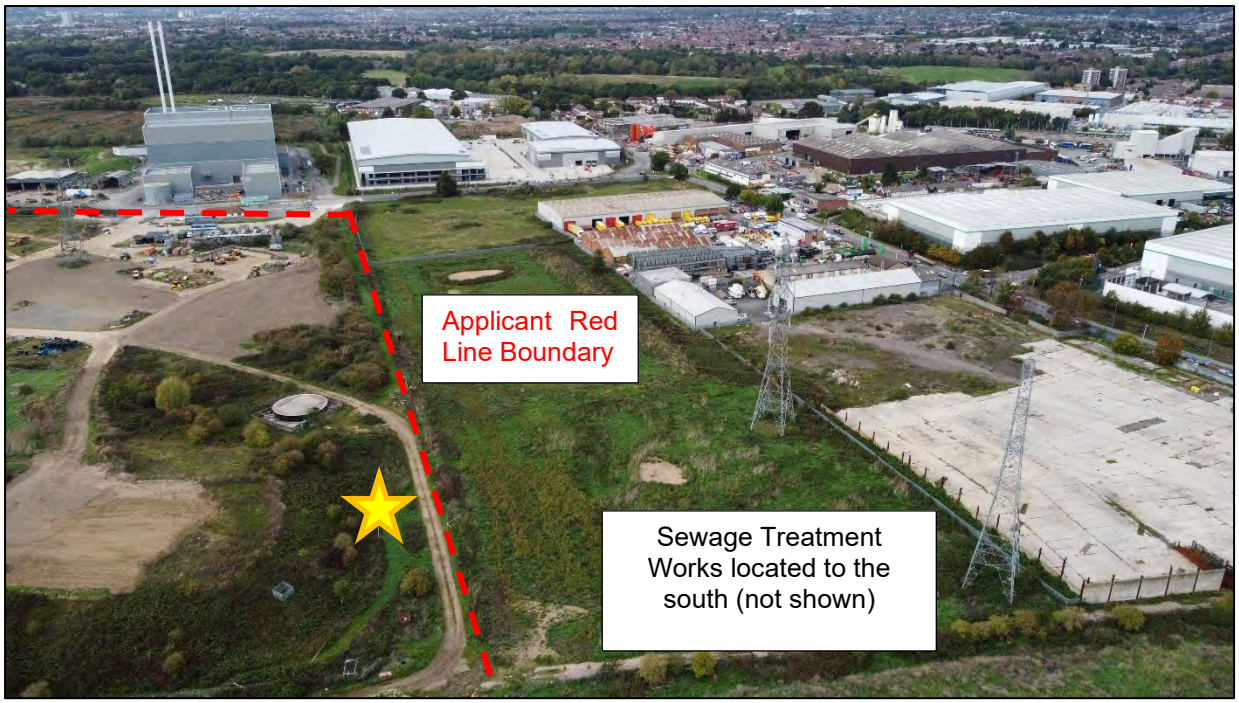

Figure 3 Abstraction Point 2: View Looking North

This proposed abstraction location is within an existing manhole located on the eastern side of the Site. The manhole provides access to the culverted MEC channel approximately 100m downstream of its discharge point from the Thames Water Waste Water Treatment Works. From its discharge point the MEC channel is culverted to the location of proposed abstraction point 2, until it daylights further downstream as shown in Figure 2. Data from Thames Water has not identified any connecting surface water inputs/connections to this culverted stretch of the MEC channel between the discharge point at the Treatment Works and this proposed abstraction location.

Water abstracted from this location could be used to water all three wet grassland areas, and is consequently the preferred option. A network of pipes and pumps would be used to convey water north-westwards to the Phase 1 and 2 wet grassland areas. Water conveyed to the south of the site, would be directed to the proposed storage area located to the north of the Phase 3 wet grassland, before flowing via gravity to the wet grassland.

ABSTRACTION POINT 3

Location: TQ 29535 65839
Water Source: Flood water from Wandle Overflow Channel

Figure 4 Phase 3 Wet Grasslands Viewed looking West

The Wandle overflow channel flows in a northerly and westerly direction through the Beddington site. The watercourse is understood to form part of a formal flood alleviation scheme of the River Wandle and is a designated Main River. The upstream end of the overflow channel is located 350m south of the south-eastern corner of the site. An offtake weir is located along the northern bank of the River Wandle. Once water levels in the River Wandle exceed the crest level of the weir (30.85mAOD), water is able to flow into the overflow channel and be stored within the Northern, Southern and Reedbed lakes (flood storage areas) on the Beddington site, before discharging through a culvert into the River Wandle.

A river level gauge is located on the River Wandle at Beddington Park, approximately 50m upstream of the offtake weir. The weir height is recorded as 1.35m in the River Wandle Hydraulic Model provided by the EA. Our assessment has shown that the maximum recorded water level in the Wandle has exceeded the weir crest level in eight of the last 12 years, on average once or twice per year (**Table 1**).

Table 1: Beddington Park Overflow Weir Level Exceedance 2012-2023

Year	Frequency of exceedance of weir crest level	Month(s) in which exceedance occurred	Average level of exceedance (m)
2012 *	1	December	0.050
2013	0	-	-
2014	3	February, March	0.030
2015	1	August	0.110
2016	0	-	-
2017	1	June	0.005
2018	2	May	0.025
2019	1	June	0.072
2020	1	August	0.148
2021	2	June	0.048
2022	0	-	-
2023	0	-	-

* Gauge data only available from November 2012-December 2012. More than one exceedance may have occurred in this year.

The proposed abstraction point is from Kingfisher Pond, located to the south-east of the Phase 3 wet grassland. Water is proposed to be abstracted when the offtake weir form the River Wandle is overtopped. Once abstracted, the water will be transferred into a storage area to the north of the Phase 3 wet grassland, and released into the habitat via a culvert as required.

The downstream end of the Phase 3 wet grasslands is located at the western end of the habitat. An existing weir allows for water level management of the wet grasslands with water being returned to the Wandle overflow channel.

The frequency, severity and time of year in which flooding (overtopping of the weir) may occur is challenging to predict. The creation of a storage area therefore allows for excess water to be stored in wetter months for use in drier time periods. It also provides additional flood storage resulting in a flood risk benefit to areas downstream. The storage area will be lined to prevent loss of water through infiltration, and ensure no groundwater interaction.

It should be noted that observations from the site warden have identified a baseflow within the Wandle overflow channel. This is suspected to be linked to the local groundwater levels and is not available for abstraction according to the EA and the published Abstraction Licensing Strategy.

Should permission be granted to abstract treated effluent from the MEC at one of the aforementioned locations, our strategy may consider using this water to sustain the Phase 3 wet grasslands. In this case, our proposals would still include the creation of a storage area, which would maximise capturing of surface water runoff, thereby reducing the potential water required from other sources.

PROPOSED ABSTRACTION VOLUMES

The maximum permitted discharge from the STW (permit 382N, issued 5th March 2018) is 234,000 m3/day. Thames Water have provided Stantec with monitored discharge volumes for the period January 2017-November 2022 (appended for your reference). The average recorded discharge is 123,358 m^3/day over the period for which Thames Water have provided data.

The water needs of the wet grassland areas will vary seasonally to suit the target bird species. The habitats are to be partially flooded (up to 30% of the total area) in winter, with the water level reducing gradually over the spring and summer months to a shallow water level with some dry islands and muddy areas in summer. Water levels will be managed to gradually increase in the autumn to achieve the desired wetter (up to 30% of the total area) flooded conditions by October/November.

Water may be required in three scenarios:

1. The filling of each habitat is required at the initial establishment stage following excavation, or in the case of partially constructed habitats, any required remedial works.

2. Once each habitat is established, ongoing water level management is required in line with the desired condition, as described in the preceding paragraph. The water level in each habitat may need topping up periodically should the volume loss due to evaporation exceed the volume of rainfall.

3. At the end of the summer period, water levels in each habitat will be gradually increased to reach inundated conditions in October/November. Water may be required if the volume of rainfall is insufficient.

The water requirements for each scenario, and how this could be managed to minimise impact on the downstream ecological conditions is described in the following sections. The calculations presented are conservative and do not take into account the influence of rainfall or any other source of water.

PHASED INITIAL FILLING OF EACH WET GRASSLAND

Each of the wet grassland habitats are currently in differing stages of establishment. All will require some degree of construction work and these works are proposed to be staggered across the overall five year construction programme. Figure 5 shows a truncated phasing construction programme illustrating when each of the wet grassland will be established. The construction works for each of the wet grassland is targeted for Autumn, after the breeding bird season has finished, and in preparation for the subsequent breeding season. The initial filling of each wet grassland is planned during the winter period when there is typically a greater chance of rainfall and therefore a reduced risk of downstream impacts if water is abstracted from the MEC channel.

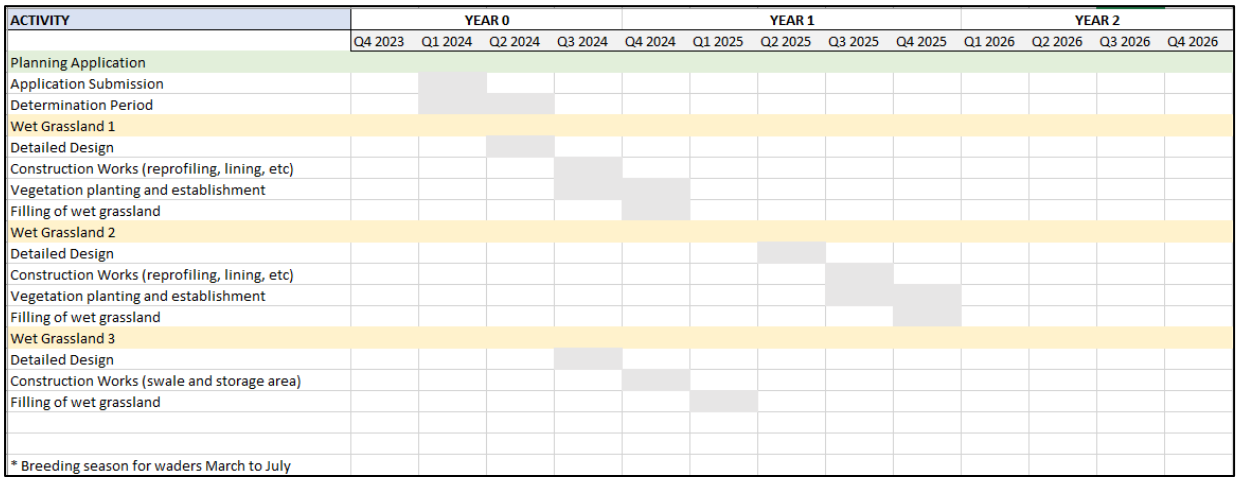

Figure 5 Draft construction phasing programme

The works required and indicative programme for each of the wet grassland habitats are described below:

Phase 1 Wet Grasslands

The Phase 1 Wet Grasslands has been excavated, however vegetation has not been established and the area is not currently functioning as a wet grassland. Works are proposed to line the habitat and there may be minor re-profiling works to alter the bed level. The habitat is intended to be filled with water in the winter of 2024 in time for the 2025 breeding season.

Phase 2 Wet Grasslands

The Phase 2 Wet Grasslands is only partially excavated and does not currently function as a wet grassland. The construction of this habitat is proposed to occur after the completion of the Phase 1 and 3 wet grassland habitats. Construction is proposed in Q3 of 2025 with initial watering of the habitat in the winter of 2025.

Phase 3 Wet Grasslands

This habitat is the most established out of all the proposed wet grassland habitats. It is currently fed by direct rainfall and suspected to interact with the groundwater table. No construction works are proposed to the habitat until Q4 2024. The proposed construction works consist of the swale and storage pond to the north of the wet grassland. No construction works are currently proposed for the wet grassland itself, however the habitat may be lined if there is evidence to suggest the groundwater table is lower than expected.

The establishment of the Phase 3 wet grassland and associated storage area is proposed to be completed by Q2 2025. In the case that the habitat will be lined, the habitat water level will be drawn down and will need to be filled. This can be staggered with the filling of the Phase 1 wet grassland over the Q4 2024 and Q1 2025. The associated storage pond is designed primarily to capture runoff from the eastern face of the former landfill, with the stored water used to top up the Phase 3 wet grassland in drier months. In the situation that a drier than expected winter month is experienced, the storage pond may be filled with abstracted water.

Table 2 shows the area of each wet grassland, and the calculated volume which would be required to fill the habitat to the target wet/flooded level in winter. A 0.3m water depth has been assumed for this purpose to provide sufficient water to fill the internal scrapes/channels and create the required 'flooding' of c.30% of the habitat, rounded up to the nearest 100m^3.

The table illustrates the duration of pumping required based on several proposed options of maximum pump rate. These rates have been selected in consideration of the daily average flow rate (1429 L/s) within the MEC, determined based on information supplied by Thames Water. Further discussion on pump rate is presented in a latter section of this note.

The initial filling of each habitat would not need to be continuous and could be achieved at a slower rate over a 1-2 week period, with breaks in pumping to suit daily flow conditions in the MEC. The required water level would also be supplemented by rainfall.

Table 2: Water Volumes Required for Initial Fill

	Wet Grassland 1	**Wet Grassland 2**	**Wet Grassland 3**
Total area of habitat (m^2)	39,735	24,956	35,456
Water volume required for initial fill (m^3)	12,000	7,500	10,700
	Pump Duration (Days)		
pump rate of 40 l/s* (3% of MEC avg daily rate)	3.4	2.2	3.1
pump rate of 80 l/s (6% of MEC avg daily rate)	1.7	1.1	1.5
pump rate of 120 l/s (9% of MEC avg daily rate)	1.1	0.7	1.0

* 40l/s represents the maximum rate of a single pump (see description under 'pump specification'). The overall pump rate can be scaled up by operating multiple units in tandem.

WATER LEVEL MANAGEMENT OF WET GRASSLANDS

On an ongoing basis, water requirements for each wet grassland area will vary from day to day according to antecedent rainfall, groundwater levels, evaporation and available volumes of stored runoff from the landfill mound (for the Phase 3 area). All habitats are proposed to be lined with impermeable material to ensure water retention, hence the impact of infiltration has been excluded.

Water level boards have been installed in each of the wet grassland areas. Management of the habitat requires regular monitoring of the water level to ensure the desired condition is reached. There is currently a full-time warden for the site and water level monitoring is included as part of their responsibilities. The appointment of the warden will continue as part of long-term management of the site. The planning application submission will include Habitat Management Plans which will recommend a minimum water level monitoring frequency of between two (summer) to four (winter) weeks. An increased frequency (minimum weekly) will be suggested during drought periods.

If water levels have dropped below target level, and no rainfall was forecast, a volume of water would be abstracted to return the habitat to the required water level. Calculations have been undertaken to estimate the potential volume lost to evaporation, and the rate at which this occurs. Table 3 shows the total target volume across all three wet grasslands and the calculated volume lost to evaporation on a weekly basis. The resultant volume remaining, is based on the assumption that no rainfall is available to refill the habitat, hence represents a conservative value. During extended periods of dry weather, the frequency of monitoring would be increased (minimum weekly) to prevent the habitats from drying out.

The findings show that assuming there is an absence of rainfall, evaporation may reduce the volume of water within the wet grasslands to below 70% of the target in the summer months. Using the month of July as the worst case (highest volume) scenario, at a pump rate of 40 l/s, this would take 14 hours (0.6 days) of continuous pumping to replenish all three habitats to the desired level.

Table 3: Evaporation Loss

Month	Total Target Volume (m^3)	Evaporation Loss per week (m^3)	Volume Remaining (%)
January	30,044	590	98%
February	30,044	446	99%
March	15,022	777	95%
April	15,022	1,227	92%
May	15,022	1,680	89%
June	5,007	2,001	60%
July	5,007	2,026	60%
August	5,007	1,692	66%
September	5,007	1,170	77%
October	30,044	673	98%
November	30,044	349	99%
December	30,044	227	99%

The rate of evaporation loss in other months, is at a much slower rate and therefore the deviation from target volume could be tolerated for a longer period of time, thereby increasing the chance that the water would be replenished by rainfall.

The habitat water levels will be monitored on a frequent basis, and it is more likely easier in practice to top up the water more frequently in smaller volumes. This would certainly be the case in the lead up to, and during the breeding bird season (March to July) when the habitats would be closely monitored.

AUTUMN REFILLING OF WET GRASSLANDS

Following the end of the breeding bird season, the wet grassland habitats would be prepared to welcome wintering birds. The water levels will be managed to gradually increase from the end of summer to achieve the desired wetter flooded conditions by October/November. This process would be reliant on rainfall in the first instance to achieve these desired conditions.

In the absence of rainfall, the volumes and indicative pump durations presented in Table 2 are relevant to demonstrate the potential maximum amount to be abstracted from the MEC, assuming a (worst case) dry starting condition.

PROPOSED PUMP RATE

Thames Water have provided daily flow rate and flow volume data for the MEC between 1st January 2017 – 12th November 2022, in 15-minute, hourly and daily increments. The overall daily flow volume data was averaged across the entire 6 year period to provide a daily average flow.

The estimated Q95 flow value was estimated by ranking the daily recorded flow volumes for each year from lowest to highest. Using the formula n*0.05, where n = number of days for which data available, the 18th value in the list was established as the Q95 value for each year where 365 days of data were available (2022 was not a full year dataset so the Q95 value was established as the 15th value in the list).

The estimated Q95 value for each year was then averaged to provide an overall Q95 average value.

Dry weather flow volumes were estimated by considering MEC flow volumes during a known extended period of drought in the summer of 2022. The lowest average MEC flow for the period 2017-2022 was recorded during the month of August 2022. Table 4 summarises the flow volumes identified above.

Table 4: MEC average flow volume summary

MEC flow	(m^3/day)	(l/s)
Overall daily average flow	123,494	1,429
Q95 average flow	101,457	1,174
Dry weather average flow	91,606	1,060

For the initial filling, and autumn refilling of the habitats, abstraction is proposed to take place in autumn/winter when drought conditions are less likely. We have put forward several options for pump rate in the event that rainfall is insufficient to fill each of the habitats to the desired level. We may seek to use a pump with a larger flow rate for the initial fill to reduce the overall pump duration.

All of these options are no more than 10% of the daily average MEC flow. The total water volume stated in Table 2 for each habitat can be achieved over an extended period (1-2 weeks) which will allow for pumping to be paused if required e.g. if a flood event occurs during the filling period.

For water level management purposes, we have identified that the summer months represent the greatest volume in which water may need to be topped up in the event of drought conditions. We are cognisant this is also the period in which downstream ecological conditions in the River Wandle/River Thames are at their most sensitive. We propose to abstract from the MEC when the flow is above the dry weather average flow as shown in Table 4 and undertake this at the lower rate of 40l/s. This flow can be correlated to a water level within the channel at the abstraction point, and the pump configured to automatically switch on/off. The water levels in the habitats will be monitored on a more frequent

basis during drought periods. Therefore, any topping up of water, can be preferentially undertaken as more frequent, smaller volumes, as opposed to less frequent, larger volumes.

PROPOSED PUMP SPECIFICATION

The exact pump type and pumping rate will be specified during the detailed design process, but for the purposes of providing an indicative pumping rate a Rotorflush pump has been considered. This type of pump has been selected as it has an integrated eel screen and meets EU Eel Protection regulations and Section 316(b) of the Clean Water Act.

The maximum available pumping rate for a single unit of this type of pump is 40 l/s. Pumps can be used in tandem to pump greater volumes if required. To power and control pumps, a small GRP kiosk is required near to the pump that houses the electrical equipment required to distribute power and control the pump using level sensors on the upstream to confirm sufficient channel depth, and downstream side of the pump to ensure top up flows are required. The kiosk can house a small telemetry unit that allows for remote operation; for example, if a flood/storm overflow event is predicted, the pumps can be switched off remotely without an operator having to attend site. The GRP kiosk can be painted to any colour deemed appropriate for the area to minimise visual impact.

OTHER CONSIDERATIONS

WATER QUALITY

Abstraction from the MEC will cease, either via manual or automated controls, when storm overflow discharges are occurring or anticipated to occur from Beddington STW. Flood alert and weather condition checks will be undertaken when water level top-ups are required and if a potential for storm overflows is identified, no abstraction will occur until flows have returned to normal levels. This will ensure that no water of lower quality than the standard MEC discharge enters the habitats.

Valencia Waste Management currently hold a discharge permit (No. EPR/VP3039SW) which contains details pertaining to emission limits to water and ongoing monitoring requirements. The emission point reference is located at the outfall of the Northern Lake, which is the receiving water body for all wet grasslands on site. The proposals and accompanying water resource strategy aim to ensure the limits set out in the current permit are not breached. A nutrient assessment will be prepared to assess the impact of the proposals on the water quality of the Northern Lake. Any required interventions will then be incorporated into the Masterplan. The nutrient assessment report will be made available to the EA for review.

FLOOD RISK

No alterations are proposed to the existing flood alleviation scheme on the site. The proposals will provide betterment to existing flood storage capacity with the provision of a new storage area to the north of the Phase 3 wet grassland area.

Queries were raised during consultation as to the operation of the Phase 1 and 2 wet grasslands in flood conditions. The EA have requested the scheme ensures that no water is discharged from these habitats into the Northern Lake during a flood event. The outfall structure between the Phase 1 and 2 wet grasslands, and between the Northern Lake and the Phase 1 wet grasslands, are syphons. In flood conditions, the flow direction of the syphons will reverse when the water level in the Northern Lake exceeds that of the Phase 1 wet grasslands, and when the water level in the Phase 1 wet grasslands exceeds that of Phase 2. The wet grassland habitats under normal operating conditions, will have some spare capacity to hold water, as the desired condition is that they are never entirely inundated. The habitats therefore are capable of retaining surplus flows from the Northern Lake.

An agricultural shed to house equipment and provide welfare facilities to bird watchers and the site warden is proposed as part of the development. The drainage strategy for the shed will incorporate provision of a rainwater harvesting tank with an overflow discharging to a nearby sewer at a controlled rate. The captured water within the tank may be used to water neighbouring vegetation and habitats.

A Flood Risk Assessment will be submitted as part of the planning application and will provide further detail, and demonstrate the proposals do not increase flood risk off site.

CONCLUSION

This letter provides a response to the queries raised by the EA in regards to the proposed water resource strategy supporting the proposed Beddington Farmlands restoration scheme. We kindly request feedback on our proposals.

Yours sincerely,

Stephanie Dufour
Senior Associate
on behalf of Stantec UK Ltd

Stantec UK Limited
First Floor 80 Turnmill Street
London
EC1M 5QU
UNITED KINGDOM

17 January 2024

Project/File:

Layla Stevens
Environment Agency
3rd Floor, Seacole Building
2 Marsham Street
London
SW1P 4DF

Dear Layla Stevens,

Reference: 331201345 Beddington Farmlands Restoration

This letter provides a brief summary of the data sources, assumptions and findings of water balance calculations that form the basis of our proposed water strategy, as requested in Stantec's latest consultation meeting with the EA on the 15th January 2024. A more detailed calculation sheet and commentary will be provided as part of the forthcoming planning application documents.

Methodology

Water balance calculations were derived by deducting potential evapotranspiration losses from average annual rainfall, multiplied by the area of each of the three wet grassland habitats, to provide a total water input per month from direct rainfall. Infiltration has not been considered as lining of all wet grasslands is proposed.

Additional calculations were undertaken to assess the potential volume of runoff per month from the eastern and southern slopes of the landfill into the southern wet grassland habitat. This is based on rainfall to the catchment area with potential evapotranspiration deducted. The landfill is capped with a relatively impermeable clay layer, but some infiltration into the capping/topsoil layers has been accounted for in the calculations using an indicative infiltration rate for clay soils.

Rainfall

Average monthly rainfall for the Beddington catchment between 1936-2022 was calculated from the National River Flow Archive dataset of historic daily rainfall to Beddington catchment, and was fitted to Standardised Average Annual Rainfall for each month. The average annual rainfall at the site over an 81 year period was 797mm per year, and when fitted to SAAR is 764mm per year.

Potential Evapotranspiration and Infiltration Losses

UKCEH provides a historic potential evapotranspiration dataset from 2000-2015 which falls within the current SAAR period.

An infiltration rate for clay soil[1] of 3 x 10^{8} has been used as a rainfall loss when calculating runoff from the former landfill.

Results

The water balance calculation aims to demonstrate the volumes of water required to be abstracted in a typical calendar year (Table 1). It shows the months in which the volume of evaporation exceeds that of rainfall and when water abstraction may be required to maintain the target water depth in each habitat.

The calculations assume that initial filling of each wet grassland has been undertaken. The volumes of water required for this initial filling have been described in the Stantec letter dated 5th January 2023. Beginning in April, the calculations show the rate of evaporation is predicted to exceed the rainfall input and abstraction may be required to maintain the target depth of water. The need for abstraction is expected to continue throughout the summer period. The frequency of abstraction will be driven by the frequency of water level monitoring specified in the Habitat Management Plan. This will recommend a frequency of weekly to fortnightly monitoring over drought and summer periods to facilitate a preference for abstracting smaller volumes of water more frequently.

At the end of the breeding season, the water levels are required to increase gradually in autumn to reach an average depth of around 0.3m. The water required for this filling has been added to the water balance calculation as a volume that may need abstracting, supplementing any rainfall. This autumn refilling can occur over several weeks and staggered across the three wet grasslands.

Please note the stated ‘Volume Required’ figures in Table 1 show the total volume required for abstraction across all wet grassland habitats for each calendar month. Rainfall input and associated losses have been taken into account. These differ from the values provided in Table 3 ‘Evaporation Loss’ of the Stantec letter dated 5th January 2023, which excludes rainfall input and therefore presents a more conservative estimate. Moreover, the values in this second table present the volume lost to evaporation over a week within each calendar month. The findings from both assessments together provide an indication of the potential volume required for abstraction covering the range of potential conditions across average to dry calendar years.

[1] Soil Infiltration Rates for Soakaways - CivilWeb Soakaway Design Spreadsheet (civilweb-spreadsheets.com)

Reference: Reference

Table 1 Water Balance Calculation Result

Month	Target Depth (m)	Abstracted Volume Required (m^3)
January	0.3	0
February	0.3	0
March	0.15	0
April	0.15	109
May	0.15	1,931
June	0.05	3,299
July	0.05	3,480
August	0.05	1,418
September	0.05	0
October	0.3	15,352
November	0.3	0
December	0.3	0

Best regards,

STANTEC UK LIMITED

Stephanie Dufour
Senior Associate
Phone: -

Attachment: [Attachment]

Appendix E Nutrient Assessment

Beddington Farmlands

Nutrient Assessment

On behalf of **Valencia Waste Management Ltd**

Project Ref: 331201435 | Rev: A | Date: February 2024

Registered Office: Buckingham Court Kingsmead Business Park, London Road, High Wycombe, Buckinghamshire, HP11 1JU
Office Address: Lakeside House, Blackbrook Business Park, Blackbrook Park Avenue, Taunton TA1 2PX
T: +44 (0)1823 218 940 E: Taunton.uk@stantec.com

Document Control Sheet

Project Name: **Beddington Farmlands**

Project Ref: **331201435**

Report Title: **Nutrient Assessment**

Doc Ref:

Date: **February 2024**

	Name	Position	Signature	Date
Prepared by:	Roberta Rogers	Assistant Engineer		07/02/24
Reviewed by:	Kirstie Thistlethwaite	Senior Environmental Scientist		07/02/24
Approved by:	Stephanie Dufour	Senior Associate		07/02/24
For and on behalf of Stantec UK Limited				

Revision	Date	Description	Prepared	Reviewed	Approved
1.0	07/02/24	First Issue	RR	KT	SD

Contents

Figures

Tables

1 Overview

1.1 Introduction

1.1.1 This Technical Note has been prepared by Stantec on behalf of our client, Valencia Waste Management Ltd (VWM), to support a planning application for a revised Restoration Management Plan (RRMP) for the Beddington Farmlands site.

1.1.2 Consultation with the Environment Agency (EA) in response to the proposals highlighted concerns of how the proposals could impact the water quality in the local environment. Therefore, the purpose of this note is to undertake a review of available data with an aim to demonstrate the proposed watering strategy underpinning restoration of the site will have no adverse impact on the water quality of the surrounding environment.

1.2 Proposed Restoration Plans

1.2.1 The proposal is for *'Proposed revised restoration and revised restoration management plan for the Beddington Landfill Site and implementation of the restoration works'* and includes the creation of habitats, including but not exclusive to, wet grassland, lakes and reedbeds and the inclusion of meadow grassland for cattle grazing included as part of the long-term strategy to manage habitats. Full details of the proposed restoration and accompanying masterplan are provided in the RRMP.

1.3 Environment Agency Consultation

1.3.1 The EA provided a consultation response (issued 22nd November 2023) to the proposed draft water resource strategy (issued 26th October 2023). A site visit was conducted on 24th November 2023 with members from the EA, accompanied by officers from the London Borough of Sutton, Valencia, and Stantec. A follow-up consultation was held on 1st December 2023. As part of the consultation, the EA raised the following concerns in relation to water quality:

- The use of final effluent (FE) from the treatment works could result in nutrient build-up in the lakes and, consequently, the River Wandle downstream;
- There is no detail regarding the control measures which would prevent FE of poor quality being taken;
- There is no detail regarding how storm discharges would be isolated.

1.4 Source of Information

1.4.1 This technical note has been prepared based on the following sources of information:

- Revised Restoration Management Plan by Stantec UK Ltd
- Environment Agency Water Quality Archive available under the Open Government Licence v3.0[1]
- The Rivers Trust Sewage Map[2]
- Beddington Wastewater Treatment Works Permit Number 382N Notice of variation and consolidation with introductory note produced by The Environmental Permitting (England & Wales) Regulations 2010 dated March 2018
- Beddington Farmlands Landfill Site Permit Number EPR/VP3039SW Notice of variation and consolidation with introductory note produced by The Environmental Permitting (England & Wales) Regulations 2010 dated November 2022
- Water Quality Sampling data provided by Valencia (1997-2023)
- Beddington Farmlands Flood Risk Assessment (FRA) by Stantec dated January 2024
- Beddington Farmlands Water Resources Report prepared by Stantec dated January 2024
- Beddington Farmlands Habitat Management Plan prepared by Stantec dated January 2024
- Norfolk Nutrient Guidance Nutrient Mitigation Solutions prepared by Royal Haskoning DHV dated April 2023

[1] https://environment.data.gov.uk/water-quality/view/landing

[2] https://theriverstrust.org/sewage-map

2 Site Overview

2.1 Existing Site

2.1.1 The Site is approximately 88.4ha area of a former landfill, located in Beddington, London, UK (approximate centre grid reference: TQ 290 663). The site has historical use as agricultural fields and primarily wet or dry meadows.

2.1.2 The existing habitats currently consist of a mix of ephemeral/short perennial, tall ruderal, and poor semi-improved grassland, with areas of standing water, scrub, and woodland to the western edge of the site. Beddington Sewage Treatment Works (STW) borders the site in the southeast corner.

2.2 Hydrological Setting

2.2.1 The site consists of a number of water bodies, ditches and drainage channels. The general direction of flow for all elements is from south to north or east to west. A location plan of the water sources is shown in **Figure 2.1**.

2.2.2 The River Wandle is an EA Main River and is located to the south and west of the site. The River Wandle has an offtake weir to the south of the site which diverts flood flows northwards into the Wandle Overflow Channel, an open channel which flows along the southern and western boundary of the site flowing through the Southern Reedbeds, Southern Lake, and the Northern Lake. The Overflow Channel and aforementioned waterbodies are all designated Main River and together form the Wandle Flood Alleviation Scheme (FAS). The outfall from the Northern Lake is a culverted structure which eventually discharges back in the River Wandle.

2.2.3 The Main Effluent Carrier (MEC) channel transports treated effluent discharged from Beddington STW. It runs along the eastern boundary of the site via a culverted channel, turning to run north-westwards across the site to the north-western corner. The MEC is a concrete lined open channel for a brief stretch as it passes through the site, it returns to a culvert before combining with the outflow for the Wandle FAS which leaves the site and discharges into the River Wandle.

2.2.4 The MEC Overflow Channel is a concrete lined overflow channel which is fed from an offtake weir of the MEC. The MEC Overflow Channel has a constant baseflow which is suspected to be due to wave action within the culverted MEC. Its primary purpose is to divert excess flows from the main MEC channel into the Northern Lake. The channel may be operational during storm events if the water volume at the STW exceeds the capacity of the storm tanks and the main MEC channel, and untreated effluent may be discharged into the Northern Lake during such storm conditions.

2.2.5 The Northern Drain is an ordinary watercourse which flows from east to west along the northern boundary of the site and collects runoff from the surrounding development. The Cemetery Drain is located within the east site boundary. The drain is permanently blocked at both upstream and downstream end and is not known to be hydraulically linked to any other watercourses/water bodies.

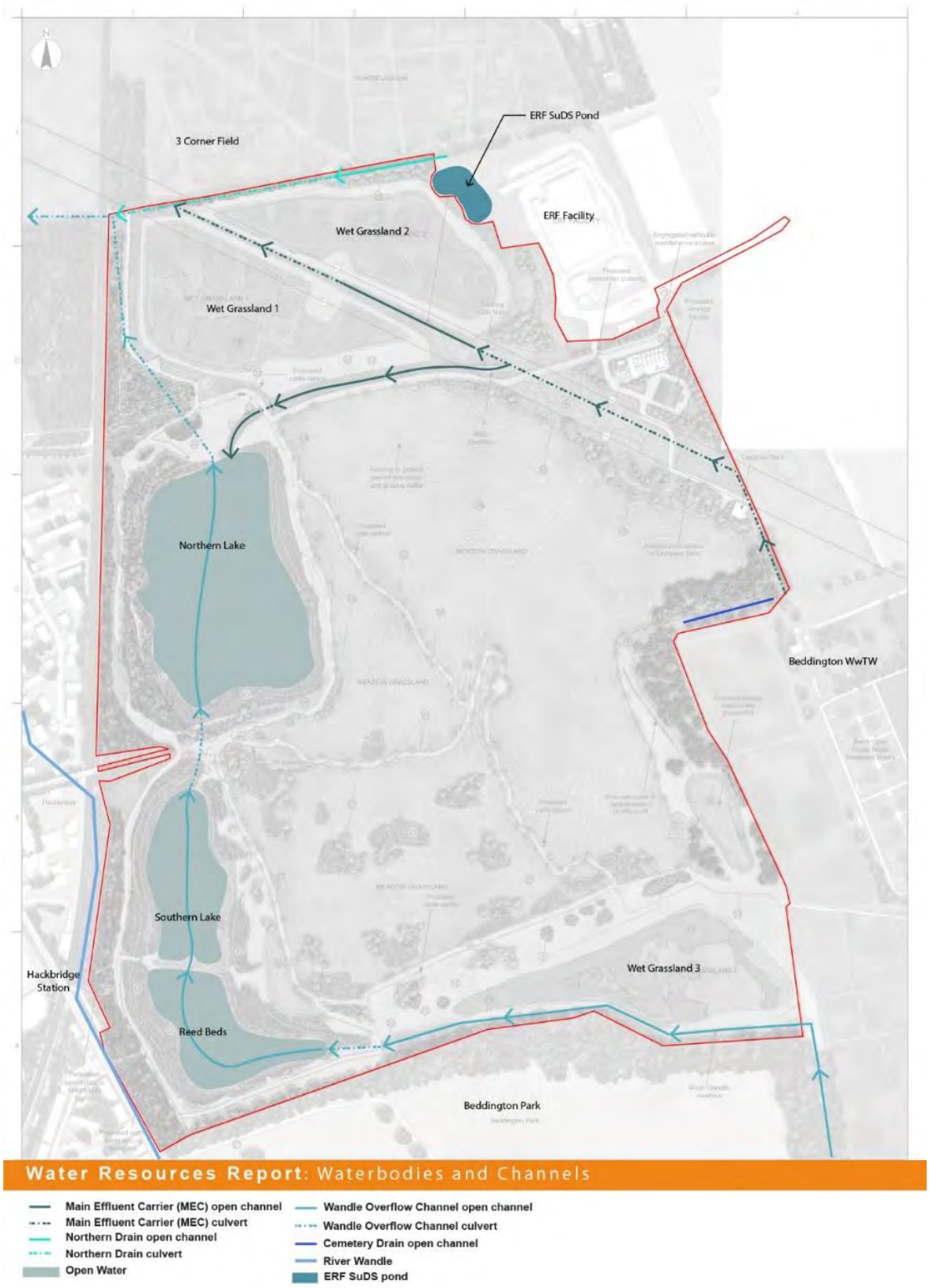

Figure 2.1: Hydrological Setting

WFD Classification

2.2.6 The site falls within the Wandle (Croydon to Wandsworth) and the Graveney Water Body (part of the Wandle Operational Catchment). The EA Catchment Data Explorer website has water quality data relating to the WFD targets for 2027. Based on the most recent water quality data recorded in 2019, the Water Body received a '*Moderate*' ecological classification and a '*Fail*' for chemical water quality.

2.2.7 Data shows the reasons for the Wandle (Croydon to Wandsworth) and the Graveney Water Body not achieving 'Good' status include, but aren't limited to;

- Point source from sewage discharge, incidents and misconnections
- Diffuse source from transport drainage
- Physical modification from urbanisation (urban development and transport), flood protection – structures, and reservoir/impoundment.

3 Proposed Water Resource Strategy

3.1 Overview

3.1.1 The proposed Wet Grassland habitats require varying water levels throughout the year in order to provide habitat for breeding, food supply and passage for migrant species. The proposed water resource strategy for each habitat is a combination of rainfall and abstracted water from the MEC channel. Abstraction from the MEC is expected to be intermittent, to supplement any rainfall that naturally flows into the wet grasslands. Abstraction will not occur during flood conditions.

3.1.2 The water requirements for Wet Grassland 1 and 2 will be met by a combination of direct rainfall and abstraction from the MEC. Water is proposed to be abstracted from the MEC channel into Wet Grassland 2, before draining via gravity through the habitat into Wet Grassland 1. Wet Grassland 1 then outfalls into the MEC Overflow channel before flowing into the Northern Lake.

3.1.3 The watering strategy for Wet Grassland 3 is a combination of direct rainfall, surface water runoff from the eastern face of the former landfill and abstraction from the MEC. Water will be collected into a proposed storage pond via a swale, and conveyed into the habitat as and when required. A tilting weir will control the water levels within this habitat, by controlling the water draining into the Filter beds and Reedbeds before entering the Southern Lake and eventually the Northern Lake.

3.1.4 Further information of the proposed water resource strategy is provided within the Water Resources Report for Beddington Farmlands prepared by Stantec.

Northern Lake

3.1.5 The Northern Lake is situated at the lowest elevation on the Site, all water bodies at the site will discharge via the lake and therefore outfall from this lake is the key hydraulic control structure on the Site. The proposed works do not include any change to this outfall structure. Once water passes through this structure, discharge from the Northern Lake passes through a culvert where it combines with the MEC overflow channel discharge. This flow then eventually discharges into the River Wandle.

3.1.6 Diverted treated effluent from the MEC channel will discharge from the site via the Northern Lake from all three Wet Grassland areas. Only treated effluent diverted via Wet Grassland Area 3 will discharge through the Reedbeds and Southern Lake. Therefore, this assessment will focus on the potential impact the diverted treated effluent could have on the Northern Lake as the receiving waterbody.

3.2 Abstraction Strategy

3.2.1 The wet grassland areas will be managed on an annual cycle to achieve specific seasonal water levels, as follows:

- October to March: High water table across the habitat. Some shallow flooding (10-300mm) across no more than 30% of the area.
- March – May: High water table at ground level across 30% of the field. Some shallow flooding covering between 5% to 10%.
- May – July: Water table to within 200mm of ground level with shallow pools and ditches to create muddy edges.

- July to September: Water table dropping to its lowest level, up to 400 mm below ground level to facilitate management across the wet grassland habitat.

3.2.2 Based on the above desired seasonal conditions, the target water depths and estimated combined volume of water for all three wet grasslands is provided in **Table 3.1** for a single calendar year.

Month	Condition	Assumed Depth (m)	Estimated Volume (m^3)
January	Wet/flooded	0.3	30044.10
February	Wet/flooded	0.3	30044.10
March	Shallow	0.15	15022.05
April	Shallow	0.15	15022.05
May	Shallow	0.15	15022.05
June	Muddy	0.05	5007.35
July	Muddy	0.05	5007.35
August	Muddy	0.05	5007.35
September	Muddy	0.05	5007.35
October	Wet/flooded	0.3	30044.10
November	Wet/flooded	0.3	30044.10
December	Wet/flooded	0.3	30044.10

Table 3.1: Predicted Depth and Volume of Wet Grassland

3.3 Discharge Strategy

3.3.1 Water is expected to be discharged from the wet grasslands into the Northern Lake when water levels are lowered gradually from winter to summer. The downstream end of each wet grassland contains a tilting weir, where the crest level is used to dictate the water level in the habitat. As indicated by **Table 3.1**, it is expected this will only occur twice a year between February and March (15,022.05 m^3) and May and June (10,014.70m^3). Therefore, over one calendar year 25,036.75m^3 of is expected to be discharged into the Northern Lake as part of the management regime. This flow will be a combination of rainfall and MEC discharge.

3.3.2 Discharge is also expected to occur following heavy rainfall or in anticipation of a flood event. The amount of water discharged will be dependent on the rainfall conditions and the amount of volume already stored in the wet grasslands at the time of the event and therefore cannot be estimated at this time.

3.4 Management Activities

Abstraction from the MEC will not occur when storm overflow discharges are occurring or anticipated to occur from Beddington STW. The Habitat Management Plan explains the measures to be undertaken to reduce the risk of water of lower quality than the standard MEC discharge entering the habitats.

4 Proposed Land Use Change

4.1 Overview

4.1.1 The site has formerly operated as a landfill. Operations ceased in November 2022 however it is acknowledged that leachate will continue to occur.

4.1.2 The restoration management plan proposes to introduce and enhance a range of habitats across the site including wet grassland, wet woodlands, lakes and reedbeds, and meadow grassland for livestock grazing.

4.2 Expected Nutrient Loading

4.2.1 Nutrient loading can occur as a result of agricultural practices. It is expected that there will be some nutrient loading from the proposed livestock grazing. It should be noted that the grazing is primarily intended for the management of the land and is expected to occur over roughly four months in each calendar year. Further information is provided in the Beddington Farmlands Habitat Management Plans.

4.2.2 Wet grassland, wet woodland, and reedbeds are widely acknowledged as habitats which have the ability to remove nutrients from the environment. **Table 4.1** summarises a number of similar measures highlighted in the Norfolk Nutrient Mitigation Solutions Report (Royal Haskoning, April 2023) as being suitable for nutrient removal.

Solution	Description	Total Nitrogen Removal	Total Phosphorus Removal
Riparian Buffer Strips	Riparian buffer strips are zones of permanent grass and/ or woodland cover that act as a separation barrier and filter between an agricultural field and a watercourse. Nutrient reductions are achieved through sedimentation of nutrient-bound particles and uptake via vegetation, which also increases surface roughness and reduces runoff rates	65% removal for a 15m buffer	Median retention rates of 67%
Wet Woodlands	Wet woodlands occur on soils that are permanently or seasonally wet. Wet woodlands increase hydraulic roughness, which slows flow velocities and allows sediment and particulate bound pollutants to fall out of suspension and enter storage on the floodplain, or in a designed wetland setting. Riparian woods reduce diffuse pollution by trapping fine sediment runoff generated by agricultural practices	Uncertain – 12-80%	Uncertain – likely to be similar to riparian buffers
Constructed Wetlands (*also known as reedbeds*)	Constructed wetlands are designed to facilitate natural processes that can remove nutrients from the influent water sources to a wetland.	Median removal rate of 37%	Median removal rate of 46%

Table 4.1: Summary of Nutrient Mitigation Solutions extracted from Norfolk Solutions Report (Royal Haskoning, 2022)

4.2.3 Whilst the habitats proposed as part of the site restoration may not exactly align with the measures highlighted in the Norfolk Solutions Report, the principles relating to nutrient removal via vegetation would still apply. Therefore, a level of nutrient removal would be expected, although this cannot be quantified at this stage.

5 Water Quality

5.1 Permit Levels

5.1.1 Thames Water have an environmental permit for Beddington STW (Permit Number: 382N) granted in 1979 and last varied and consolidated in 2018 (382N/V001). **Table 5.1** outlines the permits relevant to nutrients.

Effluent(s) and discharge point(s)	Parameter	Limit (including unit)
Secondary treated sewage effluent removal via Outlet 1.	Ammoniacal nitrogen expressed as N	2.5 mg/l
		20 mg/l (maximum)
	Total Phosphorus as P (UWWTR)	1 mg/l or minimum of 80% removal compared to influent

Table 5.1: Beddington STW Permit

5.1.2 VWM have an environmental permit for the Beddington Farmlands Landfill Site (Permit Number: EPR/VP3039SW) granted 2004 and last varied in 2022 (EPR/VP3039SW/V010). The emission point reference (1BF004SW) is located at the outfall of the Northern Lake. **Table 5.2** outlines the permits relevant to nutrients. It is understood that there is no intention to vary this permit as part of the proposed restoration plans.

Emission point Ref. & Location	Parameter	Limit (including unit)
1BF004SW	Ammoniacal -N	4.5 mg/l

Table 6.2: Beddington Landfill Permit

5.2 Water Quality Sampling Data

Beddington STW

5.2.1 Water quality sampling records are available for both the discharge from Beddington STW and the MEC overflow channel.

5.2.2 Records of water quality sampling for Beddington STW are provided on the EA Water Quality Sampling Archive (WIMS). The archive includes 10,000 samples taken between 2000 and 2023. A summary of the results for the last 10 years of sampling is provided in **Table 5.3**. A summary of the monthly variation compared to the overall average is provided in **Figure 5.1**.

Parameter	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	Average
Average Ammoniacal Nitrogen as N	0.15	0.13	0.21	0.32	0.31	0.25	0.11	0.11	0.11	0.10	**0.19**
Average Phosphorus Total as P (mg/l)	-	-	-	-	0.83	0.75	0.81	0.78	0.88	0.70	**0.79**

Table 5.3: Summary of EA WIMS Sampling Data for Beddington STW (2014-2023)

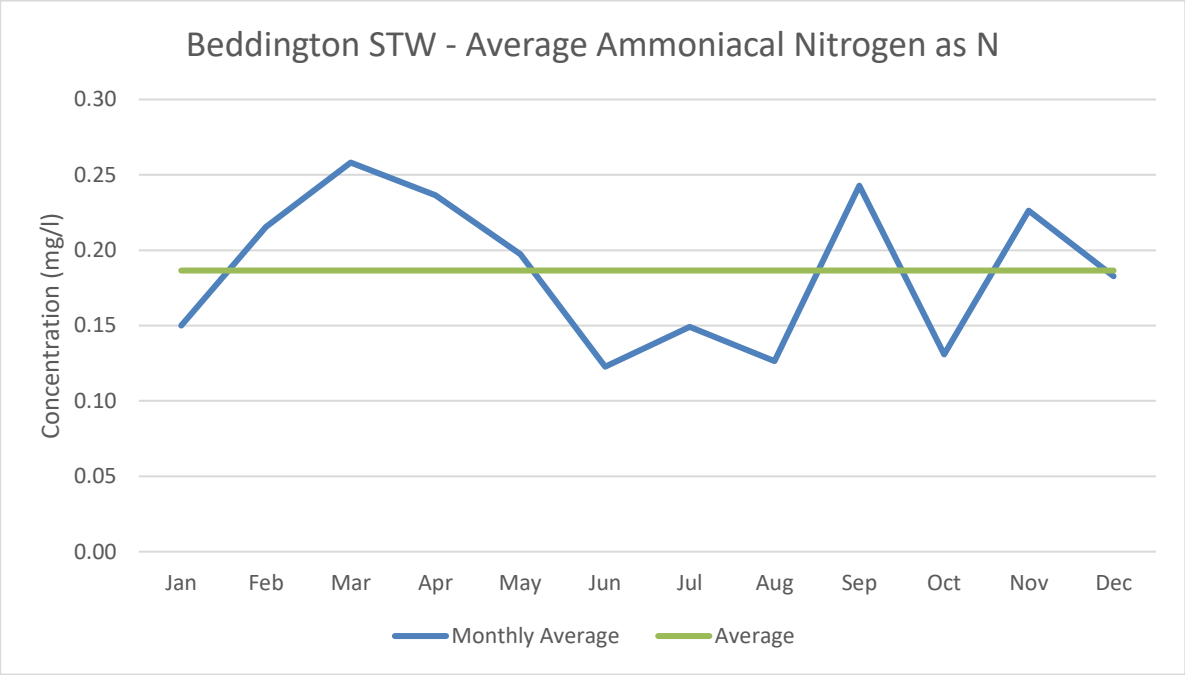

Figure 5.1: Monthly Variation of EA WIMS Sampling Data for Beddington STW (2014-2023)

5.2.3 The sampling data indicates the concentration of nutrients within the treated effluent from Beddington STW averages lower than the assigned permit. Review of the data demonstrates concentration varies monthly and therefore the mean is considered the most conservative average of the data.

5.2.4 VWM have provided sampling records for the MEC overflow channel. A summary of the results for the last 10 years is provided in **Table 5.4**. The sampling data does not include any records for phosphorus, as the current permit does not specify any limits. A summary of the monthly variation compared to the overall average is provided in **Figure 5.2**.

Parameter	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	Average
Average Ammoniacal Nitrogen as N	1.00	0.41	0.46	0.41	0.43	0.24	0.23	0.12	0.09	0.57	**0.43**

Table 5.4: Summary of MEC Overflow Channel Water Sampling provided by Valencia (2014-2023)

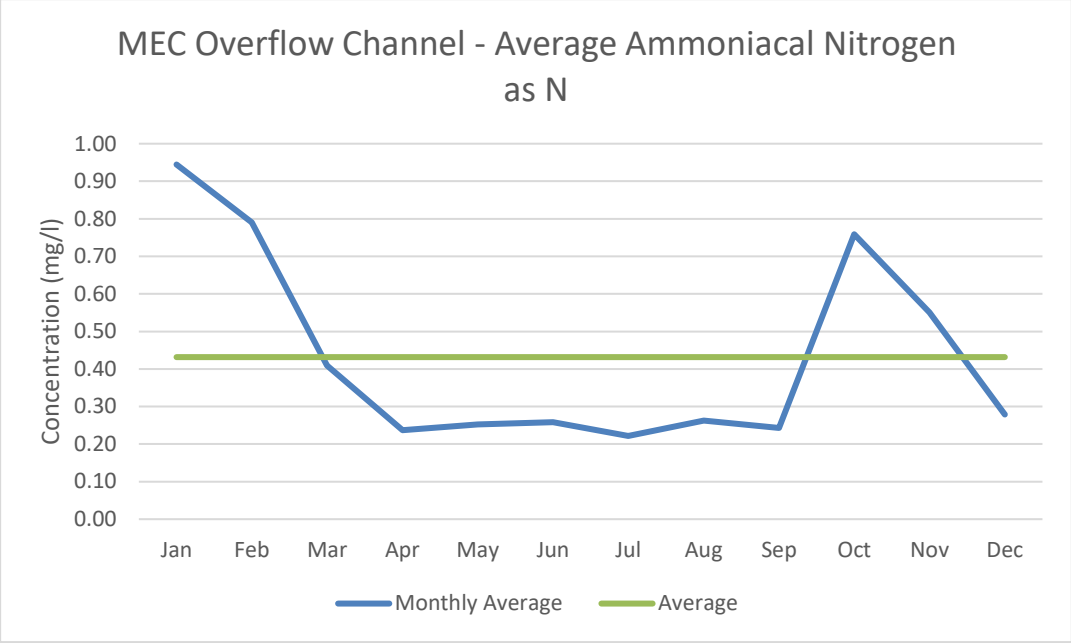

Figure 5.2: Monthly Variation of MEC Overflow Water Sampling provided by Valencia (2014-2023)

5.2.5 Review of the sampling data indicates that in the MEC overflow channel the concentration of nutrients each year averages lower than the permit assigned to the treatment works. The sampling data indicates a slightly higher average of Ammoniacal Nitrogen in the MEC overflow channel compared to the direct discharge from the treatment works. Review of the monthly variation in the data, as shown in **Figure 5.2,** indicates common months with peak concentrations across the year. This is expected as there is always a small baseflow in the overflow channel, but it is primarily utilised when there are excess flows from the STW, e.g. in situations such as when capacity of the treatment works is exceeded, and discharge is released untreated resulting in a higher nutrient loading. Therefore, the mean is considered the most conservative average of the data.

5.2.6 **Table 5.5** below summarises the number of instances in the last 10 years where the concentration of ammoniacal nitrogen was higher than the Beddington STW permit (**Table 3.1**). Based on 120 samples for the STW and 115 samples for the MEC overflow channel.

Data Source	Sampling Location	Number of records in breach of the 2.5mg/l permit limit	Number of records in breach of the 20mg/l permit limit
WIMS	Beddington STW	0	0
VWM Sampling Data	MEC Overflow Channel	3 (3%)	0

Table 5.5: Instances of Beddington STW Permit Breach for Ammoniacal Nitrogen (2014-2023)

Northern Lake

5.2.7 VWM have also provided records of water quality sampling data for the Northern Lake (at location 1BF004SW). A summary of the results for the last 10 years is provided in **Table 5.6**. A summary of the monthly variation compared to the overall average is provided in **Figure 5.1**. The sampling data does not include any records for phosphorus as the current permit does not specify any limits.

Parameter	Location	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	Average
Average Ammoniacal Nitrogen as N	Northern Lake	3.36	0.94	1.04	2.13	0.75	0.54	0.87	0.73	0.70	0.76	**1.32**

Table 5.6: Summary of Northern Lake Water Sampling provided by Valencia (2014-2023)

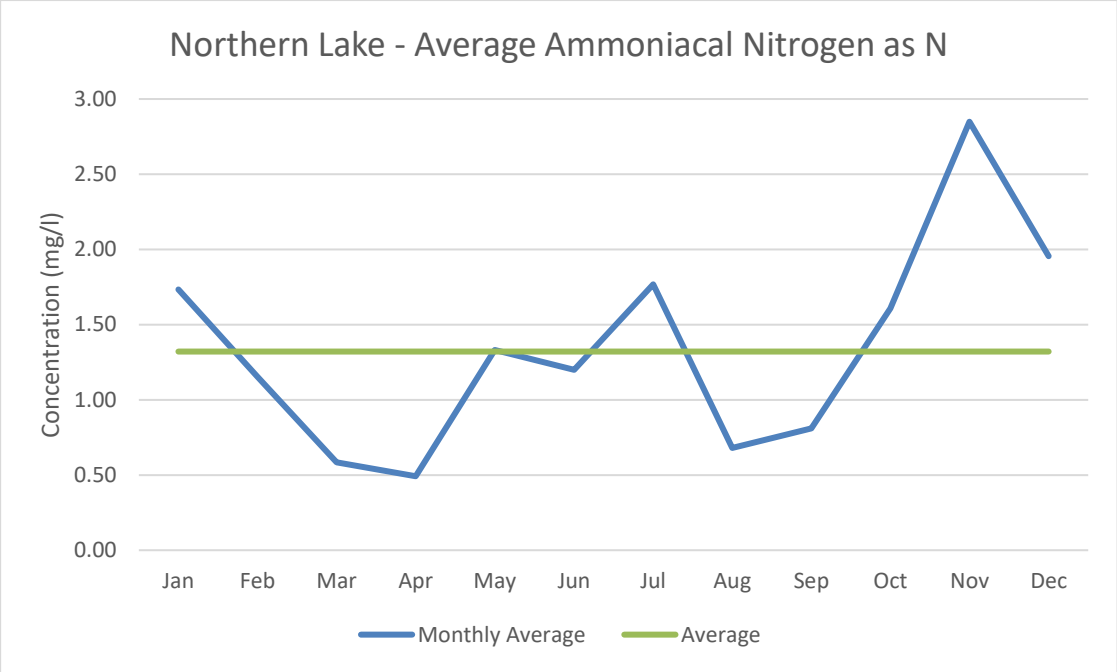

Figure 5.3: Monthly Variation of Northern Lake Water Sampling provided by Valencia (2014-2023)

5.2.8 Review of the sampling data shows that in the Northern Lake, the concentration of nutrients each year averages lower than the assigned permit. The results indicate concentration varies monthly and therefore the mean is considered the most conservative average.

5.2.9 **Table 5.7** below summarises the number of instances in the last 10 years where the concentration of ammoniacal nitrogen in the Northern Lake and the MEC overflow channel was higher than the limits set within the Northern Lake permit (**Table 5.2).** Based on 114 samples for the Northern Lake and 115 samples for the MEC overflow channel.

Data Source	Sampling Location	Number of records in breach of the 4.5mg/l permit limit
Valencia Sampling Data	Northern Lake	7 (6%)
	MEC Overflow Channel	3 (3%)

Table 5.7: Instances of Northern Lake Permit Breach for Ammoniacal Nitrogen (2014-2023)

5.2.10 The data indicates that whilst discharge from the MEC Overflow Channel has some influence over the concentration of nitrogen within the Northern Lake there are likely other factors which

have also influenced historical breaches of the Northern Lake permit. Analysis of the data indicates that in the instances where the permit limit for the Northern Lake was breached in a month, the following month showed concentration levels at regular levels indicating the breaches have not had a lasting impact on the concentration of nutrients within the lake.

5.3 Overspills

5.3.1 The Thames Water Annual Storm Overflow Activity Reports (2019-2022) have been reviewed to determine the number of instances where overspill occurred at Beddington STW (EA Permit Reference: TEMP.2381). A summary is provided in **Table 5.8**.

Year	Total Duration (hrs) all spills prior to processing through 12-24h count method	Counted spills using 12-24h count method
2019	76.78	23
2020	181.85	31
2021	101.50	18
2022	22.43	7

Table 5.8: Counted Spill for Beddington STW as reported by Thames Water

5.3.2 A comparison of the spill data against the sampling data indicates no apparent correlation between the number or duration of spills and the concentration of nitrogen within the lake, indicating that in the long term the spills are unlikely to be impacting the concentration of nutrients within the lake.

5.3.3 As discussed in **Section 3.4**, abstraction from the MEC channel will cease when storm overflow discharges are occurring or anticipated to occur from Beddington STW.

6 Nutrient Assessment

6.1 Overview

6.1.1 To understand the expected impact of the proposed watering strategy underpinning the restoration of the site on water quality in the local environment, the expected impact on nutrient loads within the Northern Lake has been quantified. The assessment compared the expected total nutrient load within the wet grassland based on the proposed discharge strategy (**Section 3.3**) and the existing loads within the Northern Lake. As there is no phosphorus sampling data or permit for the Northern Lake this assessment only considers nitrogen.

6.2 Assumptions

6.2.1 The total nutrient load within the Northern Lake has been estimated based on the following assumptions:

- Volume of the Northern Lake has been approximated as 52,317m^3 based on data extracted from the EA River Wandle hydraulic model and survey information for the existing structures.
- Concentration of nitrogen within the Northern Lake is assumed to equal 1.32mg/l based on the average concentration over the last 10 years of sampling (**Table 5.6**). On review of the data, the mean was selected as the most conservative average.

Total Volume of Northern Lake (m^3)	Expected Nitrogen Load (kg)
52,317	69.06

Table 6.1: Estimated Nitrogen Load within Northern Lake

6.2.2 The total nutrient load within the wet grassland discharge has been estimated based on the following assumptions:

- Volume of discharge from the wet grasslands will occur at least twice a year between February and March (15,022.05 m^3) and May and June (10,014.70 m^3) as a result of scheduled management practices – see **Table 3.1**.
- Concentration of nitrogen within the discharge from the wet grassland is assumed to equal 0.19mg/l based on the average concentration over the last 10 years of sampling for Beddington STW (**Table 5.3**). This is considered a conservative assumption as discharge from the wet grassland will be a combination of rainfall and MEC discharge.
- As a conservative approach, the nutrient removal benefit expected to be provided by the wet grasslands and other habitats has been discounted.

Month	Total Volume of Water Discharged from the Wet Grasslands (m^3)	Expected Nitrogen Load (kg)
March	15,022.05	2.85
June	10,014.70	1.90

Table 6.2: Expected Nitrogen Load within Wet Grassland Discharge

6.3 Outcomes

6.3.1 The expected concentration of nitrogen within the Northern Lake following the wet grassland discharge has been estimated by combining the expected loads (**Table 6.1** and **Table 6.2**) and proportioning over the volume of the Northern Lake, as summarised in the table below.

Month	Combined Nitrogen Load (kg)	Expected Nitrogen Concentration (mg/l)	Percentage increase in concentration
March	96.50	1.84	4%
June	95.55	1.83	3%

Table 6.3: Expected Nitrogen Load within Northern Lake following Wet Grassland Discharge

6.3.2 The assessment estimates the discharge from the wet grassland into the Northern Lake could result in a 4% increase in the concentration of ammoniacal nitrogen, with the expected average concentration to remain significantly below the existing permit for the Northern Lake.

6.3.3 As indicated in **Figure 5.3**, based on the historic sampling data, monthly variation in the concentration of ammoniacal nitrogen within the Northern Lake is expected and therefore a 3% increase is considered within the range variation and therefore is unlikely to have a significant long-term effect on water quality within the Northern Lake and hence in the local environment.

Sensitivity

6.3.4 The above assessment is based on average concentrations. Therefore, a sensitivity check has been undertaken based on the following parameters:

- Concentration of nitrogen within the discharge from the wet grassland is assumed to equal the highest recorded value from the last 10 years of sampling (1.0mg/l).
- Concentration of nitrogen within the Northern Lake is equivalent to the highest recorded annual average from the last 10 years of sampling (3.36mg/l)

6.3.5 The sensitivity analysis estimates the expected concentration of nitrogen in this scenario is 3.65mg/l, which is still below the existing permit for the Northern Lake. Furthermore, as discussed in **Section 3.3**, abstraction of treated effluent from the MEC will not occur when effluent of poor quality is expected (e.g. when storm overflow discharges are occurring).

6.3.6 The above analysis considers the estimated discharge from the wet grassland in line with the management regime. Other scenarios when discharge may occur include:

a. When there is heavy rainfall – discharge will primarily be rainfall and therefore the associated nutrient load is expected to be less than the loads calculated above.

b. In anticipation of a flood event – it is expected the water depths will be drawn down to similar levels considered as part of the management regime and therefore the associated nutrient load is expected to be equivalent to the loads calculated above.

6.3.7 The frequency of such events is expected to be rare and will be tied to the seasonal variation in water levels and rainfall.

6.3.8 Therefore, as the nutrient load within the wet grassland discharge is estimated to be approximately 4% of the existing nutrient load within the Northern Lake it is considered the proposed watering strategy will have no significant long-term effect on the water quality of the Northern Lake compared to existing conditions.

7 Summary

7.1 Overview

7.1.1 This Technical Note has been prepared by Stantec on behalf of our client, Valencia Waste Management Ltd (VWM), to support a planning application for a revised Restoration Management Plan (RRMP) for the Beddington Farmlands site.

7.1.2 Consultation with the Environment Agency (EA) in response to the proposals highlighted concerns of how the proposed watering strategy underpinning the restoration of the site could impact the water quality in the local environment.

7.2 Proposals

7.2.1 The proposed watering strategy includes diverting treated effluent in the Main Effluent Carrier (MEC) from Beddington Sewage Treatment Works (STW) into areas of wet grassland which then ultimately discharge into the Northern Lake, an existing water body within the site which forms part of the Wandle Flood Alleviation Scheme. The proposals ultimately do not alter the discharge location of treated effluent from the site as the Northern Lake and the MEC overflow channel discharge into the River Wandle at the same location.

7.2.2 The RRMP proposes to introduce and enhance a range of habitats across the site including wet grassland, wet woodlands, lakes and reedbeds, and meadow grassland for livestock grazing. It is acknowledged that the livestock grazing will have some associated nutrient loading and the other habitats including the wet grassland will provide some nutrient removal however this cannot be quantified at this stage and therefore have been discounted from the assessment.

7.2.3 As a result of the proposed watering strategy additional treated effluent from the MEC channel will be diverted via the Northern Lake compared to existing conditions and therefore has the potential to increase nutrient levels within the lake. Diversion from the MEC channel is expected to be intermittent, to supplement any rainfall that naturally flows into the wet grasslands and abstraction will not occur during flood conditions.

7.3 Water Quality Assessment

7.3.1 A review of the available water quality sampling data indicates the concentration of ammoniacal nitrogen within the final effluent is typically lower the existing concentration within the Northern Lake. The permit for ammoniacal nitrogen assigned to Beddington STW final effluent is lower that the permit assigned to the Northern Lake (associated with the former landfill). The current permit for the Northern Lake does not specify any limits for phosphorus, meaning the sampling data does not include any records for phosphorus, therefore phosphorous cannot be considered in this assessment.

7.3.2 An assessment of the potential impact on nutrient levels within the Northern Lake as a result of the proposed strategy has been undertaken by comparing the existing loads within the Northern Lake and the expected loading in the proposed discharge.

7.3.3 A conservative assessment has been undertaken, by assuming all flow discharged from the wet grasslands will have a nitrogen concentration equivalent to the average concentration of the treated effluent from Beddington STW, based on the last 10 years of sampling data. The concentration of nitrogen within the Northern Lake is assumed to be equivalent to the average based on the last 10 years of sampling data.

7.3.4 The assessment estimates the discharge from the wet grassland into the Northern Lake will result in a 4% increase in the concentration of ammoniacal nitrogen, with the expected average concentration to remain significantly below the existing permit for the Northern Lake.

7.3.5 Review of the sampling data indicates the concentration of nitrogen within the Northern Lake varies seasonally therefore a 4% increase is considered within an acceptable range. Furthermore, the frequency of such events is expected to be rare (twice a year in line with the management strategy and in anticipation of a flood event). It is therefore concluded the proposals are unlikely to have a significant long-term effect on water quality within the Northern Lake and hence in the local environment.

Appendix E Ground Investigation Report

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Appendix F: Bird Population Trends

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To understand the importance of restoring habitats to support key bird species, some details on European and National population trends are presented below. All references cited are from the BTO webpage[17].

Some limited information obtained from bird surveys carried out by an ecological consultant at Beddington Farmlands in 2021 and 2022 breeding season is also provided[18].

Lapwing

The lapwing is Red listed on the UK Birds of Conservation Concern (Stanbury et al., 2021) and as a species of European Conservation Concern is considered "*vulnerable*". It is listed on the IUCN Red List of Threatened Species as "*near threatened*".

Based on BTO trends lapwing abundance in the UK declined by 48% between 1995 and 2020, although the rate of decline has slowed in recent years with a 24% decrease between 2010 and 2020. In the last 5 years (2015 to 2020) this decline has been 8% (Harris et al., 2022). These declines are reflected in England with declines of 34% and 22% between 1995 and 2020 and between 2010 and 2020, respectively. Notably the 5 year change between 2015 and 2020 has been 11%. Lapwing is also in decline in Europe, having decreased in all regions since 1980 (PECBMS, 2009; PECBMS, 2020a).

The UK breeding population has decreased by 59% between 1967 and 2020; while the UK winter population has decreased by 47% between 1995/6 to 2020/21. Although the most widespread breeding waders in Britain and Ireland, they have been lost as breeders from most of southwest England, west Wales and western mainland Scotland. Between 1968-72 and 2008-2011 declines in distribution have been recorded in the southeast, including around London and eastern Kent. There has been an 18.6% contraction in range in breeding season, based on occupied 10-km squares in the UK between 1968-72 and 2008-11.

Lapwings have declined on lowland farmland since the 1980s, with declines noted throughout wet meadow areas of Wales and Southeast England. Breeding Bird Surveys which have mapped the change in relative density between 1994-96 and 2007-09 indicates that the decreases have been strongest in lowland regions and the south while some increases have occurred in some upland and northern regions of Britain. Winter numbers counted by the Wetland Bird Survey, an initiative overseen by the BTO, indicated that numbers at coastal sites increased in Britian during the 1980's and early 1990's but decreased steeply between 2005 and 2010 (Frost et al., 2020).

Reasons for populations declines are well documented and are generally the result of habitat loss and degradation due to changes in agricultural practice, including changes from spring to autumn sowing, drainage of grasslands and loss of mixed farmland. Chick mortality is thought to be the main determinant of poor Lapwing productivity, and therefore population decline. This occurs as a result of earlier cutting dates, higher stocking densities, reduced food supplies and predation (www.bto.org).

Specific to the Beddington Farmlands, annual surveys carried out by a professional consultancy identified 10 territories of lapwing during the 2022 breeding season, the same as the 2021 season. However, notably, 9 of these territories fell outside the application area in Hundred acre and in the sludge beds in South East Corner.

[17] References | BTO - British Trust for Ornithology

[18] MKA Ecology (2022, 2023) Beddington Farmlands Annual Reports

Redshank

The redshank is Amber listed on the UK Birds of Conservation Concern (Stanbury et al., 2021) and as a species of European Conservation Concern is considered “vulnerable”. It is listed on the IUCN Red List of Threatened Species as “least concern”.

Based on BTO trends redshank abundance in the UK declined by 49% between 1995 and 2020, although the rate of decline has slowed in recent years with a 14% decrease between 2010 and 2020. In the last 5 years (2015 to 2020) this decline has been 12% (Harris et al., 2022). These declines are reflected in England with declines of 47% and 27% between 1995 and 2020 and between 2010 and 2020, respectively. Notably the 5 years change between 2015 and 2020 has been a 17% decline in abundance. Redshank is also in decline in Europe, having decreased since 1980 (PECBMS, 2009; PECBMS, 2020a).

The UK breeding population has decreased by 49% between 1995 and 2020; while the UK winter population has decreased by 20% between 1995/6 to 2020/21. Breeding Bird surveys revealed a decrease of 29% in breeding birds in wet meadows between 1982 and 2002, with the most pronounced declines in the midlands, southwest and north of England. Birds which nest on saltmarshes have also been affected by grazing pressure and decreased in breeding population of 23% between 1985 and 1996 (Brindley et al, 1998; Norris et al., 1998). Winter populations have shown some increases since the 1970s but have been in decline since 2001, although this trend may now be in reverse.

Redshank distribution has contracted by 44% across Britain and Ireland between 1968-72 and 2008-11 with notable losses throughout Scotland, the north west and south of England. Redshank decline is related to changes in habitat management, in particular drainage and agricultural intensification, in particular grasslands, of breeding grounds. Higher stocking densities cause chick mortality although livestock grazing has benefits in creating more diverse swards. Predation in some populations (e.g. Uists) can have a significant problem for redshank.

Specific to the Beddington Farmlands, annual surveys carried out by a professional consultancy (MKA Ecology, 2023) confirmed that redshank were absent during the 2021 and 2022 breeding seasons.

Tree Sparrow

The tree sparrow is Red listed on the UK Birds of Conservation Concern (Stanbury et al., 2021) and as a species of European Conservation Concern is considered “least concern”. It is listed on the IUCN Red List of Threatened Species as “least concern”.

Based on BTO trends tree sparrow abundance in the UK increased by 100% between 1995 and 2020, although the rate of increase has dropped significantly in recent years with only a 1% increase between 2010 and 2020. In the last 5 years (2015 to 2020) this pattern has reversed with a 9% decline (Harris et al., 2022). In England, there was an increase in abundance of 48% between 1995 and 2020 but a 5% decrease between 2010 and 2020. The decline between 2015 and 2020 has been more marked with a 12% reduction in tree sparrow abundance. In Europe, tree sparrow has declined across western and northwestern areas such that the status of the bird is no longer considered secure (PECBMS, 2009; PECBMS, 2020a).

The UK breeding population has increased by over 100% between 1995 and 2022 (Harris et al., 2022), despite having withdrawn completely from some southern and western regions on Britain. Breeding season distribution between 1968-72 and 2008-11, based on occupancy of 10-km squares, has decreased by 37%, with these losses notable in the south and south east. In winter the range contraction between 1981-84 and 2007-11 has been 17.5%. Tree sparrows are now concentrated in low-lying parts of central and Northern England, in eastern Scotland, the Welsh marshes and in parts of Eastern Ireland.

Reasons for population declines have been attributed to agricultural intensification and reductions of winter food sources (Field and Anderson, 2004), including the loss of winter stubbles and seed-rich habitats. The loss of wetland-edge habitats may also impact food sources for chicks which rely on invertebrate prey. Conservation efforts including nest box provision and agri-environment schemes to promote winter food resources.

Specific to the Beddington Farmlands, annual surveys carried out by a professional consultancy confirmed that this species was no longer present on Site, with the last observation being in March 2020 (MKA Ecology, 2023). The 2022 report highlights the absence of a nearby population source and the declines elsewhere in south-eastern England which would limit any likelihood of re-colonisation.

Although long term monitoring should be treated with caution, the population of tree sparrows appears to have exhibited a long term decline since 2008, with some significant drops between 2007-8 and 2011-4 (MKA Ecology, 2023).

Yellow Wagtail

The yellow wagtail is Red listed on the UK Birds of Conservation Concern (Stanbury et al., 2021) and as a species of European Conservation Concern is considered “least concern”. It is listed on the IUCN Red List of Threatened Species as “least concern”.

Based on BTO trends yellow wagtail abundance in the UK declined by 36% between 1995 and 2020 but has increased by 28% between 2010 and 2020. In the past five years (2015-2020, the increase has dropped slightly to 11%. Population abundance in England reflects these values with a decrease of 25% between 1995 and 2020 but increase of 29% and 10% between 2010 and 2020, and 2015 and 2020, respectively (Harris et al., 2022). The European trend (comprised of many races) has declined since 1980 (PECBMS, 2009; PECBMS, 2020a). Britain holds almost the entire world population of the distinctive race flavissima, so population changes in the UK are of global conservation significance

The UK breeding population of yellow wagtail has decreased by 69% between 1967 and 2020. The majority now breed in England with densities highest in East Yorkshire, Lincolnshire, the Fens, Broadland and the Essex and Kent coastal marshes. Confirmed breeding is limited in the south, and virtually absent in Wales and Scotland during 2008-11.

Declines in distribution have been recorded in the northwest throughout Cumbria and Lancashire and the south, including around London and Bristol. There has been an 32.3% contraction in range in breeding distribution, based on occupied 10-km squares in the UK between 1968-72 and 2008-11. Distribution in winter between 1981-84 and 2007-11 has decreased by over 85%.

Reasons for populations declines are attributed to agricultural intensification with declines being more notable in wetland and marginal upland areas (Henderson et al., 2004; Wilson and Vickery, 2005). Loss of invertebrate food resources as a result of this intensification will likely have contributed to population declines. Impacts on wintering grounds in Western Africa are yet to be investigated as a cause of population declines.

Specific to the Beddington Farmlands, annual surveys carried out by a professional consultancy (MKA Ecology 2023) confirmed that yellow wagtail were not breeding during the 2021 and 2022 breeding seasons despite being recorded as present.

Little Ringed Plover

The little ringed plover is Green listed on the UK Birds of Conservation Concern (Stanbury et al., 2021) and as a species of European Conservation Concern is considered “least concern”. It is listed on the IUCN Red List of Threatened Species as “least concern”.

Although details on long term trends for this species are not available, numbers have increased from 467 pairs in 1973 to an estimate of 1,239 pairs in 2007. Both population size and range has increased

considerably since 1984 (Conway et al., 2019) although most recent surveys suggest that numbers have remained stable to 2019 (Eaton et al., 2019). Additionally, the UK winter population has increased by 8% between 1995/6 to 2020/1.

Little ringed plover breeding range is concentrated in north central and southeast England but breeds sparsely in other regions of the UK. Between 1968-72 and 2008-11 the breeding range increased by 107%. This is a significant increase for a species which bred for the first time in Britain in 1938. Climate change and habitat availability are considered to be possible drivers of population and breeding range increases (Snow and Perrin, 1998).

Specific to the Beddington Farmlands, annual surveys carried out by a professional consultancy (MKA Ecology 2023) confirmed that only two little ringed plover territories were present in 2022, an increase in 1 territory from 2021.

Ringed Plover

The ringed plover is Red listed on the UK Birds of Conservation Concern (Stanbury et al., 2021) and as a species of European Conservation Concern is considered “least concern”. It is listed on the IUCN Red List of Threatened Species as “least concern”.

Although details on long term trends for ringed plover are not available, a BTO survey has showed an increase in breeding population between 1973-4 and 1984 (Prater, 1989). Surveys in England and Wales revealed an increase of 12% in breeding birds in wet meadows between 1982 and 2002 (Wilson et al. 2005), although the BTO national survey in 2007 found an overall population decrease of around 37% since 1984. Wintering Bird Surveys have shown that wintering numbers have been in decline since the late 1980’s, with a 52% decrease between 1995/6 and 2020/1, although they have stabilised since around 2010/11 (Frost et al., 2020)

The distribution of breeding ringed plovers is generally coastal and they are widely distributed around the UK. The breeding range has increased by 3.5% between 1968-72 and 2008-11 while winter range between 1981-4 and 2007-11 has increased by 1.5%.

Changes in population have been attributed to human disturbance, particularly on beach nesting sites, and predation. The latter is a main issue on Uist populations where introduced hedgehogs exit (Jackson et al., 2004).

Specific to the Beddington Farmlands, annual surveys carried out by a professional consultancy (MKA Ecology 2023) confirmed that no ringed plover territories were present in 2021 or 2022, with no birds recorded on the Site.

Common Tern

The common tern is Amber listed on the UK Birds of Conservation Concern (Stanbury et al., 2021) and as a species of European Conservation Concern is considered “least concern”. It is listed on the IUCN Red List of Threatened Species as “least concern”.

Based on BTO trends, common tern abundance in the UK increased by 21% between 1995 and 2020, and by 54% between 2010 and 2020. In the last 5 years (2015 to 2020) however the species has demonstrated a 25% decline (Harris et al., 2022). Figures specific to England are no available.

The UK breeding population has not changed between 1995-2020 while the UK winter population has increased by 49% between 1995/6 and 2020/1. Conclusions derived from the stability of breeding population should be reserved given the highly aggregated breeding populations in large colonies.

Breeding common terns are primarily coastal and on lochs and islands in Scotland but dominated by inland colonies in England. However, there are substantial losses of breeding colonies in Scotland whereas gains in eastern and central England between 1968-72 and 2008-11.

The reason for the loss of coastal colonies is not clear but may be related to predation, disturbance and vegetation covering suitable nesting substrate.

Specific to the Beddington Farmlands, annual surveys carried out by a professional consultancy (MKA Ecology 2023) confirmed that no common tern territories were present in 2021 or 2022, with no birds recorded on the Site.

Water Pipit

The water pipit is Amber listed on the UK Birds of Conservation Concern (Stanbury et al., 2021) and as a species of European Conservation Concern is considered “least concern”. It is listed on the IUCN Red List of Threatened Species as “least concern”. It is a winter visitor to British and Irish wetlands, arriving in September and October.

Water pipits mostly winter in the south of Britain and Ireland with a preference for coastal areas while inland records are associated with large wetlands and marshes in the largest river valleys. There has been an increase in winter range between 1981-84 to 2007-11 with birds appearing at more coastal and inland sites.

Specific to the Beddington Farmlands, annual surveys carried out by a professional consultancy (MKA Ecology 2023) confirmed that water pipit were present on Site as a winter visitor.

Green Sandpiper

The green sandpiper is Amber listed on the UK Birds of Conservation Concern (Stanbury et al., 2021) and as a species of European Conservation Concern is considered “least concern”. It is listed on the IUCN Red List of Threatened Species as “least concern”. Most birds are seen during autumn migration when they are passing through Britain from Scandinavia to African Wintering grounds.

BTO records indicate that there were only 2 breeding pairs between 2013-17 and 290 birds in winter between 2011-15. However, there has been a 10% decrease in UK Winter population between 1995-96 and 2020-21.

Green sandpipers are most frequent throughout England and south and north Wales during winter, coastal areas of Scotland and are widely distributed throughout Ireland except the northwest. Distribution has increased during the breeding season by 100% between 1968-72 and 2008-11 although the breeding population is exceedingly small. Winter distribution has changed by just over 56% between 1981-4 and 2007-11.

Reasons for increases in the number of birds in winter may be a result of milder winters.

Specific to the Beddington Farmlands, annual surveys carried out by a professional consultancy (MKA Ecology 2023) confirmed that green sandpiper were present on Site as a winter visitor.

Reed Warbler

The reed warbler is Green listed on the UK Birds of Conservation Concern (Stanbury et al., 2021) and as a species of European Conservation Concern is considered “least concern”. It is listed on the IUCN Red List of Threatened Species as “least concern”.

Based on BTO trends, reed warbler abundance in the UK has increased by 29% between 1995 and 2020 and remained stable between 2010 and 2020. In the last 5 years (2015 to 2020) abundance has again increased by 10% (Harris et al., 2022). Numbers across Europe have been broadly stable since 1980 (PECBMS, 2009; PECBMS, 2020a).

The UK breeding population has increased by 105% between 1967 and 2020 (Woodward et al., 2020). There has been an expansion in range of reed warblers which bred for the first time in Scotland

in 1987 with a 41% expansion between 1968-72 and 2008-11. Similarly, there has been an expansion in winter range of 25% between 1981-4 and 2007-11.

Improved breeding success in the UK caused by warmer climates has been postulated as one of the reasons for population increases and range expansion. Sympathetic reedbed management for other target species has also benefitted reed warblers.

Specific to the Beddington Farmlands, annual surveys carried out by a professional consultancy (MKA Ecology 2023) confirmed that reed warbler occupied 42 territories in 2022 and 41 in 2021. However, the majority of these territories were outside the Site in Hundred Acrea and South East Corner.

Sedge Warbler

The sedge warbler is Amber listed on the UK Birds of Conservation Concern (Stanbury et al., 2021) and as a species of European Conservation Concern is considered “least concern”. It is listed on the IUCN Red List of Threatened Species as “least concern”.

Based on BTO trends, sedge warbler abundance in the UK declined by 19% between 1995 and 2020, although the rate of decline increased in recent years with a 29% decrease between 2010 and 2020. In the last 5 years (2015 to 2020) this decline has been 11% (Harris et al., 2022). Numbers in Europe have been broadly stable since 1980 (PECBMS, 2009; PECBMS, 2020a).

The UK breeding population has decreased by 42% between 1967 and 2020 (Woodward et al., 2020). The species breeds throughout the UK while being absent or at low density in the uplands.

Although overall there has been a slight increase of 3.5% in range during the breeding season, based on 10km survey squares although it should be noted that this species breeding populations fluctuate considerably due to wet-season rainfall in their west African wintering grounds. Adult survival rates are one of the key drivers of population size.

Specific to the Beddington Farmlands, annual surveys carried out by a professional consultancy (MKA Ecology 2023) confirmed that sedge warbler occupied 3 territories in 2022 and 4 in 2021.

Reed Bunting

The reed bunting is Amber listed on the UK Birds of Conservation Concern (Stanbury et al., 2021) and as a species of European Conservation Concern is considered “least concern”. It is listed on the IUCN Red List of Threatened Species as “least concern”.

Based on BTO trends, reed bunting abundance in the UK increased by 30% between 1995 and 2020, and by 6% between 2010 and 2020. However, in the last 5 years (2015 to 2020) the species has declined by 2% (Harris et al., 2022). This pattern is similar for England with a 35% increase between 1995 and 2020, and by 5% between 2010 and 2020. The decline in the last 5 years (2015-2020) was 4%. There has been a decline across Europe since (PECBMS, 2009; PECBMS, 2020a).

The UK breeding population has not changed between 1967-2020 although the breeding distribution has decreased by 5% between 1968-72 to 2008-11. Declines are most notable in the south east of England, including in survey squares around London. The winter range has increased by over 24% between 1981-84 and 2007-11.

Declines have likely been driven decreasing survival rates, perhaps related to agricultural intensification as well as declines in winter food availability.

Specific to the Beddington Farmlands, annual surveys carried out by a professional consultancy (MKA Ecology 2023) confirmed that reed bunting occupied 2 territories in 2022 and 3 in 2021. Both territories were recorded off Site in Hundred Acre although other birds were recorded at the Northern Lake.

Bearded Tit

The bearded tit is Green listed on the UK Birds of Conservation Concern (Stanbury et al., 2021) and as a species of European Conservation Concern is considered “least concern”. It is listed on the IUCN Red List of Threatened Species as “least concern”.

The UK breeding population was recorded as 695 pairs between 2013-17, which has doubled over the 25 years to 2019. Birds are dependent on extensive reed beds, such as those in east Anglia, the English south coast and small populations in Wales and Scotland.

Between 1968-72 and 2008-11 the breeding range increased by 82.2 % while the winter range increased by 15.7% between 1981-4 and 2007-11. Increases tend to be focused on the east Anglian coast, the south coast of England, with gains in Yorkshire and Scotland.

Population increases and range expansion is likely related to the creation and restoration of reedbeds.

Specific to the Beddington Farmlands, annual surveys carried out by a professional consultancy (MKA Ecology 2023) confirmed that bearded tit were not breeding during the 2021 and 2022 breeding seasons.

Bittern

The bittern is Amber listed on the UK Birds of Conservation Concern (Stanbury et al., 2021) and as a species of European Conservation Concern is considered “least concern”. It is listed on the IUCN Red List of Threatened Species as “least concern”.

The UK breeding population was recorded as 191 males in 2017 increasing to 227 pairs in 2019 (Eaton et al., 2021) with a winter population of 795 birds between 2017-8. The UK winter population has increased by 300% between 1995-6 and 2020-1.

Bittern are widespread in the UK although birds are most frequent in the wet reedbeds of central England and along coastal areas, although birds do occur in smaller reedbeds and pools as well as riverbanks. Breeding distribution between 1968-72 and 2008-11 has increased by 134.3% while winter distribution change between 1981-84 and 2007-11 has increased by over 157%.

Conservation efforts to restore and manage reedbeds have benefitted bittern populations. Impacts of climate change in south east England will likely require ongoing management of habitat (Brown et al., 2012).

Specific to the Beddington Farmlands, annual surveys carried out by a professional consultancy (MKA Ecology 2023) confirmed that bittern were not breeding during the 2021 and 2022 breeding seasons.