Gallions Lower Tidal Test Site – Environmental Description

1. Introduction

1.1. Purpose and Scope

The function of this environmental description is as supporting documentation to inform consent and licensing applications for the Gallions Lower Tidal Demonstrator site. In addition, the document can be used to inform and remind potential developers of their responsibilities towards the receiving environment. An initial examination of seasonal environmental sensitivities has been undertaken, based on present understanding of the environmental characteristics of the area. The description covers the character of the physical and biological environment as well as the hydromorphology around the Gallions Lower site. The following sections provide background and a detailed description of each important environmental characteristic.

1.2.Context

The Gallions Lower test site was designated in 2021 to facilitate scale and full-size trials of the types of schemes that could be used in an environment, used and built up as it is of the tidal Thames. Given that the tidal Thames as a specific environment that requires specific design features and the constraints of an estuary and inland waterway, the underutilised mooring provides good opportunity for a demonstrator site. The PLA has set conditional use of the site for demonstrator before tidal technologies are deployed elsewhere in order that the appropriateness of location, use and impact can be appraised by data sharing and collaboration with the promotors first, in a controlled manner.

The developer will be required to enter into a mooring agreement that is also a temporary works consent (Section 66 - Port of London Act 1968) with the PLA. This agreement will have conditions of use specific to the technological design of the demonstrator, including data collection required by the PLA or advised by others. However, as the designated site utilises an existing mooring, it benefits from several exemptions from other consenting bodies and interested parties. Under the Marine and Coastal Access Act, the demonstrator fits under its purpose *to carry out a scientific experiment or survey at sea* and is therefore exempt from an MMO Marine Licence; The PLA will submit any relevant notifications to the MMO. In addition, the moorings themselves benefit from historical consent through their longevity and therefore do not require additional planning permission under Town & Country Planning Acts. A developer looking to utilise a different test site location on the tidal Thames would be subject to gaining consents and licenses from the PLA, MMO, EA and local planning authority.

2. Location

The tidal energy test site is based in Thamesmead, on the south side of the river in the Royal Borough of Greenwich (Figure 1) which is within Port of London Authority limits. The reach is Gallion's Reach, and the mooring is just inside the Thames Barrier Control Zone.

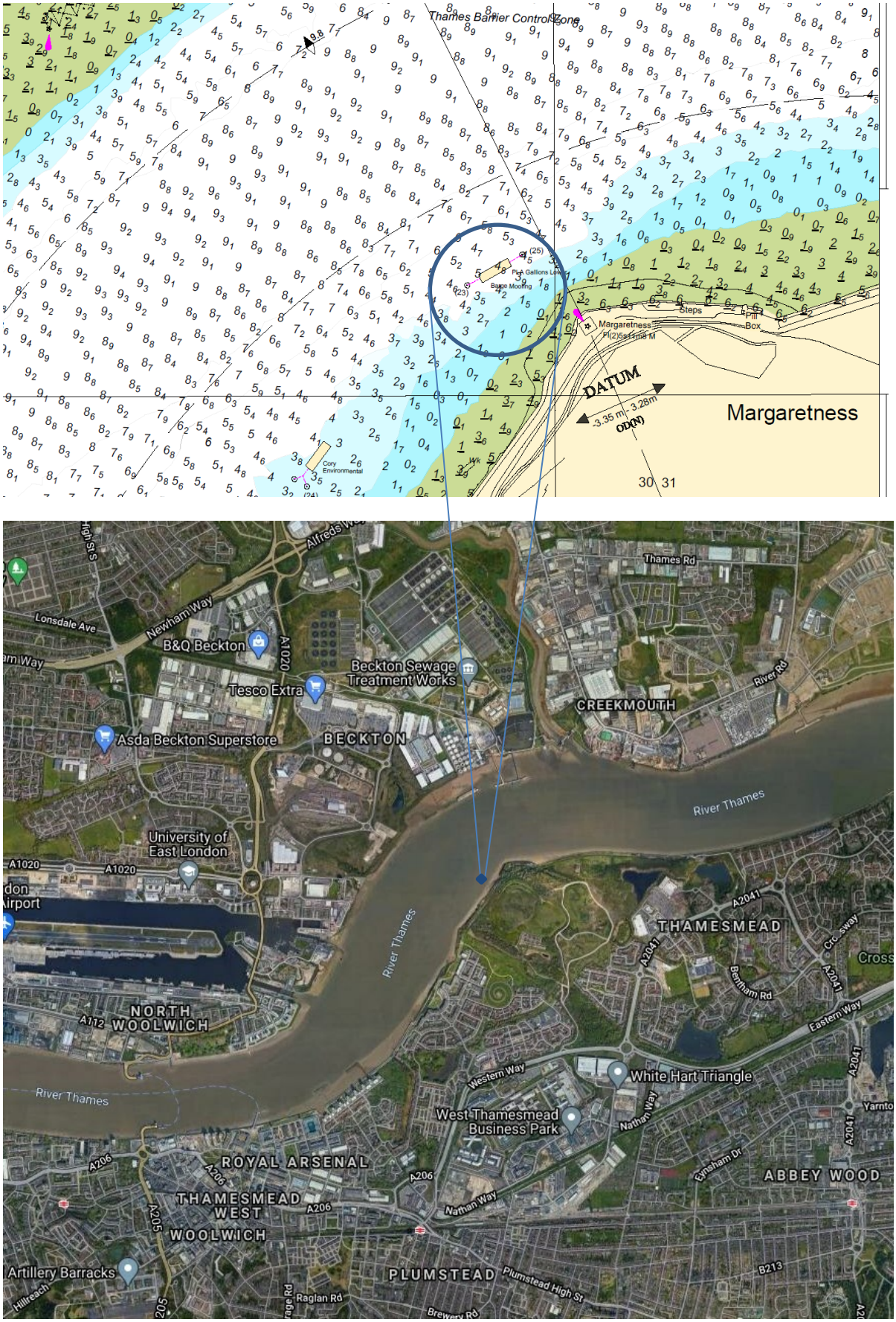

Figure 1: Location of mooring to be used as a tidal demonstrator.

2.1.Coordinate boundaries of site

The following table provides the coordinates for the boundary corners of the site.

Table 1: Boundary coordinates (British National Grid) for Gallions Lower Demonstration Site

Test Site	Corner A	Corner B	Corner C	Corner D
Gallions Lower	545182.083, 181003.446	545207.742, 181018.113	545211.283, 181011.526	545185.635, 180996.488

3. Site Infrastructure

The site is a collar barge mooring which is based outside of the authorised channel. This mooring is midstream and representative of most moorings available on the river. It is at a depth of 5.2m below Chart Datum, at a point in the river that is 590m wide and 65m away from the authorised channel. The site is at a depth that a turbine of 3m span would not touch the surface nor the bed at extreme low waters. The mooring can currently accomodate up to 30m long barge and pontoons. As the site is midstream, it does not possess a dock or slipway or have services such as electricity, therefore access to the site is only available via river. If you would like to discuss specific requirements and details about the site infrastructure, please contact the PLA directly.

4. Riverbed Habitats

4.1. Physical

Gallions Lower is located in a relatively shallow area, with maximum water depths of between 4.8 – 5 meters. These depths are representative of the south side of the river in this reach. Deeper waters can be found in the authorised, navigable channel; however, the mooring is not authorised in this zone.

The riverbed of the Thames Estuary consists primarily of a hard bed of gravel, stones, clay or chalk. There are two exceptions, one being the “mud reaches” (Gallions, Barking and Halfway reaches) and the other being Gravesend Reach. Downstream of Mucking, the seabed of the inner and outer estuary comprises fine sands interspersed with black mud in areas such as Southend Flats and Blyth Sands [2]. The intertidal areas of the Thames Estuary are characterised by large expanses of mud and sandflats backed by seawalls with some small areas of saltmarsh.

British Geological Survey information for Gallions Lower show that the physical seabed at the site is made up of mainly sedimentary rocks which are shallow marine in origin. The rocks are biogenic and detrital and are comprised of carbonate material which form distinct beds of chalk [1]. The underlying geology also consists of alluvium (clay, silt, sand and peat) which are fluvial in origin. Sediment samples taken in 2009 by the PLA at Gallions Shoal, approximately 500m upstream of the tidal test site, show that that sediment is predominately medium sand.

4.2.Biological

The main habitats within close proximity to the Gallions Lower site are Thames’ priority mudflat. Mudflats and sandbank are the most prevalent habitat within the tidal River Thames and are formed of fine sediments and are exposed at low tide and fully submerged at high tide. This habitat is typically formed of fine sediment which creates a soft environment which is easy for small invertebrates to burrow within.

The PLA has previously commissioned summer and winter benthic surveys at a nearby site, approximately 1km from the Gallions Lower test site, to assess the status of the microbenthic communities as part of a wider review of the operational and maintenance dredging areas in the tidal Thames. During the winter survey, the biomass composition was dominated by the Crustacean and Mollusca, with the smallest proportion of the biomass comprised from representatives of the Annelida phylum [3]. In comparison, the biomass composition during summer survey at this site was dominated by the Phyla Annelida [4]. There have also been recorded sightings of marine mammals such as seals near to the test site.

5. Hydromorphology

Hydromorphology refers to the natural processes and attributes of a river and estuary, such as the River Thames. This includes the hydrological processes (water flow, energy, etc) and geomorphological (surface features) ones. Several key hydromorphological processes in the river are dependent on the flow velocity, which varies between flood and ebb tides. It is also important to note that the flow velocity varies across a river section, changing within both the distance across the channel and with changing depth.

5.1. Tidal Diamond for Gallions Lower

Flow velocity around the perimeter of the river channel demonstrates slower speeds than the centre of the river due to friction with the riverbed and other marine infrastructure. The area of higher flow velocity is typically located towards the outside of meanders and slower on the inside of meanders. For the Gallions Lower site, the PLA have extracted a tidal diamond from the Thames 2D base model (Table 2).

It should be noted when using this information that values are from a 2D depth averaged numerical model of an average spring tide with average freshwater discharge at Teddington and interpolation to the shoreline isn't precise.

Table 2: Tidal Diamond for Gallions Lower Site

Gallions Lower Barge Mooring

	Hours	Spring			Neap		
		Direction (Degrees Grid North)	Velocity (m/s)	Velocity (knots)	Direction (Degrees Grid North)	Velocity (m/s)	Velocity (knots)
Before local HW (Flood)	-6	233	0.09	0.17	230	0.35	0.68
	-5	230	0.46	0.90	233	0.32	0.62
	-4	232	0.73	1.42	233	0.31	0.60
	-3	235	0.87	1.70	233	0.38	0.74
	-2	238	0.83	1.62	234	0.57	1.11
	-1	239	0.83	1.62	237	0.58	1.13
	HW	251	0.33	0.64	253	0.23	0.45
After local HW (Ebb)	+1	045	0.79	1.53	045	0.48	0.93
	+2	045	1.16	2.25	046	0.81	1.57
	+3	045	1.08	2.09	045	0.78	1.51
	+4	046	0.99	1.92	046	0.65	1.26

	+5	048	0.73	1.42	046	0.36	0.70

The PLA has also carried out studies, using ADCP fixed system monitoring flow rates over a spring tidal cycle in 1m water depth at low tide and 8m at high tide. The location is representative of a typical downriver site and the recorded flows indicative of the potential that is available, recognising that different locations will have their own unique characteristics. For further detail on this study, please visit: http://www.pla.co.uk/Environment/Alternative-Energy/Tidal-energy-heat-map.

5.2. Tidal Energy Heat Map

In 2016, the PLA undertook a study on the potential tidal energy in the river Thames [5]. Generally tidal turbines are limited by tidal velocities, the depth of water or the location they are to be placed as there are many other obstructions and uses for the river. The study focused on velocities at 1 m/s as generally this is the minimum velocity that tidal turbines will start working at. The average velocity magnitude was used to provide the most representative tidal velocities in a normal spring-neap tidal cycle [5]. The river was divided into six separate areas and the Gallions Lower site is located within area 3 (Figure 2). Figure 2 shows a representation of the time period in any 24 hours that the river flow is predicted to be equal or greater than 1 m/s, derived from a 2D numerical model using an average height of tide. Further details about the Thames 2D model can be found here: https://www.pla.co.uk/Hydrography/Tidal-Information

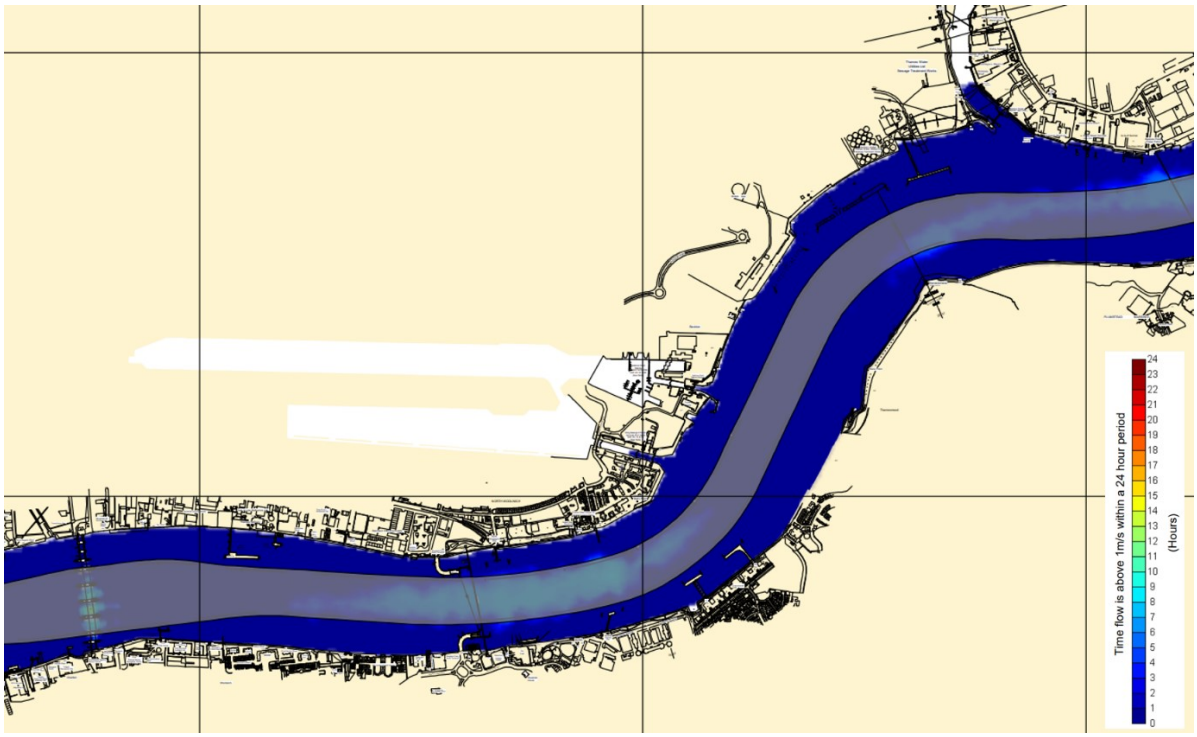

Figure 2: PLA Tidal Velocities Heat Map for Area 3

6. Key Seasonal Environmental Sensitivities

When conducting an environmental assessment for an upcoming development, there are several factors and sensitivities which should be accounted for within the application. The importance of the tidal Thames as a wildlife corridor for animals such as migratory fish species is recognised by its designation as a Site of Importance for Nature Conservation (SINC). As

mentioned previously, the site is some distance from the authorised channel and the bank to reduce the risk from fish aggregating in the sheltered intertidal areas during higher flows. In addition, the use of the site for tidal turbines demonstration has been limited to avoid spring season for full scale trials to minimise impacts on large migrations through the river of fish. Although developers should be aware that other seasonal or temporary operational constraints may be placed in the mooring agreement if the specific design was believed to impact species during other periods of time. An application to use the site should take into consideration any potential impacts on migratory species, including proposals for any necessary ecological monitoring.

6.1.Seasonality Chart for Woolwich to Barking Reach

Feature	January	February	March	April	May	June	July	August	September	October	November	December	Woolwich Reach	Gallions Reach	Barking Reach
Protected sites															
SINC															
Animals															
Invertebrates															
Tentacled Lagoon Worm															
Fish															
Salmonid Migrating Outbound															
Salmonid Migrating Inbound															
Silver eels Migrating Outbound															
Elvers Migrating Inbound															
Twaite Shad															
Mammals															
Nesting Birds															
Birds															
Nesting Birds															

7. References

[1]	British Geological Survey, “Geology of Britain,” [Online]. Available: https://mapapps.bgs.ac.uk/geologyofbritain/home.html?&_ga=2.15558196.328651398.1638458749-103386433.1638458749.
[2]	C. C. Inglis and F. H. Allen, “The regimen of the Thames Estuary as affected by currents, salinities, and river flow,” *Proceedings of the Institution of Civil Engineers,* vol. 7, pp. 827-878, 1957.
[3]	Emu Ltd, “Thames Benthic Study Winter Survey,” Port of London Authority, Gravesend, 2005.
[4]	Emu Ltd, “Thames Benthic Study Summer Survey,” Port of London Authority, Gravesend, 2005.
[5]	Port of London Authority, “Thames Estuary Tidal Power Report,” Port of London Authority, Gravesend, 2016.