Associated British Ports

Swansea Inner West Pier Marine Works

Environmental Appraisal

October 2018

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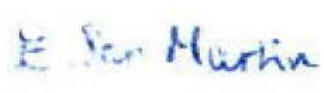		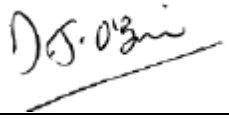

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Notice

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Summary

Project background

Swansea West Pier is located to the south of Swansea Barrage (or the Tawe Barrage) in Swansea Bay on the western bank of the entrance to the River Tawe (Afon Tawe). The inner section of the pier (Inner West Pier) is approximately 240 m long and comprises a timber retaining wall which was constructed in the 1800s to aid navigation to the Port of Swansea. This section of the pier is now in visibly poor condition and has suffered structural failure at several locations but remains safe. Emergency repair works were carried out in December 2017 and July 2018; however, further failure is possible in the near future and to counter this risk and any adverse consequences, a long-term solution is required.

ABP owns Swansea West Pier and is proposing to construct a new retaining wall aligned immediately in front (seaward) of the Inner West Pier, in order to provide adequate long-term protection for navigation and to maintain the current stability of the coastline in the future. Following an ongoing, iterative design process, the preferred engineering design option for the Proposed Development is a driven combination pile wall. Some form of scour protection may be required at localised locations at the toe of the new retaining wall. The upper surface layer of the seabed will also need to be dredged on a local basis and to a shallow depth in advance of constructing the new retaining wall to mitigate the risk of striking obstructions during piling. Subject to the agreement of NRW, it is proposed to dispose of the dredged material at the Swansea (Outer) licenced disposal ground (LU130).

The installation of piles is likely to be carried out from a jack-up barge or similar marine plant with a crane and piling equipment (both vibro and percussive piling). Two piling rigs may be used to allow piling operations to take place concurrently in order to accelerate the construction programme. The dredging will be undertaken using a backhoe dredger or similar marine plant, which will transfer material into a split hopper barge. Barges and vessels will be used to transfer piles from the laydown area at the eastern site compound on ABP land at Swansea Docks to the application site.

Consenting and approach to assessment

ABP has a general power to maintain and renew Swansea West Pier under the Swansea Harbour Act 1864. Before exercising this power, ABP will need to seek the prior approval for this Proposed Development from Welsh Ministers. A marine licence will also be required from Natural Resources Wales (NRW) under the Marine and Coastal Access Act 2009.

NRW, in their screening opinion, has advised that the Proposed Development does not require a statutory Environmental Impact Assessment (EIA). An Environmental Appraisal (this report) has therefore been prepared to document the required environmental information in support of the marine licence application. This has taken into account advice provided in the screening opinion by NRW and statutory consultees. As well as this, a project website has been developed and a public stakeholder event has been held to engage with the local community and interested parties.

Based on the initial assessment undertaken in a Screening and Scoping Report and subsequent advice received, the following topics have been assessed in this Environmental Appraisal:

- Water and Sediment Quality (Section 6.1);

- Marine Ecology (Section 6.2);
- Terrestrial Ecology (Section 6.3);
- Commercial and Recreational Navigation (Section 6.4);
- Coastal and Flood Protection (Section 6.5);
- Airborne Noise and Vibration (Section 6.6);
- Landscape/Seascape and Visual (Section 6.7); and
- Transport and Access (Section 6.8);

For each of these topics, the relevant impact pathways were identified and assessed. These impact pathways comprise the potential environmental changes resulting from the Proposed Development and the features of interest (receptors) that are likely to be affected. A standardised methodology consistent with the requirements of EIA has been applied to assess the significance of these impact pathways.

Conclusion

The majority of impacts identified in this Environmental Appraisal have been assessed to be of no or minor adverse significance. The key issues were found to be those associated with elevated levels of noise and vibration during construction on marine fauna and residents, and the displacement of vessels and risk of an accident or incident involving marine craft during construction. Following the adoption of appropriate mitigation measures, the residual impact will be reduced to minor adverse at worst. Once the Proposed Development has been constructed, no significant impacts are anticipated during operation.

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1 Project Summary

1.1 Project background

Swansea West Pier is located near to the Swansea Barrage (or the Tawe Barrage) in Swansea Bay (Figure 1). The inner section of the pier (hereafter referred to as the Inner West Pier) is approximately 240 m long and comprises a timber retaining wall. Associated British Ports (ABP) owns Swansea West Pier and is proposing to construct a new retaining wall aligned immediately in front (seaward) of the Inner West Pier, in order to provide adequate long-term protection for navigation and to maintain the current stability of the coastline in the future. These works comprise the Proposed Development. Following an ongoing, iterative design process, the preferred engineering design option for the Proposed Development is a driven combination pile wall.

ABP has a general power to maintain and renew Swansea West Pier under the Swansea Harbour Act 1864. Before exercising this power, ABP will need to seek the prior approval for this Proposed Development from Welsh Ministers. A marine licence will also be required from Natural Resources Wales (NRW) under the Marine and Coastal Access Act 2009.

A Screening and Scoping Report (ABPmer, 2018) was submitted to NRW to seek a screening opinion as to whether the Proposed Development constitutes development which requires a formal Environmental Impact Assessment (EIA) under the Marine Works (EIA) Regulations 2007 (as amended). NRW determined that the Proposed Development does not require a statutory EIA and an Environmental Appraisal (this report) has therefore been prepared to document the required environmental information in support of the marine licence application. This report will also inform Welsh Ministers' decision to approve the Proposed Development under the Swansea Harbour Act 1864.

ABPmer has been commissioned by ABP to lead the preparation of this Environmental Appraisal. AECOM led the engineering design work and provided input to the project methodology and a number of landside environmental topics. Thomson Ecology Ltd prepared the terrestrial ecology assessment.

1.2 Report structure

The structure of this Environmental Appraisal is as follows:

Section 1 **Project Summary**: A brief summary of the Proposed Development and background information.

Section 2 **Project Need and Alternatives**: The need for the Proposed Development and review of alternatives.

Section 3 **Project Description and Methodology**: A description of the Proposed Development and proposed project methodology.

Section 4 **Consents and Approvals and Policy Guidance**: Overview of the consent requirements and information required to inform and accompany the marine licence application.

Sections 5 **Impact Assessment Approach:** A review of the scope of the Environmental Appraisal and impact assessment methodology that has been applied.

Section 6 **Environmental Receptors**: Review of baseline information and assessment of potential impacts arising from the Proposed Development on the existing environment.

Section 7 **Cumulative and In-combination Effects**: Assessment of the cumulative and in-combination impact(s) of the Proposed Development together with other plans and projects in the wider area.

Section 8 **Conclusions**

Appendix A **Application Drawings**
Appendix B **Consultation Log**
Appendix C **Habitats Regulations Assessment**
Appendix D **Water Framework Directive Compliance Assessment**
Appendix E **Navigational Risk Assessment**
Appendix F **Species Protection Plan**
Appendix G **Underwater Noise Assessment**
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Appendix I **Landscape, Seascape and Visual Effects**
Appendix J **Transport Statement**

1.3 References

ABPmer (2018). Swansea Inner West Pier Works, Screening and Scoping Report, ABPmer Report No. R.2985. A report produced by ABPmer for ABP, May 2018.

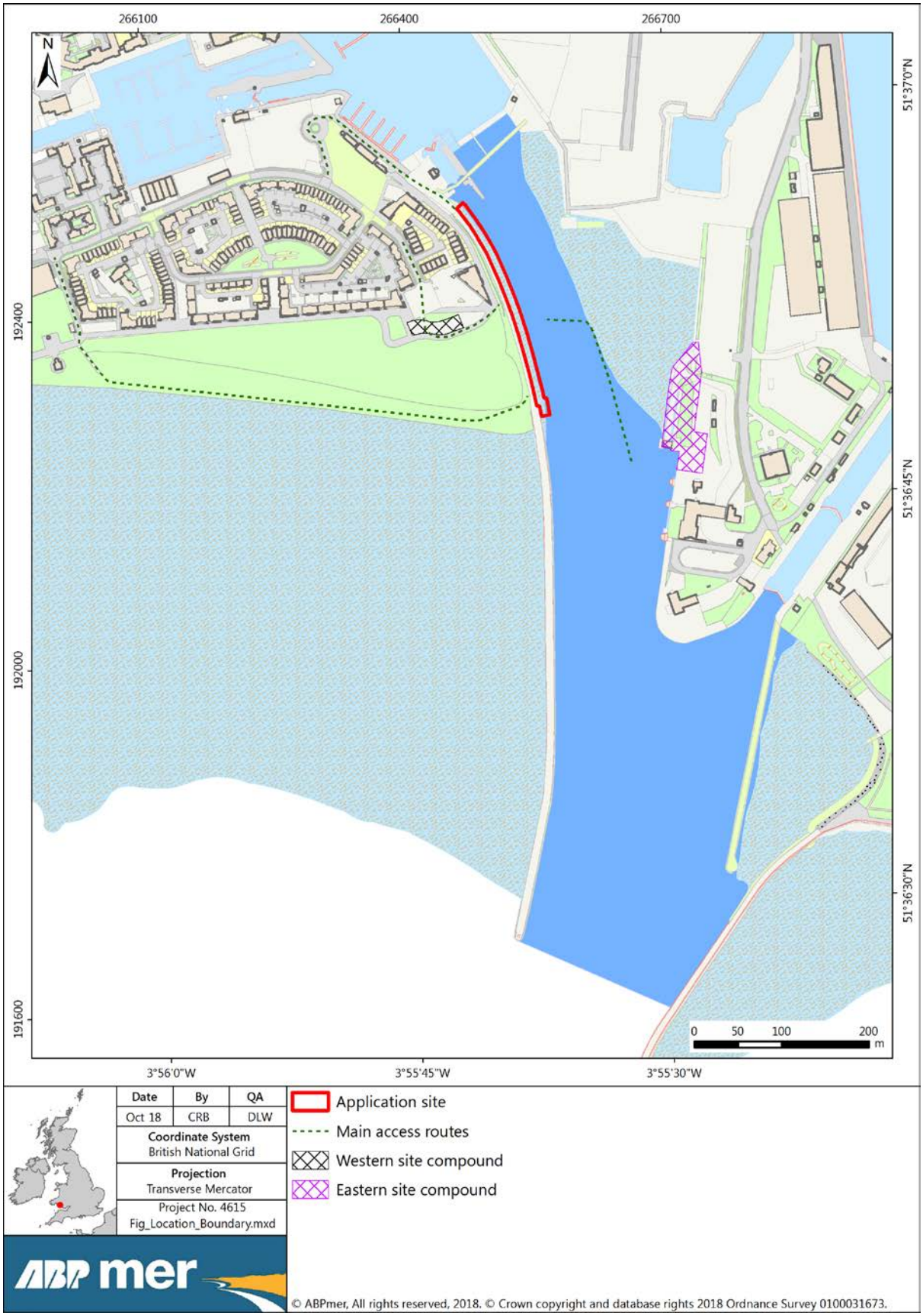

Figure 1. Location overview - Swansea West Pier Marine Works

2 Project Needs and Alternatives

2.1 Project need

The current pier wall was constructed in the 1800s to aid navigation to the Port of Swansea. The Inner West Pier is in visibly poor condition and has suffered structural failure at several locations but remains safe (Figure 2). Emergency repair works were carried out in December 2017 and July 2018, however, further failure is possible in the near future and to counter this risk and any adverse consequences, a long-term solution is required.

Figure 2. Swansea Inner West Pier following emergency repair works (July 2018)

2.2 Consideration of alternatives

A range of approaches have been considered for the Swansea Inner West Pier structure, including Do Nothing, Do Minimum and Do Something. Due to the poor structural condition of the inner section of the West Pier, it is not considered that the Do Nothing or Do Minimum options are viable. The complete removal of the existing pier structure is also not considered viable given its role in holding and protecting the coastline at this location. These alternative options are discussed in more detail in the following sections.

2.2.1 Do nothing

The Do Nothing option would involve leaving Swansea West Pier to continue to fall into disrepair. There would be a number of disadvantages to this approach. These include significant health and safety risks associated with a failing structure adjacent to land with public access. There are also risks associated with the structural failure of the pier causing slip failure of the adjacent land it currently retains (including the nearby residential apartment blocks). In addition, there are navigational risks associated with hazards from the remaining structure falling into the marine environment. On the

basis of these significant adverse consequences, this option is not considered viable and has not been taken forward for further consideration.

2.2.2 Do minimum

The Do Minimum option would involve undertaking repairs on pier sections as they fail. Without significant intervention, repairs are unlikely to be able to be designed to a set standard. This is due to repaired sections having to be tied-in to adjacent sections that are already significantly beyond their intended design life. The Do Minimum approach would therefore not fully mitigate the risks associated with the condition of the existing structure. As the structure is beyond its design life and is failing in multiple sections, repairs would have to be completed at an increasing rate, and potentially at short notice (e.g. after a winter storm event).

The disadvantages for this option are very similar to the Do Nothing option. It is therefore not considered that a Do Minimum option is a viable solution and this option has not been taken forward for further consideration.

2.2.3 Removal of existing structure

The outer and inner sections of Swansea West Pier provide wave protection to the navigation channels. If the pier structure were to be removed, it would lead to increased wave exposure along the frontage, to the Swansea Port access channel and to the Tawe Lock. This could lead to operational restrictions and/or re-design of the port frontage to withstand the increased wave conditions.

Swansea West Pier acts as a terminal groyne, which means it holds the beach and dune areas to the west of the pier in their current positions. Without the presence of structures, the net littoral drift at this location would be to the east, due to the shape of the Bay and prevailing wave conditions. This would effectively result in the west side facing area of the current port becoming a terminal groyne. The movement of sand could be sufficient to limit access to the Swansea Barrage or potentially block this area completely. The impact on the entrance to the River Tawe (Afon Tawe) would be difficult to mitigate, for example by maintenance dredging.

Under a pier removal scenario, it is likely that the beach area to the west of the pier would erode, as the sand mass is transported and redistributed eastwards. This loss of beach material would potentially lead to flood and coastal erosion issues along the coastal frontage west of the pier. Without the pier acting as a groyne, the coastline would also have a tendency to retreat back towards a position where it was prior to the construction of the West Docks, noting that there have been other significant changes at this location which contribute to the current coastline position.

On the basis that these changes would have significant environmental impacts, a scheme to remove the pier is not considered viable and has not been taken forward for further consideration.

2.2.4 Options appraisal

An options appraisal has been undertaken by AECOM to assess the potential engineering solutions for the Inner West Pier on the basis of technical, environment and economic criteria. The options appraisal process involved a phased approach as follows:

- Phase 1 – Initial review of the advantages and disadvantages of a wide range of options. Options that were judged as unfeasible or having significant disadvantages were ruled out from further assessment; and

- Phase 2 – Closer scrutiny of remaining options by comparing them across a range of different criteria. The options considered most favourable at this stage were then taken forward to form the Short List.

A range of possible options (nine in total) were identified for the site, based on existing data reviewed and an understanding of existing risks and constraints. These were as follows:

- Gravity retaining rubble mound;
- Gravity retaining wall;
- Gravity retaining caisson structure;
- Sheet piled wall;
- Sheet piled wall with raker piles;
- Sheet piled wall with ground anchors;
- Contiguous bored cast *in situ* piles;
- Driven combination pile wall (tubular piles and sheet piles or HZ piles and sheet piles); and
- Buttress wall.

The options that were taken forward (five in total) were assessed against a number of criteria, including environmental impact (e.g. noise, size of footprint), buildability, construction time and maintenance requirements. These were as follows:

- Gravity retaining caisson structure;
- Sheet piled wall with ground anchors;
- Contiguous bored cast *in situ* piles;
- Driven combination pile wall (tubular piles and sheet piles or HZ piles and sheet piles); and
- Buttress wall.

Two options were selected as the preferred options from this list:

- Contiguous bored cast *in situ* piles; and
- Driven combination pile wall (tubular piles and sheet piles or HZ piles and sheet piles).

These were selected as they have good buildability, a relatively small footprint (close to on-line), and require little maintenance. They are also achievable in terms of cost and construction time.

2.2.5 Preferred option

Following on from the options appraisal, two remaining options were taken forward and presented in the Screening and Scoping Report (ABPmer, 2018), and are as follows:

- Option 1 – Contiguous bored cast in situ piles;
- Option 2 – Driven combination pile wall; and
- A combination of Options 1 and 2.

Following an ongoing, iterative design process, Option 2 has been selected as the preferred option due to environmental considerations (Table 1). Option 2 will involve a shorter construction programme which will enable potential environmental effects to be more effectively managed (e.g. minimising piling during key fish migration periods).

Details of the preferred option for the Proposed Development are presented in Section 3.

2.3 References

ABPmer (2018). Swansea Inner West Pier Works, Screening and Scoping Report, ABPmer Report No. R.2985. A report produced by ABPmer for ABP, May 2018.

Table 1. Potential environment effects associated with Options 1 and 2

Topic	Receptor	Impact pathway/ potential effect	Option 1	Option 2
Water and sediment quality	Water and sediment quality	Potential impacts from redistribution of sediment-bound chemical contaminants during construction	Discharge of bored/drill arisings *in situ*.	No arisings.
			Disturbance of surficial sediments during bed preparation and the placement of piles on the seabed will be the same.	
Marine ecology	Benthic habitats and species	Direct habitat loss as a result of the Proposed Development	Location/design/footprint of piled wall will be the same.	
	Mobile features (fish, marine mammals and coastal birds)	Disturbance (noise/visual) during construction	Overall, lower levels of noise (bored/drilling of tubular piles and vibro-piling of sheet piles)*.	Overall, higher levels of noise (vibro/percussive piling of tubular piles and vibro-piling of sheet piles).
			Longer piling programme (approx. 8-12 months).	Shorter piling programme (approx. 6-8 months).
Terrestrial ecology	Rare plants and invertebrates	Disturbance/ damage or removal	Access requirements will be the same.	
	Bats and otter	Disturbance from external lighting during construction and operation	Lighting requirements will be the same.	
		Disturbance from noise and vibration during construction	Overall, lower levels of noise (bored/drilling of tubular piles and vibro-piling of sheet piles)*.	Overall, higher levels of noise (vibro/percussive piling of tubular piles and vibro-piling of sheet piles).
			Longer piling programme (approximately 8-12 months).	Shorter piling programme (approximately 6-8 months).
Commercial and recreational navigation	Vessel navigation	Accident or incident involving commercial or recreational	Greater number of marine equipment and barges/vessels required.	Lower number of marine equipment and barges/vessels required.

Topic	Receptor	Impact pathway/ potential effect	Option 1	Option 2
		vessels and the construction works Displacement of vessels during construction Accident or incident involving construction craft Water quality impacts from pollutants resulting from accidents, incidents or spillages	Longer marine construction programme.	Shorter marine construction programme.
			Longer period of Swansea Barrage closure (approximately 6 weeks).	Shorter period of Swansea Barrage closure (approximately 4 weeks).
Coastal and flood protection	Flood risk	Increase in vulnerability to flood events during construction, to the construction site and surrounding area	Longer construction programme.	Shorter construction programme.
Airborne noise and vibration	Local residents	Significant levels of construction noise at nearby sensitive receptors Significant levels of construction vibration at nearby sensitive receptors Significant levels of construction traffic noise at nearby sensitive receptors	Overall, lower levels of noise (bored/drilling of tubular piles and vibro-piling of sheet piles)*.	Overall, higher levels of noise (vibro/percussive piling of tubular piles and vibro-piling of sheet piles).
			Longer piling programme (approx. 8-12 months).	Shorter piling programme (approx. 6-8 months).
Landscape / seascape and visual	Landscape and visual	Temporary adverse effects to local landscape (townscape) character and views during construction	Longer construction programme.	Shorter construction programme.

Topic	Receptor	Impact pathway/ potential effect	Option 1	Option 2
		Permanent beneficial effects on landscape (townscape) character and views during operation as a result of the repaired pier, and new public realm	The location/design/footprint of the piled wall and landside works will be the same.	
Transport and access	Driver and pedestrian delay	Increase in driver and pedestrian delay through changes in the volume, composition or speed of traffic during construction	Access requirements will be the same.	
	Road safety	Increase in risk / number of road accidents during construction		
	Community severance	A division which separates people from places, facilities and other people during construction		
	Fear and intimidation	Increased fear and intimidation for pedestrians		
* This approach may require use of percussive piling to achieve the required design depth.				

3 Project Description and Methodology

3.1 Project description

3.1.1 Application site and surrounding area

The Proposed Development is located to the south of the Swansea Barrage in Swansea Bay, at the northern end of the West Pier on the western bank of the entrance to the River Tawe. Figure 1 shows the red line application boundary for the Proposed Development (the application site). The application site comprises a failing and deteriorated section of existing pier and fronting intertidal area.

The application site is bounded to the north by Swansea Marina, beyond which lies Swansea City Centre. West of the northern section of the application site is an upper walkway and residential buildings. The upper walkway comprises the Wales Coast Path National Trail and National Cycle Network Trail 4, linking the Swansea Bay promenade to the west of the site with Trafalgar Bridge just north of the site, via the River Tawe. West of the southern section is Swansea Bay Beach. This beach is designated as a Site of Importance for Nature Conservation (SINC) for its sand dune and intertidal habitat as well as having a marine and ornithological interest. On the eastern side of the entrance to the River Tawe are Swansea Docks and contemporary mixed-use developments.

3.1.2 Ground conditions

A geotechnical desk study has been undertaken which involved collating and interpreting relevant available data, including geological maps and historical boreholes in the surrounding area. Based on the findings of this study a preliminary ground model was derived which consists of the following soil/rock layers:

- Made Ground/ Pier Fill (only encountered behind the proposed seawall);
- Marine Beach Deposits/ Wind Blown Sand;
- Glacial Deposits/ Sand, Gravel and Till; and
- South Wales Middle and Lower Coal Measures Formation.

This ground model is preliminary and an additional ground investigation (GI) will be undertaken to better define the ground conditions at the location of the new retaining wall.

3.1.3 Proposed Development

The Proposed Development comprises the following components that are described further below:

- Retaining wall;
- Scour protection; and
- Bed preparation works.

Retaining wall

The Proposed Development is to construct a new 240 m long retaining wall along to the line of the existing Inner West Pier, providing a robust and safe structure for up to 50 years. The new retaining wall will be located approximately 5 m seaward of the existing timber structure to avoid conflict with, and potentially destabilising, the existing structure, as well as avoiding any overlap with the adjacent

navigational channel. This will result in the effective reclamation of approximately 0.3 ha of intertidal habitat.

The proposed dimensions and layout of the proposed new retaining wall are shown on the application drawings included in Appendix A. The dimensions and footprint of the new wall have taken into account the level of information currently available, along with outputs from the design process suitable to concept level. Final dimensions are subject to further design and GI works.

The new retaining wall will comprise approximately 1.5 to 2.0 m diameter steel tubular piles with approximately 0.6 to 0.9 m wide 'U' or 'Z shaped steel sheet-piled 'infill panels' installed between the steel tubular piles.

The new retaining wall will tie back into the southern extent of the existing timber piled Inner West Pier, with a 90° return piled wall, adjacent to the transition of the sheet piled Outer West Pier. As part of this tie-in, a section of reinforced concrete will be required to fill the gap between the existing inclined pier face and the last steel tubular pile. At the northern extent of the Inner West Pier, the new retaining wall will tie back into the concrete transition section of the pier with a 110° return piled wall.

A reinforced capping beam will be included for the length of the new retaining wall to tie the piles together and to provide a finished top surface. The final level of the capping beam will provide an acceptable level of protection against overtopping.

Drainage system

There are two known surface water outfalls discharging from the 'Aurora Building' complex, extending through the edge of the existing pier. There is an additional outfall in the north, located behind the holding pontoon. This outfall has not shown up on utility records and therefore is assumed to drain a private property.

Scour protection

Provision for scour protection may be required in areas where there is an abrupt change in the direction of the pier (perpendicular to the existing alignment), such as at the tie-in at the southern end of the pier. The scour protection could take the form of:

- Allowance for scour to the maintenance level (-4.2 mOD). The current design assumes that there is no passive resistance to the pile above this level;
- Increasing the diameter and length of the piles to accommodate loss in passive resistance due to scour; and
- Addition of scour protection material along the interface with the channel bed.

Providing resilience to scour within the pile design is likely to result in an overly conservative pile size due to uncertainty in estimating the scour depth. As such, design of scour protection is likely to be more reliable. The detailed design of any required scour protection will be undertaken after further GI information is obtained to inform decisions on the optimum scour protection arrangement. For the purposes of this assessment, it has been assumed that some form of scour protection will be required at localised locations at the toe of the new structure. This will be designed to maximise environmental enhancement opportunities (e.g. loose rip rap).

Bed preparation works

One of the main risks associated with the proposed piling works is encountering obstructions within the ground such as debris from the collapsed wall and boulders. To mitigate the risk of striking

obstructions during piling, it is likely to be necessary to remove the surficial layer of the bed. Due to the poor condition of the existing pier, any excavation in front of the pier may reduce its stability, and it is therefore suggested that any bed preparation works (dredging) are undertaken on a local basis and to a shallow depth (estimated to be 1.5 m).

Assuming, as a worst case, that bed preparation works are required along the entire length of the Inner West Pier structure, the dredge area will extend to approximately 1,200 m^2 and the volume to be dredged would be in the region of 1,800 m^3.

3.2 Project methodology

3.2.1 Site compounds

A laydown area has been identified on existing ABP land at Swansea Docks for the storage of construction materials during the construction phase ('eastern site compound' on Figure 1). In addition, welfare and management offices, tool shed and plant storage areas are required during the construction phase and this is proposed to be provided by the existing Marina Park car park to the west of the application site ('western site compound' on Figure 1).

3.2.2 Working hours

The standard working hours for dredging, pile installation and concrete capping activities will be from 07:00 to 19:00 Mondays to Fridays and 08:00 to 13:00 on Saturdays. There will be some support activities outside these hours (e.g. barge movements).

3.2.3 Plant and machinery

The installation of piles is likely to be carried out from a jack-up barge or similar marine plant with a crane and piling equipment (both vibro and percussive piling). The dredging will be undertaken using a backhoe dredger or similar marine plant, which will transfer material into a split hopper barge. Barges and vessels will be used to transfer piles from the laydown area at the eastern site compound to the application site.

3.2.4 Construction methodology

It is envisaged that the bed preparation works will be required in advance of piling and will involve backhoe dredging, with the arisings deposited at an offshore disposal ground via a split hopper barge. The hopper barge is likely to have a capacity between 300 m^3 and 1000 m^3, and therefore up to six loads to a disposal ground would be required, based on a worst-case dredge volume of 1,800 m^3. Subject to the agreement of NRW, it is proposed to dispose of the dredged material at the Swansea (Outer) licenced disposal ground (LU130).

The steel tubular piles will be driven to the required design level in the Coal Measures Formation layer. It is anticipated that this will be initially by a vibratory hammer to resistance and then percussively (impact) driven to the required depth. Two piling rigs may be used to allow piling operations to take place concurrently in order to accelerate the construction programme.

The steel sheet-piled 'infill panels' between the steel tubular piles will be installed to resistance (approximately 5 to 10 m below bed level) by pushing or driving under vibration.

After piles have been driven a concrete pilecap will be constructed, with concrete brought to the site by road and pumped over the existing pier to the line of the new retaining wall.

The holding pontoon and supporting steel piles adjacent to the Swansea Barrage will be temporarily removed during to the construction of the northern section of the new retaining wall.

The construction of the northern section of the new retaining wall will block the navigation channel and entrance to the Swansea Barrage. It will therefore be necessary to close the Swansea Barrage for a period of around 4 weeks whilst the piling works are being undertaken in this area.

3.2.5 Construction workforce

Peak workforce size is anticipated to be 40-50 personnel, with workers undertaking shifts of 07:00 to 19:00 during the weekday period (hence arriving and departing the site outside of standard network peak hours (08:00-09:00 and 17:00-18:00)) and 08:00 to 13:00 on Saturdays.

It is anticipated that workers will arrive at the eastern site compound within the hour before their shift starts and leave in the hour following the end of their shift. The peak hours for movement of construction workers during the weekday are therefore expected to be 06:00-07:00 and 19:00-20:00. On Saturdays, construction workers would travel to and from the site between 07:00-08:00 and 13:00-14:00.

3.2.6 Parking

Construction worker parking will be provided within the eastern site compound on ABP land at Swansea Docks, with workers able to walk to the application site using the footbridge at the entrance to the marina or transported to the application site via minibus.

3.2.7 Construction vehicles, routes and deliveries

Eastern site compound

A proportion of deliveries will take place to the eastern site compound on Swansea Docks, where they will be transported to the application site by barge, therefore reducing the number of Heavy Goods Vehicle (HGV) deliveries to the application site. Deliveries to the eastern compound are likely to arrive by rail or road. Vehicles travelling to the eastern site compound will use the A4067 Oystermouth Road and/or the A483 Fabian Way, which connects to the M4 to the west (Figure 3).

There is anticipated to be a maximum of 10-15 HGV deliveries per week to the eastern site compound at Swansea Docks, which is an average of approximately three HGV deliveries per day. Construction workers will also travel to / from the eastern site compound in cars or light vehicles with a maximum of 50 construction worker trips per day.

Assuming deliveries are spread throughout the 07:00-19:00 weekday period, but deliveries do not take place within the highway peaks of 08:00-09:00 and 17:00-18:00, a profile of delivery and construction worker trips is presented in Table 2 for the eastern site compound.

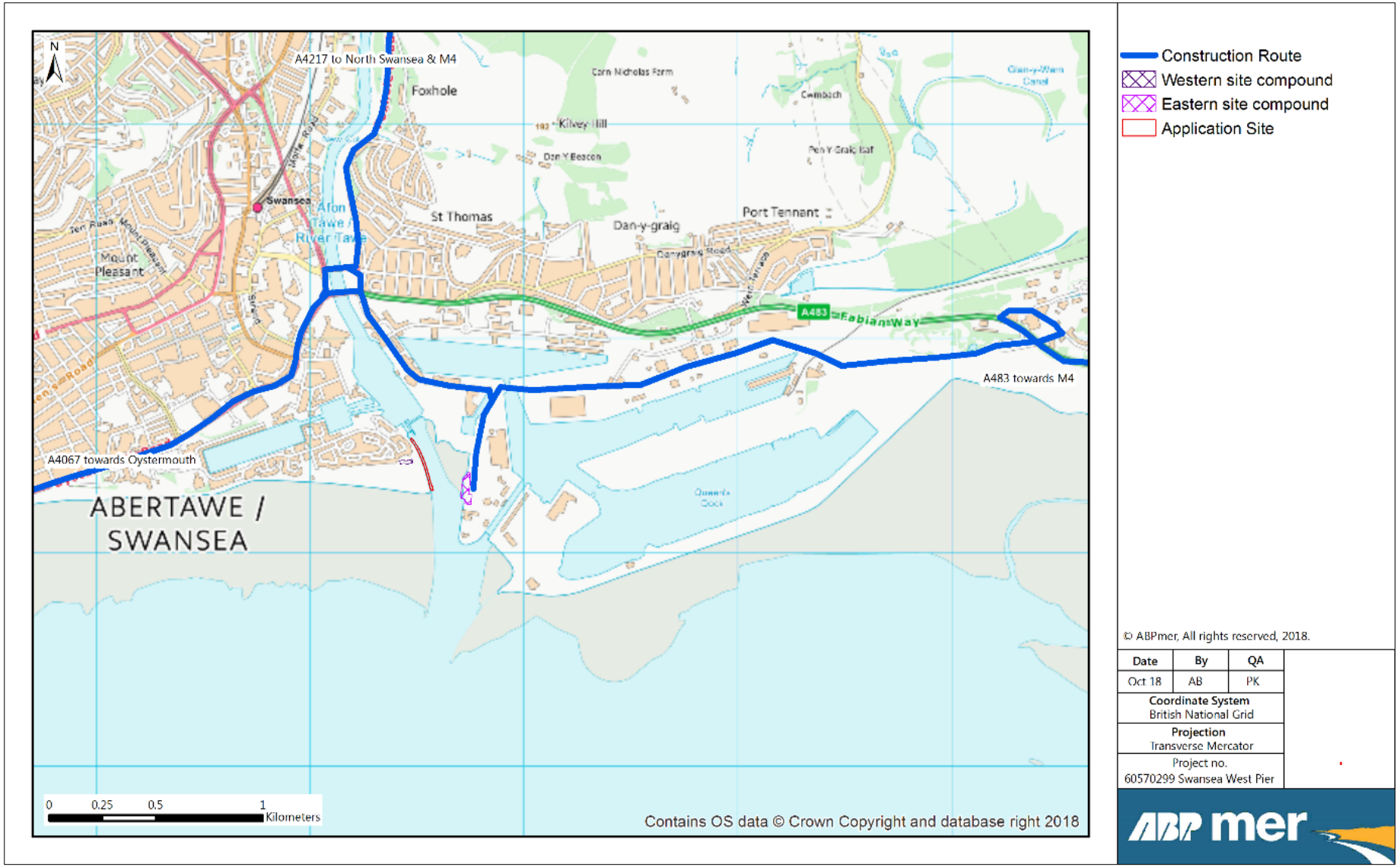

Figure 3. Construction routes to the Eastern site compound

Table 2. Construction trip profile – Eastern site compound

	Arrivals		Departures		Total	
Time	**HGV**	**Light (workers)**	**HGV**	**Light (workers)**	**HGV**	**Light (workers)**
06:00-07:00	0	50	0	0	0	50
07:00-08:00	0	0	0	0	0	0
08:00-09:00	0	0	0	0	0	0
09:00-10:00	1	0	1	0	2	0
10:00-11:00	0	0	0	0	0	0
11:00-12:00	0	0	0	0	0	0
12:00-13:00	1	0	1	0	2	0
13:00-14:00	0	0	0	0	0	0
14:00-15:00	0	0	0	0	0	0
15:00-16:00	1	0	1	0	2	0
16:00-17:00	0	0	0	0	0	0
17:00-18:00	0	0	0	0	0	0
18:00-19:00	0	0	0	0	0	0
19:00-20:00	0	0	0	50	0	50
Daily	**3**	**50**	**3**	**50**	**6**	**100**

Application site/ western site compound

Movements to and from the application site/western site compound are related to the delivery of equipment, plant and concrete. Overall, the construction of the Proposed Development will generate 63 daily arrivals and 63 daily departures, a total of 126 daily movements, of which 26 will be HGV movements. The majority of daily movements, 100 construction worker movements and six HGV movements will take place to and from the eastern site compound, with the remaining 20 daily HGV movements taking place to and from the western site compound / application site, which is equivalent to a maximum of two HGV movements per hour. Construction trip profiles are detailed further in Section 6.8.

Construction vehicles accessing the western site compound will use Dunvant Place, Trawler Road and the A4067 Oystermouth Road. The construction traffic routes to and from the western site compound are presented in Figure 4.

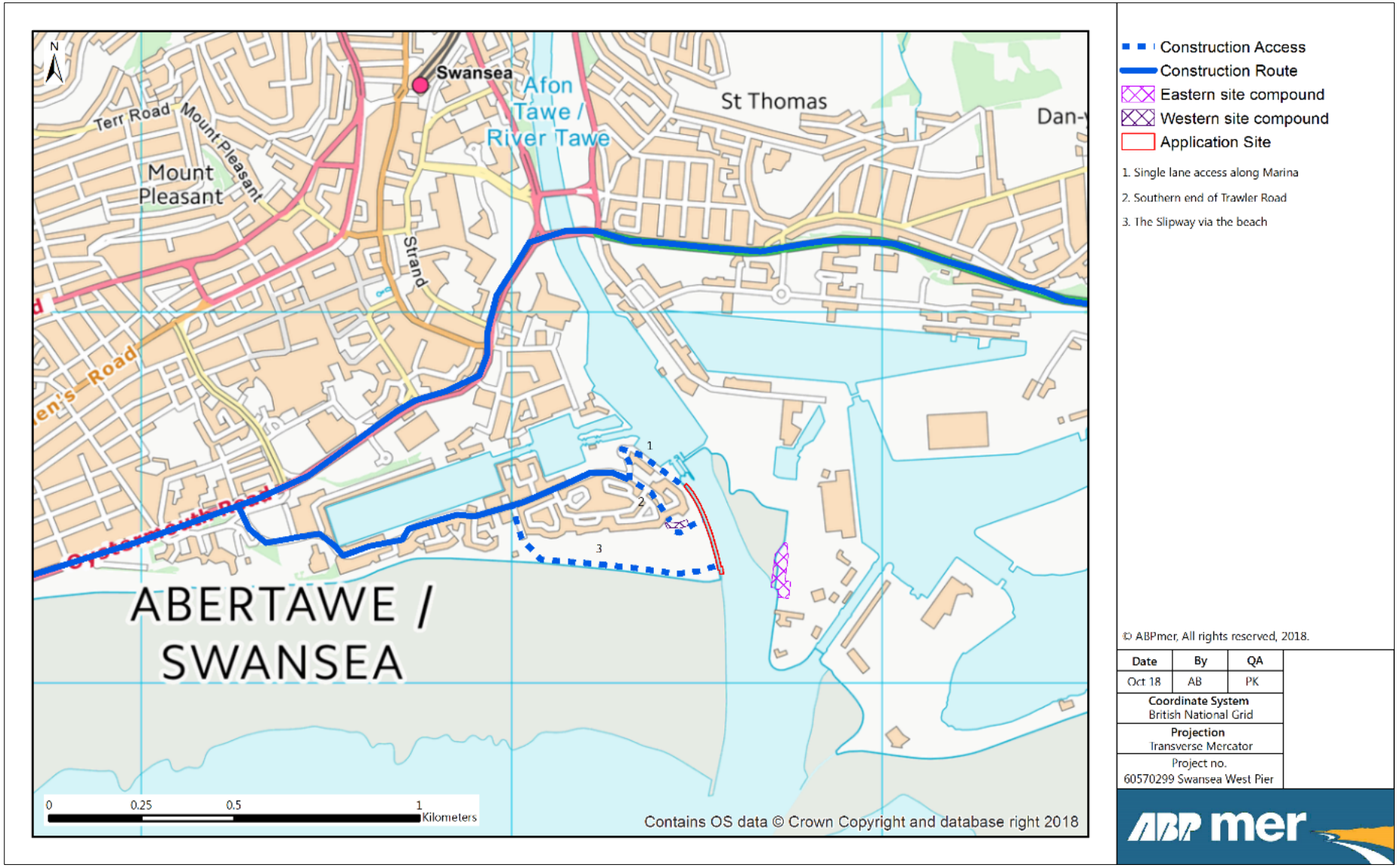

Figure 4. Construction routes to the Western site compound

Vehicular access to the application site/western site compound will be from one or a combination of the following three locations as follows:

- From the single lane access road alongside the marina which leads to the northern extent of the pier;
- From the southern end of Trawler Road; and
- From the Slipway via the beach in order to access the southern extent of the pier.

The delivery of concrete is expected to take place via the single lane access road alongside the marina.

3.3 Programme

The indicative timescales for the key stages of the Proposed Development are outlined below in Table 3. ABP regards the project as a matter of urgency and has set 2019 as the target date for commencement of construction. This would avoid the pier structure having to withstand a second winter period when the risk of further failure or collapse of the pier structure is greater.

Table 3 Indicative project programme

Stage of Development	Indicative Period	Duration
Surveys and investigations (including GI works)	May 2018 to May 2019	12 months
Environmental studies/ assessment	April to September 2018	6 months
Submission of consent applications	November 2018	1 month
Consultation and regulatory approval	December 2018 to March 2019	4 months
Discharging of consents	April to May 2019	2 months
Construction (including dredging)	June 2019 to April 2020	11 months

3.4 Best practice procedures and standard mitigation measures

Environmental management best practice will be implemented by contractors during construction. This will involve adherence to a number of guidelines, including the following:

- British Standard (Various) (BSI, 2015)[1] and Eurocodes (2015)[2];
- Construction, Design and Management (CDM) Regulations (2015)[3];
- Construction Industry Research and Information Association: Environmental Good Practice on Site Guidelines (CIRIA, 2010);
- Office of Government Commerce: Construction Excellence Guidelines (OGC, 2011)[4];
- All appropriate NRW guidelines, specifications and standard details;
- Guidance for Pollution Prevention (particularly GPP5 for works in or near water)[5];
- CIRIA guidance C745 for engineering works in the coastal and marine environment (CIRIA, 2016);
- BS 5228 – noise and vibration from construction activities (BSI, 2009); and
- SEPA Good Practice Guide on Engineering in the water environment (SEPA, n.d.).

1 https://www.bsigroup.com/en-GB/standards/british-standards-online-database/
2 https://eurocodes.jrc.ec.europa.eu/home.php#
3 http://www.legislation.gov.uk/uksi/2015/51/contents/made
4 https://www.designingbuildings.co.uk/wiki/Achieving_Excellence
5 http://www.netregs.org.uk/environmental-topics/pollution-prevention-guidelines-ppgs-and-replacement-series/guidance-for-pollution-prevention-gpps-full-list/

Adherence to environmental management best practice will be controlled through a Construction Management Plan (CMP) in accordance to guidance (IEMA, 2016). The CMP will be provided to NRW prior to works commencing following detailed design of the Proposed Development and will set out the mitigation needed to manage environmental effects (see Section 4.4.8). The CMP will be a live document that will be updated as new information or details emerge of how mitigation will be achieved.

3.5 References

BSI (2009). BS 5228-1:2009 – Code of practice for noise and vibration control on construction and open sites – Part 1: Noise. [Online] Available at: http://www.barbicanliving.co.uk/wp-content/uploads/2016/04/BS-5228-Part-1-Noise.pdf (accessed 11 October 2018)

CIRIA (2016). Coastal and marine environmental pocket book (second edition) (C745).

CIRIA (2010). Environmental good practice on site (third edition) [Online] Available at: https://warwick.ac.uk/fac/sci/eng/eso/modules/year4/es94y/c692_environmental_good_practice_on_site_3rd_edition.pdf (accessed 11 October 2018)

IEMA (2016). The EIA Guide To: Delivering Quality Development. Available at: https://www.iema.net/assets/newbuild/documents/Delivering%20Quality%20Development.pdf (accessed 03/07/2018)

SEPA (n.d.). Engineering guidance [Online] Available at: https://www.sepa.org.uk/regulations/water/engineering/engineering-guidance/ (Accessed 11 October 2018)

4 Consents and Approvals

4.1 Introduction

The Proposed Development requires a range of consents and approvals under different enabling and authorising legislative provisions, supported by detailed technical and environmental investigations. The principal consents/approvals and studies that are required are summarised in the following sections.

4.2 Welsh Ministers consent

ABP has a general power to maintain Swansea West Pier under the Swansea Harbour Act 1864. Section 36 of the 1864 Act allows ABP to enter land adjoining the pier and do "*such works as may be necessary*" to repair and renew it, and carry out the necessary works within the limits of deviation. Under the 1864 Act, before exercising this power, the Trustees (now ABP) would have had to obtain the approval of the Board of Trade. Under the provisions of the Wales Act this power has devolved to Welsh Ministers[6]. As a consequence, approval is sought from Welsh Ministers for the following:

- Approval of works plans under the 1864 Act (Section 26);
- Approval of works below the high water mark and works in tidal or navigable water (Section 27); and
- Alteration of a tidal works (Section 12 of the Harbours, Docks and Piers Clause Act 1847).

4.3 Land ownership

ABP is the freehold owner and operator of Swansea West Pier (Figure 5). The inner pier structure ties into a wall owned by the Swansea City Council (SCC) adjacent to the Swansea Barrage. Figure 6 shows the land registry ownership areas. The Proposed Development will take place on land owned by the Council and it is noted that Section 36 of the 1864 Act grants powers of access to the port undertaker across adjacent land for the purposes of undertaking "*such works as may be necessary*" for maintenance and repair. Repairs to the existing surface of the pier and adjacent land will be undertaken as a separate project to the Proposed Development (see Section 4.6).

[6] Under the Wales Act, from 1 April 2018 responsibility for port development policy for harbours wholly in Wales apart from major trust ports will be transferred from the Department for Transport (DfT) and the Marine Management Organisation (MMO) to Welsh Ministers. This responsibility extends to applications for Harbour Revision and Empowerment Orders, private act ('Admiralty') consents, applications for powers to make harbour directions and confirmation of byelaws.

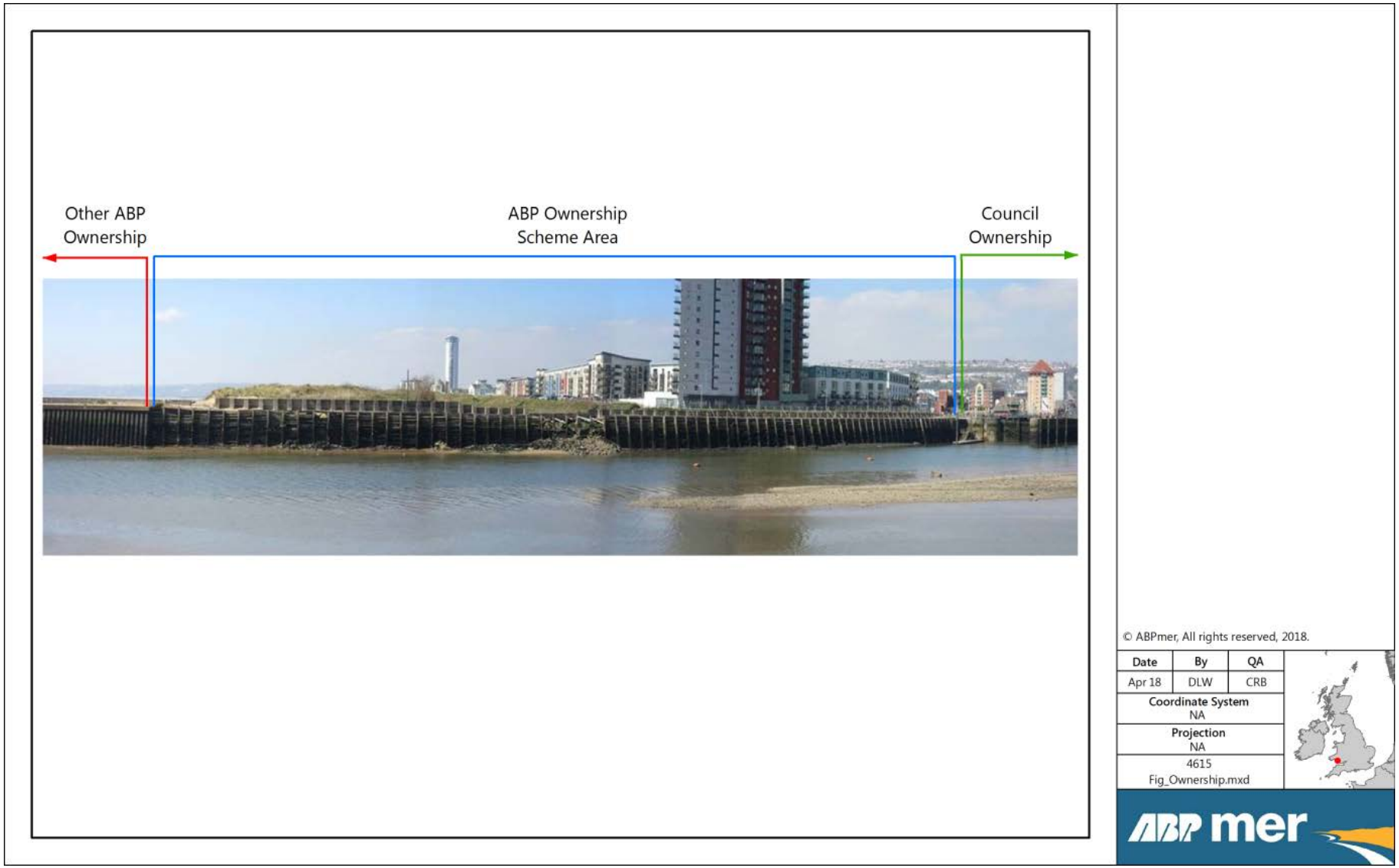

Figure 5. Ownership of Swansea West Pier

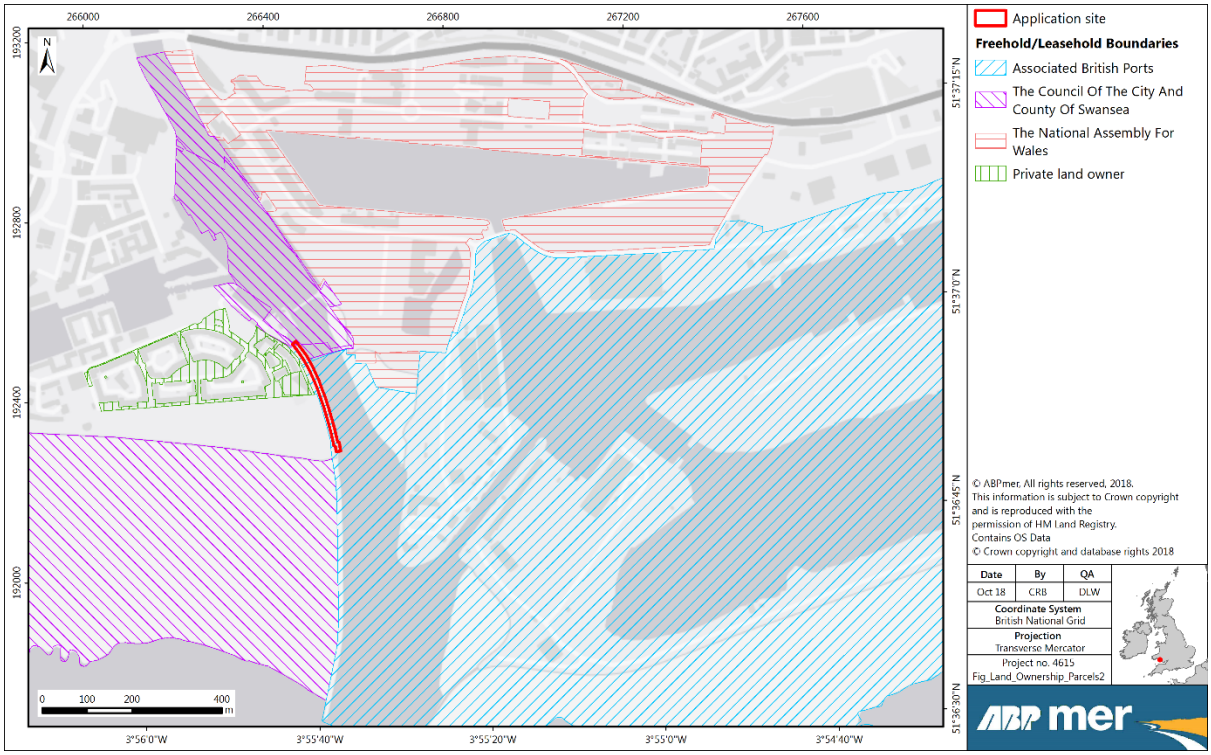

Figure 6. Land ownership information

4.4 Marine licence and marine planning

The current process of marine licencing under the Marine and Coastal Access Act 2009 came into force on 6 April 2011. This process requires anybody wishing to undertake works below mean high water springs (MHWS), including removals and deposits at sea, to obtain a marine licence from NRW. The Proposed Development therefore requires a marine licence. The licence will cover those works that impact upon the marine environment, namely the installation of piles, and any required scour protection, bed preparation and disposal of dredge arisings.

It is anticipated that in considering the marine licence application, NRW will take into account Government policy statements and guidance.

In the context of the Proposed Development, the principles of sustainable development have been taken into account, namely:

- Achieving a sustainable marine economy;
- Ensuring a strong, healthy and just society;
- Living within environmental limits;
- Promoting good governance; and
- Using sound science responsibly.

The UK Marine Policy Statement (Her Majesty's (HM) Government, 2011), which is now in force, contributes to the achievement of sustainable development in the UK marine area. Prepared under Section 44 of the Marine and Coastal Access Act 2009, it provides the framework for the preparation of Marine Plans and informing decisions affecting the marine environment. It ensures that marine resources are used in a sustainable way in line with marine objectives thereby:

- Promoting sustainable economic development;

- Enabling the UK's move towards a low-carbon economy, in order to mitigate the causes of climate change and ocean acidification and adapt to their effects;
- Ensuring a sustainable marine environment which promotes healthy, functioning marine ecosystems and protects marine habitats, species and our heritage assets; and
- Contributing to the societal benefits of the marine area, including the sustainable use of marine resources to address local social and economic issues.

The Welsh National Marine Plan is currently being developed by Welsh Government, and a draft has undergone consultation. This Plan, when adopted, will support sustainable decision-making; support a vision for clean, healthy, safe and biologically diverse seas; and integrate Welsh policy with the rest of the UK (aided by the UK Marine Policy Statement).

4.4.1 Consenting documentation

In addition to the above, advice from NRW has also been sought on the following:

- Environmental Impact Assessment (EIA);
- Habitats Regulation Assessment (HRA);
- Water Framework Directive (WFD) Assessment;
- Navigational Risk Assessment (NRA);
- Flood Risk Activity Permit (FRAP); and
- Construction Management Plan (CMP).

The following sections summarise each of the above and summarises their requirement to support the marine licence application for the Proposed Development.

4.4.2 Environmental Impact Assessment

A Screening and Scoping Report (ABPmer, 2018) was submitted to NRW on 2 May 2018 in accordance with The Marine Works (EIA) Regulations 2007 (as amended) with a view:

i. To seek a screening opinion as to whether or not the Proposed Development constitutes development which requires a formal EIA; and if it is determined that EIA is required: -
ii. To request a scoping opinion, as to the information to be provided in the required Environmental Statement (ES).

A screening opinion was received from NRW on the 25 July 2018 which determined, based on the information provided and views of the consultation bodies, that the Proposed Development does not require a statutory EIA as it is unlikely to have any significant adverse impacts on the environment. An Environmental Appraisal (this report) has therefore been prepared to document the required environmental information in support of the marine licence application.

NRW provided specific advice on further environmental work that would need to be undertaken within the Environmental Appraisal. A number of other stakeholders were also consulted, including SCC and the public, which further informed the scope of the Environmental Appraisal. A consultation log is provided in Appendix B, and this feedback is summarised in Section 5.

4.4.3 Habitats Regulations Assessment

There are no internationally designated sites in the immediate vicinity of the Proposed Development or Swansea (Outer) licenced disposal ground (LU130). However, it is considered that the works

required for the Proposed Development trigger the requirement for a Habitats Regulations Appraisal (HRA) given the potential for disturbance impacts on mobile interest features during construction.

The legal process that needs to be followed for an HRA is very clearly laid out. In simple terms, it was pursued in two key stages. First, this involved determining whether there was a Likely Significant Effect (LSE) on any designated sites.

As noted, in the context of the Proposed Development, it is considered likely that that there is potential for LSE and as a consequence, the second phase, an Appropriate Assessment, is required. In accordance with the latest available guidance for undertaking HRAs, information is provided to enable the competent authority (in this case NRW) to undertake an Appropriate Assessment, assessing the effects of the development on the features for which the sites are designated. This is provided as a technical appendix (Appendix C) to the Environmental Appraisal.

4.4.4 Water Framework Directive

The Water Framework Directive (WFD) (2000/60/EEC) establishes a framework for the management and protection of Europe's water resources. It is implemented in England and Wales through the Water Environment (Water Framework Directive) (England and Wales) Regulations 2003 (as amended), known as the Water Framework Regulations. The overall objectives of the WFD as implemented by the Water Framework Regulations is to achieve "good ecological and good chemical status" in all inland and coastal waters by 2015 (now working towards revised objectives for 2021) unless alternative objectives are set or there are grounds for time limited derogation. For example, where pressures preclude the achievement of good status (e.g. navigation, coastal defence) in heavily modified water bodies (HMWBs), the WFD provides that an alternative objective of "good ecological potential" is set. Groundwater waterbodies are included in the WFD and are assessed on quantitative and chemical status. There is also a general "no deterioration" provision to prevent decline in status.

To support the marine licence application, a WFD Compliance Assessment has been prepared to determine whether the Proposed Development complies with the objectives of the WFD. This was undertaken in two stages; firstly, the potential for the works to cause a 'deterioration' or failure of the water body to meet its WFD objectives was reviewed in a WFD screening and scoping exercise. It was considered that the works have the potential to cause a 'deterioration' or failure of the water body to meet its WFD objectives, and further detailed assessment was undertaken. This considered the potential implications of the Proposed Development on the achievement of 'good' status within adjacent WFD water bodies. This information is provided as a technical appendix to the Environmental Appraisal (Appendix D) following the format specified in the latest 'Clearing the Waters for All' guidance by the Environment Agency, and NRW internal guidance "OGN72: Guidance for assessing activities and projects for compliance with the WFD".

4.4.5 Navigational Risk Assessment

In addition, a Navigational Risk Assessment (NRA) is required in support of the marine licence application. Navigational risk requires consideration by the Harbour Authority in its role as the Statutory Harbour Authority (SHA). To carry out this assessment, a specific NRA is required in support of the proposed scheme. It was not envisaged that public consultation in the form of a Hazard Observation Workshop is needed for this scheme, given the type and scale of the works. However, consideration is given to local interested parties (e.g. marina owners and/or users). The specific requirements of the assessment have been agreed with the Maritime and Coastguard Agency (MCA) and Trinity House (where aids to navigation are involved). The NRA is included in Appendix E.

4.4.6 Flood risk activity permit

Flood risk activities are now regulated under environmental permits (previously flood defence consents) under the Environmental Permitting (England and Wales) Regulations 2016. Flood risk activity permits are required for works in, over, under or near a main river or flood defence (including a sea defence), or within a flood plain. This is to ensure activities do not cause a risk of flooding, make existing flood risk worse, or interfere with flood risk management assets.

Exclusions for a flood risk activity permit include circumstances when an application has been made for a marine licence. NRW has confirmed that the Proposed Development is excluded from requiring a flood risk activity permit and the requirements of an environmental permit for a flood risk activity will be fulfilled by the marine licence. NRW will provide comments on flood risk matters as part of the marine licence application and relevant conditions will be included in the marine licence where appropriate.

4.4.7 Protected species

Various species of animal are protected from being killed, injured or disturbed under provisions in the Habitats Regulations and Section 9(4) and Schedule 5 of the Wildlife and Countryside Act 1981 (as amended). These include cetaceans, turtles, basking sharks, otters and bats. In particular, Regulation 43 of the Habitats Regulations makes it an offence to deliberately disturb wild animals of any such species (i.e. European Protected Species) in such a way as to be of likely significance:

- To impair their ability:
  - To survive, to breed or reproduce, or to rear or nurture their young; or
  - In the case of animals of a hibernating or migratory species, to hibernate or migrate; or
- To affect significantly the local distribution or abundance of the species to which they belong.

Section 9(4) of the Wildlife and Countryside Act 1981 (as amended) makes it an offence to intentionally or recklessly disturb dolphins, whales or basking sharks subject to a defence that the act was the incidental result of a lawful operation and could not reasonably have been avoided. Natural England and Countryside Council for Wales (CCW, predecessor to NRW) produced detailed guidance on the application of these provisions in 2007.

NRW, in their EIA screening opinion, has not requested any protected species licences and has advised that the works as currently proposed are not likely to have a significant effect on any European Protected Species.

SCC has advised that a Species Protection Plan should be prepared with details of the potential impacts of the Proposed Development specifically on otters and bats, and any proposed mitigation measures to avoid and/or minimise these impacts. This Species Protection Plan is included in Appendix F.

4.4.8 Construction management plan

A CMP will be provided to NRW following the submission of the marine licence application and prior to works commencing. This plan will present the final design of the Proposed Development and include a detailed construction methodology. The potential impact of the Proposed Development on any sensitive receptors identified in this Environmental Appraisal will be taken fully into account in the CMP. Environmental management best practice (see Section 3.4) will be set out in accordance with all relevant guidance and any associated legislation.

4.5 Well-being and Future Generations (Wales) Act

The Well-being of Future Generations (Wales) Act became law in April 2015 and is concerned with improving the social, economic, environmental and cultural well-being of Wales. It requires public bodies to consider the long-term issues, work better with people and communities and each other, look to prevent problems and take a more joined-up approach. To help public bodies achieve the same vision, the Act puts in place seven well-being goals. Linked to the goals, a set of National Indicators are currently under development to help measure whether the goals are achieved.

Opportunities of incorporating some integrated green grey infrastructure (Naylor *et al.*, 2017) into the detailed design of the Proposed Development are being explored in collaboration with NRW and the University of Swansea. These include installing 'artificial pools' and/or 'vertical sea gardens' on the steel sheet infill piles between the tubular piles. These would comprise a variety of materials with different properties and shapes so that they can be colonised by intertidal species. There is also potential for the placement of variable and diverse objects at the toe of the new retaining wall to attract colonisation and enhance biodiversity. These potential enhancement measures would help meet the Resilient Wales goal of the Well-being of Future Generations (Wales) Act "*to maintain and enhance a biodiverse natural environment with healthy functioning ecosystems that support social, economic and ecological resilience and the capacity to adapt to change*".

4.6 Permitted development for landside works

Any future repairs to the surface of the pier and adjacent land will be pursued as a separate project to the Proposed Development. These landside works would be entirely within the 'limits of deviation' on the Swansea Harbour Act 1864 as defined by the statutory plans. As noted above, the pier is located adjacent to SCC land. If any landside works were to involve work on SCC land, they would be carried out under the provisions of Part 11 of The Town and Country Planning (General Permitted Development) Order 1995. This would require SCC's prior approval of any plans and specifications. Should the landside works fall entirely within ABP owned land, they would be carried out under the provisions of Part 17 of The Town and Country Planning (General Permitted Development) Order 1995.

Discussions are currently ongoing with SCC and Welsh Government to determine potential opportunities for enhancing the access and amenity of the area for the local and wider community as part of the landside works. Linking with the strategic vision or regeneration aspirations of the area and any available funding streams for these enhancements are also being explored.

4.7 References

ABPmer (2018). Swansea Inner West Pier Works, Screening and Scoping Report, ABPmer Report No. R.2985. A report produced by ABPmer for ABP, May 2018.

HM Government (2011). UK Marine Policy Statement [Online] Available at: https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/69322/pb3654-marine-policy-statement-110316.pdf (accessed June 2018).

Naylor, L. A., Kippen, H., Coombes, M. A., Horton, B., MacArthur, M. and Jackson, N. (2017). Greening the Grey: A Framework for Integrated Green Grey Infrastructure (IGGI). Technical Report. University of Glasgow, Glasgow.

5 Impact Assessment Approach

5.1 Impact Assessment Scope

5.1.1 Screening and consultation

NRW, in their screening opinion, has advised that the Proposed Development does not require a statutory EIA. The screening opinion provided advice from NRW and statutory consultees on further environmental assessment work that is required to inform the marine licence application. Comments were also received separately from SCC on ecology and environmental health issues. A summary of the comments received to date from statutory consultees is included in Table 4. The full set of detailed comments is presented Appendix B.

Table 4. Summary of key consultee comments and actions undertaken in Environmental Appraisal

Consultee	Topic	Comment	Action	Section(s) in Environmental Appraisal
NRW	Water Framework Directive	Release of contaminants from suspended sediments could lead to a deterioration of WFD status, and if elevated levels of contaminants are found, there may be a requirement to determine fate of sediment.	This impact pathway has been scoped into the Environmental Appraisal, which has involved a review of the fate of sediment-bound contamination. A WFD assessment has also been undertaken.	Section 6.1 and Appendix D
	Invasive non-native species	Invasive species assessment to be undertaken for marine craft and floating pontoons.	This impact pathway has been scoped into the Environmental Appraisal.	Section 6.2
	Marine mammals	Use relevant Marine Mammal Management Unit to assess potential impacts, and potential impacts and mitigation must be sufficiently explored.	Potential impacts on marine mammals have been considered at the scale of Marine Mammal Management Units. Appropriate mitigation has been identified to minimise and/or avoid significant adverse effects.	Section 6.2
	Migratory fish	Sensitive spawning seasons for relevant fish receptors should be considered, and the requirement for mitigation if they coincide with piling. Qualifying features of Carmarthen Bay and Estuaries SAC should be considered. Effects of acoustic barriers should be recognised.	A baseline review of sensitive spawning seasons and qualifying fish interest features of Carmarthen Bay and Estuaries SAC has been undertaken. The potential effect of underwater noise on fish has been scoped into the Environmental Appraisal. Detailed underwater noise modelling has been undertaken to inform the assessment and requirement for mitigation.	Section 6.2 and Appendix G
	Water quality	Changes in water quality should be considered for marine receptors.	The release of contaminants from suspended sediments has been scoped into the Environmental Assessment. The implications to both water quality and marine ecology receptors have been determined.	Sections 6.1 and 6.2
	Additional comments	Possibility of incorporating some integrated green grey infrastructure within the engineering design.	This is currently being investigated and will continue to be explored subject to funding.	Section 6.2.4
NRW / MCA	Navigation	NRA must incorporate risks and mitigation not covered by observance of existing harbour procedures, and the CEMP must incorporate required communication and marking protocols. Port Marine Safety Code (PMSC) and Guide to Good Practice to be considered in NRA.	An NRA has been undertaken in accordance with available guidance. Appropriate mitigation measures have been identified and will be incorporated in a CMP.	Section 6.4 and Appendix E
NRW / Glamorgan Gwent Archaeological Trust	Archaeology	No further assessment required.	This topic has been scoped out of the Environmental Appraisal.	N/A
SCC	Rare plants	Section 7 species should be considered.	A baseline review of Section 7 species has been undertaken.	Section 6.3
	Invasive non-native species	New Zealand flax *Phormium* sp. should be included in the Biosecurity Plan.	The potential spread of this invasive non-native species has been scoped into the Environmental Appraisal. A Biosecurity Plan will be produced.	Section 6.3

Consultee	Topic	Comment	Action	Section(s) in Environmental Appraisal
	Otter	Otter are present in vicinity of Proposed Development and should be considered.	A baseline review of otter has been undertaken. The potential impact pathways relevant to otter have been identified and assessed.	Section 6.3
	Bats	Bats should be included in impact assessments regarding lighting and construction noise, and mitigation measures should be detailed in CEMP.	The potential impact pathways relevant to bats have been identified and assessed. Appropriate mitigation measures have been identified and will be included in a CMP.	Section 6.3 and Appendix F
	Marine mammals and fish	CEMP should include mitigation for impacts from underwater noise during construction. Local scientific papers should be consulted for species distribution.	A baseline review of marine mammals and fish have been undertaken which has involved reviewing publicly available scientific papers. Appropriate mitigation measures have been identified and will be included in a CMP.	Sections 6.2
	Birds	Assessment of possible impacts on birds using development site should be undertaken.	This impact pathway has been scoped into the Environmental Appraisal.	Section 6.2
	Intertidal ecology	Phase 1 Habitat Survey should be undertaken.	A Phase 1 intertidal habitat survey has been undertaken to inform the baseline review and assessment.	Section 6.2
	European Protected Species	Species protection plan should be prepared, with mitigation measures and description of residual impacts. Mitigation measures should be included in CEMP.	A Species Protection Plan has been prepared which details mitigation measures to ensure any potential disturbance impacts on bats and otters during construction are minimised. These will be included in a CMP.	Section 6.3 and Appendix F
	Local biodiversity records	SEWBReC Aderyn system should be used in assessment to identify flora and fauna in vicinity of Proposed Development.	This resource has been used to inform baseline review.	Section 6.3
	Noise	Restrict working hours to 08:00-18:00 Mon-Fri and 08:00-13:00 Saturday unless specific reasons why works are required outside of these hours. The CEMP should detail construction works, noise levels of construction plant, method statements, anticipated noise monitoring positions, and predicted noise and vibration levels.	Piling will need to be restricted to the autumn/winter to avoid significant adverse effects on migratory fish (see Section 6.2.4). Working hours of 07:00-19:00 during the weekday period are therefore proposed to ensure that the works can be undertaken over a single construction period and avoid the need to re-mobilise the marine works a second year which would extend the overall construction programme and increase the risk of further pier collapse in the interim. These longer working hours also avoid personnel arriving at site during the standard network peak hours. An airborne noise and vibration assessment has been undertaken on this basis. A CMP will be produced which will incorporate further detail of information that has been requested.	Section 6.6

In order to engage with the public, a website[7] has been created which provides an overview of the Proposed Development, the work undertaken so far, and access to reports that have been produced. It also provides a means of contacting the project team if there are any concerns or comments, as well as advertising any stakeholder events. The only comments received to date via the website have been consultees registering an interest in attending the stakeholder workshop event or requesting to be kept updated on progress with the Proposed Development.

A stakeholder workshop event was held on the 26 September 2018 at ABP Swansea Harbour Office. It offered a drop-in session where attendees could find out more about the Proposed Development and discuss any concerns. The event attracted a small number of local residents and members of the Maritime Quarter Residents Association, representatives from SCC, and local business owners. A feedback form was provided at the event, and a summary of the responses received is provided in Table 5.

Table 5. Summary of feedback from stakeholder workshop event

Stakeholder type	Reason for attending	Expectations met? / General feedback	Specific Comments
Resident	To see current ideas being considered and understand timescales.	Yes.	Vital that both the marine works (Proposed Development) and landside works are delivered to ensure a better environment for local residents. Full engagement with the Maritime Quarter Residents Association would benefit all – good cooperation to date.
	As a concerned resident.	Good to have an overview of problems with the West Pier. Timetable of the project is reasonable – sincerely hope this is achieved.	I will contact councillors, Assembly Member and Member of Parliament, to lobby for funds for improvement to the project.
	Significant interest as resident and asked by Residents Association to liaise with ABP regarding repairs to storm damaged wooden pilings.	An interesting account of what has been achieved, what is due to happen and to illustrate expectations.	Construction period seems optimistic, allowing for Swansea weather and tides. If works are completed on time it will be good. To date, good relations developed with ABP.
Local business owner	To discover what is happening to the West Pier in the future.	Yes – more informed, and it appears an exciting and beneficial project.	The more that can be done to link the area to the marina and the university, the more people can come along and enjoy the city.

A Hazard Identification (HAZID) workshop with port stakeholders at the Port of Swansea was also held on the 6 September 2018. The workshop was run to identify and raise known and potential hazards relating to the Proposed Development. A summary of this can be found in Appendix E.

Following the HAZID workshop, follow up contact has been made to concerned individuals. It was highlighted that vibration during piling works could interact with the utilities tunnel that runs below Swansea Barrage. This potential impact and appropriate mitigation measures are considered further in Section 6.6. Concerns were also raised regarding the closure of the Tawe Lock whilst the northern end of the new retaining wall is being constructed, as this may have implications on a number of

[7] https://www.swanseawestpier.co.uk/

users, namely commercial fishermen and recreational users. This potential impact is considered further in Section 6.4.

5.1.2 Final scope of Environmental Appraisal

In line with the Screening and Scoping Report (ABPmer, 2018) and comments that have been received since (Section 5.1.1), the following topics have been assessed in this Environmental Appraisal:

- Water and Sediment Quality (Section 6.1);
- Marine Ecology (Section 6.2);
- Terrestrial Ecology (Section 6.3);
- Commercial and Recreational Navigation (Section 6.4);
- Coastal and Flood Protection (Section 6.5);
- Airborne Noise and Vibration (Section 6.6);
- Landscape/Seascape and Visual (Section 6.7); and
- Transport and Access (Section 6.8);

Further details of the full scope of the further assessment work that has been undertaken for each topic are provided at the beginning of each specific topic section (Section 6).

Five topics have not been specifically assessed in this Environmental Appraisal. The rationale for not undertaking further assessment is presented in detail in the Screening and Scoping Report and summarised in Table 6.

Table 6. Topics that have not been assessed in this Environmental Appraisal

Receptor	Rationale
Physical processes	Changes in tidal levels, flow regime, wave climate, bed level and sediment disturbance during both the construction and operation of the Proposed Development are negligible in terms of physical processes and are not considered to require any further assessment work. The potential implications of changes to other receptors, namely water quality and marine ecology, are considered in Sections 6.1 and 6.2.
Cultural heritage	A number of previous detailed assessments undertaken by Glamorgan-Gwent Archaeological Trust cover the archaeological and historical background and potential of the Proposed Development and study area. The Proposed Development is considered to have limited potential to damage unknown archaeological remains or change the cultural setting of designated heritage assets. No further assessment work on this topic is therefore considered necessary.
Infrastructure and other marine users	The Proposed Development is unlikely to interfere with infrastructure or other marine users during both construction and operation. A surface water outfall that runs through the existing Inner West Pier structure will be incorporated into the final design of the Proposed Development. Potential interference with commercial and recreational navigation is considered within Section 6.4. This topic is therefore not considered to require further assessment.
Human health	Disturbance to residents and visitors during construction will be considered further as part of the airborne noise and vibration topic (Section 6.6) and the landscape/ seascape and visual topic (Section 6.7). Control of dust emissions during construction have been considered in the transport and access assessment (Section 6.8). Beneficial effects will result during the operation of the Proposed Development and these have been assessed in the coastal and flood protection assessment (Section 6.5) and the landscape/seascape and visual assessment (Section 6.7).
Air quality and greenhouse gas emissions	Any potential changes in air quality will be controlled by the adoption of established construction mitigation practices (Section 3.4). These measures will adhere to best practice guidance and will be included in a CMP (see Section 4.4.8). A greenhouse gas (GHG) emission assessment is not considered necessary given the scale and nature of the Proposed Development and that there are few alternatives to the construction materials that are proposed to be used. Measures to minimise GHG emissions where possible will be included in the CMP. Overall, therefore, this topic is not considered to require further assessment.

5.2 Impact Assessment Methodology

Although the Proposed Development is deemed by NRW to not require a statutory EIA, to facilitate the impact assessment process and ensure a robust assessment is undertaken, a standardised methodology consistent with the requirements of EIA has been applied.

This methodology has been developed from a range of sources, including the Town and Country Planning (EIA) Regulations 2017 (as amended), Marine Works (EIA) Regulations 2007 (as amended), the new EIA Directive (2014/52/EU), statutory guidance, consultations and ABPmer's previous (extensive) EIA project experience. The Environmental Appraisal has furthermore been undertaken following the principles of the Charted Institute of Ecology and Environmental Management's (CIEEM) latest guidelines for ecological impact assessment in the UK and Ireland (which consolidate advice for terrestrial, freshwater and coastal environments) (CIEEM, 2018). These updated guidelines combine the Guidelines for Ecological Impact Assessment in the UK and Ireland: Terrestrial, Freshwater and Coastal, 2nd edition (CIEEM, 2016) and the Guidelines for Ecological Impact Assessment in Britain and Ireland: Marine and Coastal (IEEM, 2010), with the aim to promote good practice by ecologists, encourage a scientifically rigorous and transparent approach and create a common framework for ecological impact assessment (EcIA).

It should be noted that certain environmental topics have a specific impact assessment methodology following recognised best-practice procedures. In these instances, topic-specific methodologies have been applied and described in the relevant assessment sections. These specifically relate to coastal and flood protection (Section 6.5); airborne noise and vibration (Section 6.6); and landscape, seascape and visual (Section 6.7).

The Transboundary Regulation 17 of the Marine Works (EIA) (amendment) Regulations 2017 has not been considered in the impact assessment due to the predicted localised effects of the Proposed Development and the large distance between the study area and the nearest Member State.

The Environmental Appraisal considers the impacts from the entire proposed activity, covering the whole scope of the Proposed Development. Under each topic, the environmental issues are divided into distinct 'receiving environments' or 'receptors'. The effect of the proposed activity on each of these is assessed by describing in turn: the baseline environmental conditions of each receiving environment; the 'impact pathways' by which the receptors could be affected; the significance of the impacts occurring; and the measures to mitigate for significant adverse impacts where these are predicted.

This Impact Assessment Framework, which is presented in the following sections, is designed to incorporate the key criteria and considerations without being overly prescriptive.

5.2.1 Stage 1 – Identify Receptors and Changes

The first stage identifies the potential environmental changes resulting from the proposed activity and the features of interest (receptors) that are likely to be affected (which are together referred to as the impact pathway). This aspect of the assessment has been developed in consultation with key statutory and non-statutory authorities.

The impact pathways which are considered relevant to this Environmental Appraisal are set out at the beginning of each specific topic section (Section 6).

5.2.2 Stage 2 – Understand Change and Sensitivity

The second stage involves understanding the nature of the environmental changes to provide a benchmark against which the changes and levels of exposure can be compared. The scale of the impacts via the impact pathways depends upon a range of factors, including the following:

- Magnitude (local/strategic):
- Spatial extent (small/large scale);
- Duration (temporary/short/intermediate/long-term);
- Frequency (routine/intermittent/occasional/rare);
- Reversibility;
- Probability of occurrence;
- Confidence, or certainty, in the impact prediction;
- The margins by which set values are exceeded (e.g. water quality standards);
- The importance of the receptor (e.g. designated habitats and protected species);
- The sensitivity of the receptor (resistance/adaptability/recoverability);
- The baseline conditions of the system; and
- Existing long-term trends and natural variability.

5.2.3 Stage 3 – Impact Assessment

The likelihood of a feature being vulnerable to an impact pathway is then evaluated as a basis for assessing the level of the impact and its significance.

The key significance levels for either beneficial or adverse impacts are described as follows:

1. Insignificant: Insignificant change not having a discernible effect;
2. Minor: Effects tending to be discernible but tolerable;
3. Moderate: Where these changes are adverse they may require mitigation; and
4. Major: Effects are highest in magnitude and reflect the high vulnerability and importance of a receptor (e.g. to nature conservation). Where these changes are adverse they will require mitigation.

Impact assessment guidance tables

The matrices in Tables 7 to 9 have been used to help assess significance (see below).

Table 7 was used as a means of generating an estimate of exposure. Magnitude of change needs to be considered in spatial and temporal terms (including duration, frequency and seasonality), and against the background environmental conditions in a study area. Once a magnitude has been assessed, this should be combined with the probability of occurrence to arrive at an exposure score which can then be used for the next step of the assessment, which is detailed in Table 7. For example, an impact pathway with a medium magnitude of change and a high probability of occurrence would result in a medium exposure to change.

Table 7. Exposure to change, combining magnitude and probability of change

Probability of Occurrence	Magnitude of Change			
	Large	Medium	Small	Negligible
High	High	Medium	Low	Negligible
Medium	Medium	Medium/Low	Low /Negligible	Negligible
Low	Low	Low /Negligible	Negligible	Negligible
Negligible	Negligible	Negligible	Negligible	Negligible

Table 8 was then used to score the vulnerability of the features of interest based on the sensitivity of those features and their exposure to a given change. Where the exposure and sensitivity characteristics overlap then vulnerability exists, and an adverse effect may occur. For example, if the impact pathway previously assessed with a medium exposure to change acted on a receptor which had a high sensitivity, this would result in an assessment of high vulnerability. Sensitivity can be described as the intolerance of a habitat, community or individual of a species to an environmental change and essentially considers the response characteristic of the feature. Thus, if a single or combination of environmental changes is likely to elicit a response then the feature under assessment can be considered to be sensitive. Where an exposure or change occurs for which the receptor is not sensitive, then no vulnerability can occur. Similarly, vulnerability will always be 'none' no matter how sensitive the feature is, if the exposure to change had been assessed as 'negligible'.

Table 8. Estimation of vulnerability based on sensitivity and exposure to change

Sensitivity of Feature	Exposure to Change			
	High	Medium	Low	Negligible
High	High	High	Moderate	None
Moderate	High	Moderate	Low	None
Low	Moderate	Low	Low	None
None	None	None	None	None

The vulnerability was then combined with the importance of the feature of interest using Table 9 to generate an initial level of significance. The importance of a feature is based on its value and rarity, such as the levels of protection. For example, if a high vulnerability was previously given to a feature of low importance, an initial level of significance of minor would be given.

Table 9. Estimation of significance based on vulnerability and importance

Importance of Feature	Vulnerability of Feature to Impact			
	High	Moderate	Low	None
High	Major	Moderate	Minor	Insignificant
Moderate	Moderate	Moderate/Minor	Minor/Insignificant	Insignificant
Low	Minor	Minor/Insignificant	Insignificant	Insignificant
None	Insignificant	Insignificant	Insignificant	Insignificant

5.2.4 Stage 4 – Impact Management

The final stage is to identify any impacts that are found to be moderate and/or major adverse significant and require mitigation measures to reduce residual impacts, as far as possible, to environmentally acceptable levels. Within the assessment procedure the use of mitigation measures will alter the risk of exposure and, hence, will require significance to be re-assessed and thus the residual impact (i.e. with mitigation) identified.

5.2.5 Confidence Assessment

Following the significance assessment, a confidence assessment was undertaken which recognises the degree of interpretation and expert judgement applied. This is presented in the summary table contained within the conclusions section of each impact assessment section. Confidence was assessed on a scale incorporating three values: low, medium and high.

5.2.6 Cumulative Impact and In-Combination Assessment

Under The Marine Works (EIA) Regulations (Amendment) 2017 it is necessary to assess the potential cumulative impacts of a proposed activity on all environmental receptors together with other existing or consented developments in the area. Under The Conservation of Habitats and Species Regulations 2010 (as amended) ('Habitats Regulations'), it is also necessary to consider the in-combination effects of a development proposal specifically on the designated features of European Sites. The cumulative impact and Habitats Regulations in-combination assessments are presented in Section 7.

5.3 References

ABPmer (2018). Swansea Inner West Pier Works, Screening and Scoping Report, ABPmer Report No. R.2985. A report produced by ABPmer for ABP, May 2018.

Charted Institute of Ecology and Environmental Management (CIEEM) (2016). Guidelines for Ecological Impact Assessment in the UK and Ireland: Terrestrial, Freshwater and Coastal, 2nd edition. Available at: https://www.cieem.net/data/files/Publications/EcIA_Guidelines_Terrestrial_Freshwater_and_Coastal_Jan_2016.pdf (accessed 03/07/2018).

CIEEM (2018). Guidelines for Ecological Impact Assessment in the UK and Ireland (Terrestrial, Freshwater, Coastal and Marine). Available at: https://www.cieem.net/data/files/ECIA%20Guidelines.pdf (accessed 01/10/2018).

Institute of Ecology and Environmental Management (IEEM) (2010). Guidelines for Ecological Impact Assessment in Britain and Ireland: Marine and Coastal. Available at: https://www.cieem.net/data/files/Resource_Library/Technical_Guidance_Series/EcIA_Guidelines/Final_EcIA_Marine_01_Dec_2010.pdf (accessed 03/07/2018).

6 Environmental Receptors

There is the potential for environmental effects to arise from the Proposed Development. This section presents the further assessment work that has been undertaken to determine the significance of potential effects on the following topics and associated receptors identified during the screening phase (see Section 5.1):

- Water and Sediment Quality;
- Marine Ecology;
- Terrestrial Ecology;
- Commercial and Recreational Navigation;
- Coastal and Flood Protection;
- Airborne Noise and Vibration;
- Landscape / Seascape and Visual;
- Transport and Access; and
- Cumulative and In-combination Effects.

6.1 Water and Sediment Quality

This section presents the assessment of potential impacts of the Proposed Development on water and sediment quality receptors.

6.1.1 Consultation and scope

Based on the Screening and Scoping Report, and the subsequent advice provided by NRW and statutory consultees (see Section 5.1), Table 10 presents the water and sediment quality receptors, impact pathways, and further work that has been carried out to inform the marine licence application.

Table 10. Impact pathways and summary of further work for water and sediment quality

Receptor	Impact Pathway	Requires Further Assessment?	Justification	Summary of Further Work
Water quality	Potential changes to suspended sediment concentrations during construction	No	Sediment will be disturbed into the water column during pile insertion (both impact driven and bored piles) and bed preparation works, and then dispersed by the flows before resettling to the bed. The potential increase in suspended sediment concentrations will be negligible, in the context of background levels and natural variability, and short-term (i.e. limited to the construction works).	No further assessment work has been undertaken for this impact pathway. The impact of the dredge and disposal of dredge arisings from any bed preparation works (an addition to the construction methodology since the Screening and Scoping Report) has been assessed in the context of disturbing sediment-bound contamination (see end of table).
	Potential changes to dissolved oxygen during construction	No	Increased levels of suspended sediments can lead to a reduction in dissolved oxygen concentrations in the water column. However, given the potential increase in suspended sediment concentrations during all construction activities will be negligible, particularly in comparison to background levels and natural variation, and short-term, it is unlikely to result in significant reductions in dissolved oxygen.	No further assessment work has been undertaken for this impact pathway.
	Potential changes to levels of contaminants in water (including accidental spillages) during construction	No	The proposed works will not directly introduce contaminants to the marine environment and good practice measures, such as those described in 'Guidance for Pollution Prevention: Works and maintenance in or near water (GPP5)', will be used to prevent/reduce the potential for accidental spillages[8] during construction (Section 3.4).	No further assessment work has been undertaken for this impact pathway. Mitigation measures to minimise or avoid the risk of spillages during construction have been identified and are set out in Section 6.1.4. These will be included in the CMP (Section 4.4.8). The potential release of fuel and oil following a vessel accident, incident or spillage during construction will be considered further in the NRA (see Section 6.4).

[8] http://www.netregs.org.uk/media/1418/gpp-5-works-and-maintenance-in-or-near-water.pdf?utm_source=website&utm_medium=social&utm_campaign=GPP5%2027112017 (Accessed April 2018).

Receptor	Impact Pathway	Requires Further Assessment?	Justification	Summary of Further Work
Water and sediment quality	Potential impacts from redistribution of sediment-bound chemical contaminants during construction	Yes	The proposed works could lead to the resuspension of contaminated sediments. Once in suspension, sediment-bound contaminants could be released into the water column (dissolved fraction) and redistributed in the surrounding area.	Sediment samples have been collected and analysed for contaminants to inform the assessment of this impact pathway. A detailed review of the quantity and fate of contaminated sediments during construction activities has been undertaken as per NRW advice. This includes consideration of the impact during dredging from any bed preparation works (an addition to the construction methodology since the Screening and Scoping Report). In addition, a WFD Assessment has been prepared following the latest available guidance (Appendix D).
	Potential impacts from disposal at sea of sediment-bound chemical contaminants	Yes	Disposal of dredge material at Swansea (Outer) licenced disposal ground has the potential to impact water quality of the Bristol Channel Outer North coastal water body.	Assessment of the disposal of dredge arisings at the Swansea (Outer) licenced disposal ground has been included in this impact pathway. In addition, a WFD Assessment has been prepared following the latest available guidance (Appendix D).

6.1.2 Baseline review

Data sources

The principal data sources that have informed this assessment are as follows:

- Water Watch Wales website (http://waterwatchwales.naturalresourceswales.gov.uk/en/);
- Sediment contaminant concentration data;
- Environmental quality standard (EQS) dossiers, prepared by the Sub-Group on Review of the Priority Substances List (2011) under Working Group E of the Common Implementation Strategy for the WFD;
- WFD (Standards and Classification) Directions (England and Wales) 2015[9].

Water quality

Water quality standards are regulated at EU level through the WFD (2000/60/EC), the Priority Substances Directive (2008/105/EC, 2013/39/EU), the revised Bathing Water Directive (2006/113/EC) and the MSFD (2008/56/EC). The WFD provides for holistic management of all water bodies including rivers, estuaries, groundwater, lakes and coastal waters to 1 nm offshore. The WFD integrates and requires protection of designated shellfish waters, through the Water Environment (Water Framework Directive) (England and Wales) Regulations 2017; bathing waters, through the revised Bathing Water Directive (2006/7/EC) (BWD); nature conservation sites, through the Habitats and Birds Directives (92/43/EEC, 2009/147/EC); and eutrophication, through the Nitrates Directive (91/676/EC).

River Basin Management Plans (RBMPs) set out measures through which compliance with WFD objectives will be achieved. The Western Wales RBMP identifies the 'Tawe Estuary below barrage including docks' transitional water body (ID: GB541005900900) at the application site (NRW, 2016). It is recorded as a heavily modified water body (HMWB) due to flood protection use, and navigation, ports and harbours use. This means 'ecological potential' is applied rather than 'ecological status'. The overall status of the waterbody is 'moderate', with an ecological potential of 'moderate', and a chemical of status of 'good'. The reasons for not achieving good status are zinc concentrations and the HMWB mitigation measures assessment. Located immediately upstream is the 'Tawe - Beaufort Weir to barrage' transitional water body (ID: GB541005900901) and immediately downstream is the 'Swansea Bay' coastal water body (ID: GB641008260000), both of which are HMWBs and currently at moderate overall status. Based on the location and scale of the Proposed Development, the construction of the Proposed Development is considered unlikely to cause a significant non-temporary effect on these adjacent water bodies. However, the disposal of dredge arisings at the Swansea (Outer) licenced disposal ground may cause a short term temporary impact on the 'Bristol Channel Outer North' coastal water body (GB611008590001). This has a 'good' chemical status, a 'medium' ecological status, and a 'medium' overall status. Dissolved inorganic nitrogen is attributable to its 'medium' ecological status. However, it is also noted that eleven benthic samples taken in the vicinity of the disposal ground had a 'poor' or 'bad' classification according to the Infaunal Quality Index (IQI)[10] (Callaway, 2016). WFD waterbodies adjacent to the Proposed Development and licenced disposal ground are shown in Figure 7.

WFD protected areas are shown in Figure 8 (nature conservation sites are described in Section 6.2 and 6.3). Swansea Bay bathing water, located to the west of the Proposed Development, was assessed as having good bathing water quality in 2015, 2016 and 2017 (NRW, 2018). Designated shellfish water

[9] http://www.legislation.gov.uk/uksi/2015/1623/pdfs/uksiod_20151623_en_auto.pdf

[10] The IQI was developed to assess the ecological status of the macrobenthic invertebrate infaunal assemblages of sediment habitats in UK coastal and transitional water bodies for the WFD (Phillips *et al.,* 2014).

protected areas are located in Swansea Bay (east, west and south) as well as Queen's Dock Swansea[11]. The Queen's Dock classification zone (located within the Swansea Bay bivalve mollusc production area) is classified as Class B (long term) meaning shellfish must not exceed 4,600 *Escherichia coli* per 100 g flesh and 10 % of samples must not exceed 46,000 *E. coli* per 100 g flesh (Cefas, 2011). Harvested bivalve molluscs can go for human consumption after purification in an approved plant, after relaying in an approved Class A relaying area or after an EC approved heat treatment process[12].

There are a number of potential sources of organic pollution including freshwater input (e.g. River Tawe and associated contaminants in catchment), animal (e.g. livestock) and bird populations, humans and urbanised environments (e.g. surface water runoff), sewage discharges (e.g. combined sewer overflows), and boating activity from Swansea Marina. The Tawe Estuary is designated as a Coastal "Sensitive Area (Eutrophic)" under the Urban Waste Water Treatment Directive (91/271/EEC)[13].

[11] https://naturalresources.wales/media/676244/shellfish-water-protected-areas-wales-2016-8-feb-002.pdf (Accessed April 2018).

[12] https://www.food.gov.uk/sites/default/files/classification-list-05-feb-18.pdf (Accessed April 2018).

[13] https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/69592/pb13811-waste-water-2012.pdf (Accessed 24th September 2018)

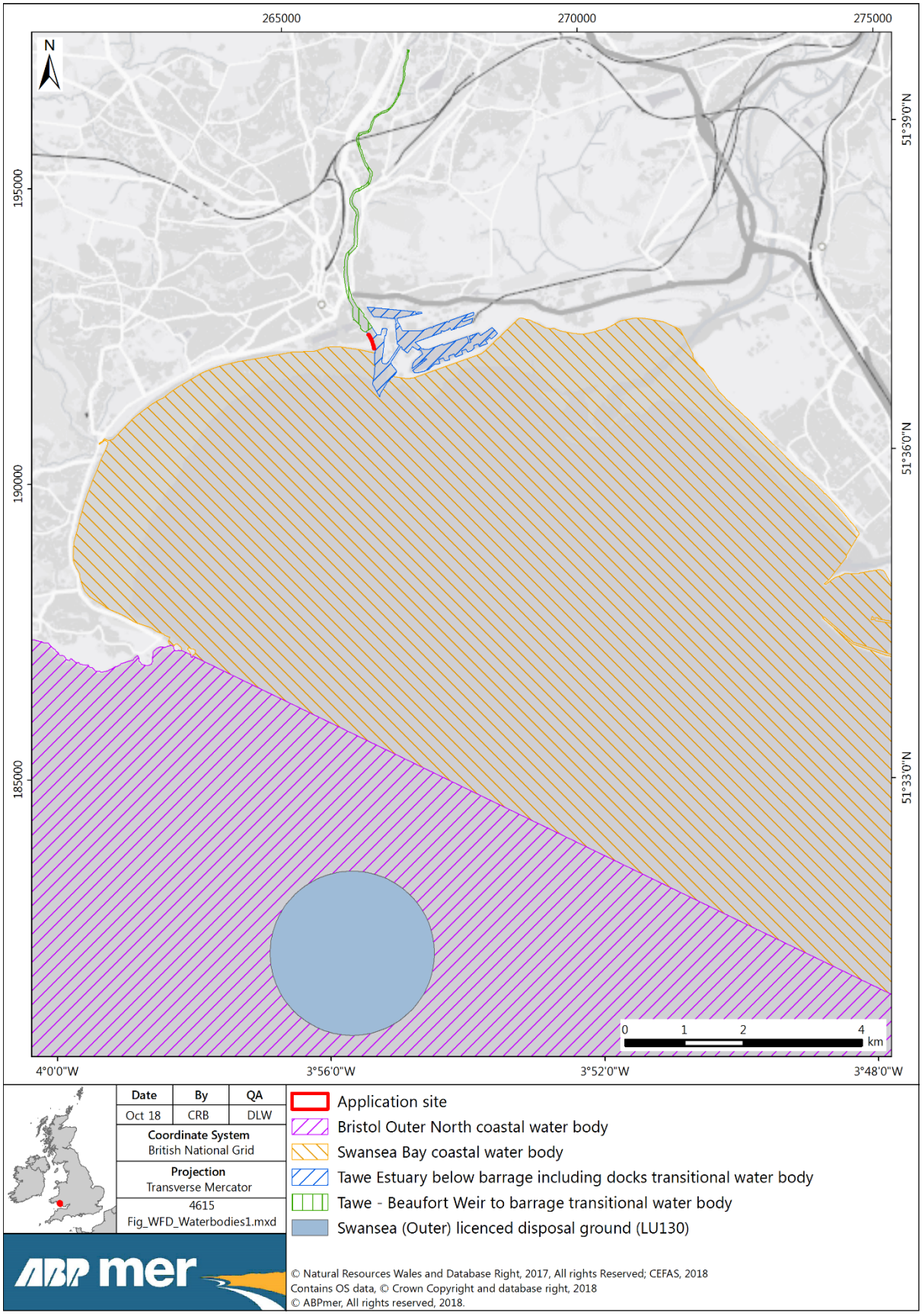

Figure 7. WFD waterbodies in the vicinity of the application site and Swansea (Outer) licenced disposal ground

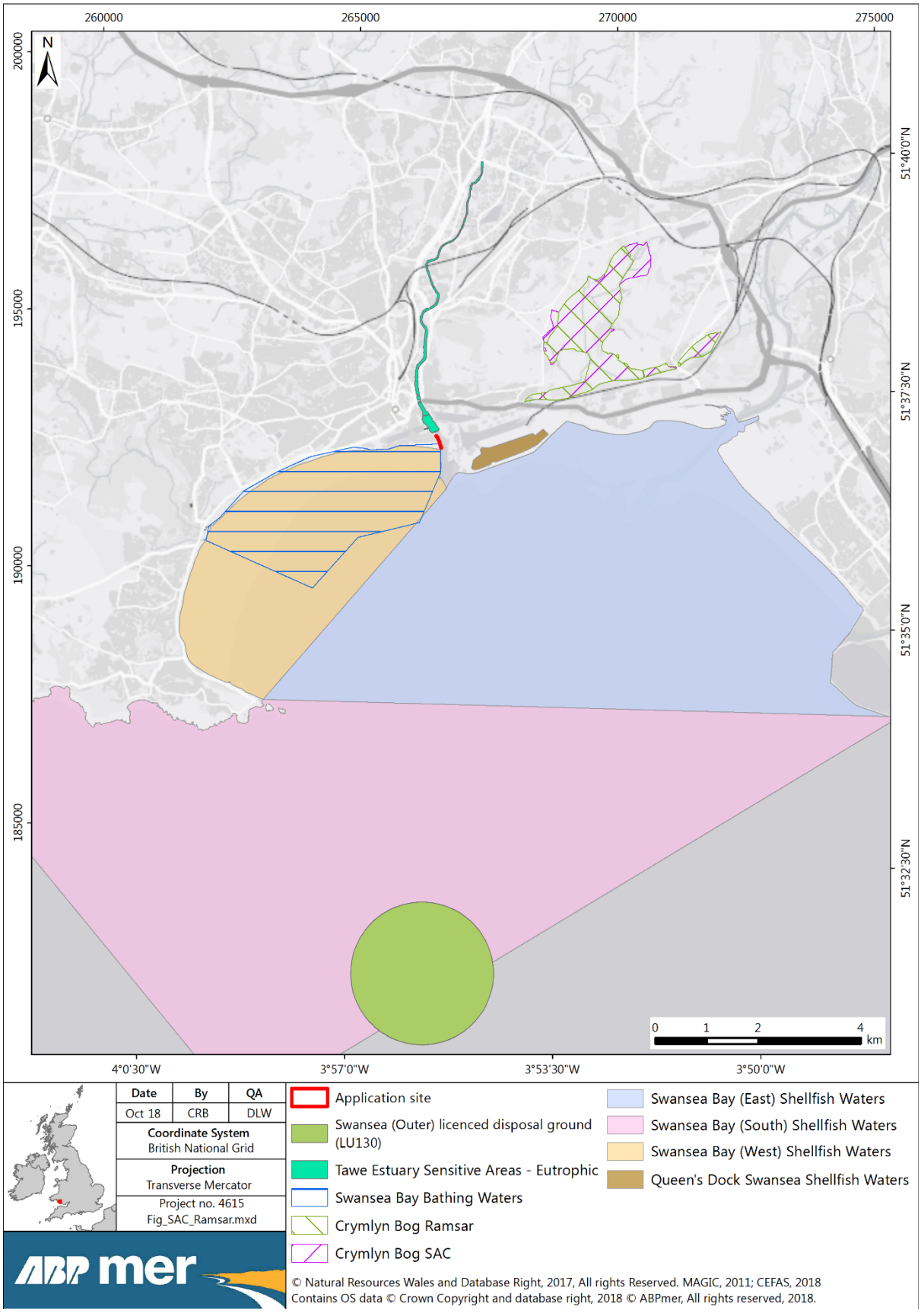

Figure 8. WFD protected areas in the vicnity of the application site.

Physico-chemical parameters

Flow speeds passing the West Pier development site are for the most part low (0.1 – 0.2 m/s). Average suspended sediment concentrations are circa 100 and 200 mg/l, surface to bed respectively, however around low water (LW) measurements between the Piers indicate values in excess of 600 mg/l (ABP Research and Consultancy Ltd, 1997). These measurements were made prior to the construction of the Barrage and therefore should be considered only as indicative. These earlier studies established that sediment from fluvial sources was less than 10 % of the total material moving in and out of the estuary. On this basis, it is likely that all sediment in suspension currently is of marine origin.

Sediment quality

Sediment samples, collected on the 14 July 2018, were taken from three locations on the foreshore fronting Swansea Inner West Pier in accordance with the OSPAR guidelines and the sediment contamination sample plan received from Cefas and agreed with NRW (Figure 9). Samples were located in the north section (Sample 1), the middle section (Sample 2), and the south section (Sample 3) of the Proposed Development. Sediment contamination data and particle size fractions for each sample are presented in Table 11 and Table 12, respectively. In the absence of formal quantitative EQS for sediments the data have been compared to the Centre for Environment, Fisheries and Aquaculture Science (Cefas) Guideline Action Levels (ALs) (see Appendix D).

The concentrations of all of the contaminants tested were below Cefas AL2[14], with most being below or slightly above Cefas AL1. The least contaminated sediment was taken from Sample 3, due to the higher proportion of sand compared clay/silt. Higher contaminant concentrations were found in Samples 1 and 2, which also had higher proportions of clay/silt. Most polycyclic aromatic hydrocarbons (PAHs) were above Cefas AL1. Sample 2 had the highest concentrations of PAHs, with some being orders of magnitude higher than Cefas AL1.

[14] There is no Cefas AL2 stated for PAHs and PCBs (sum of ICES 7)

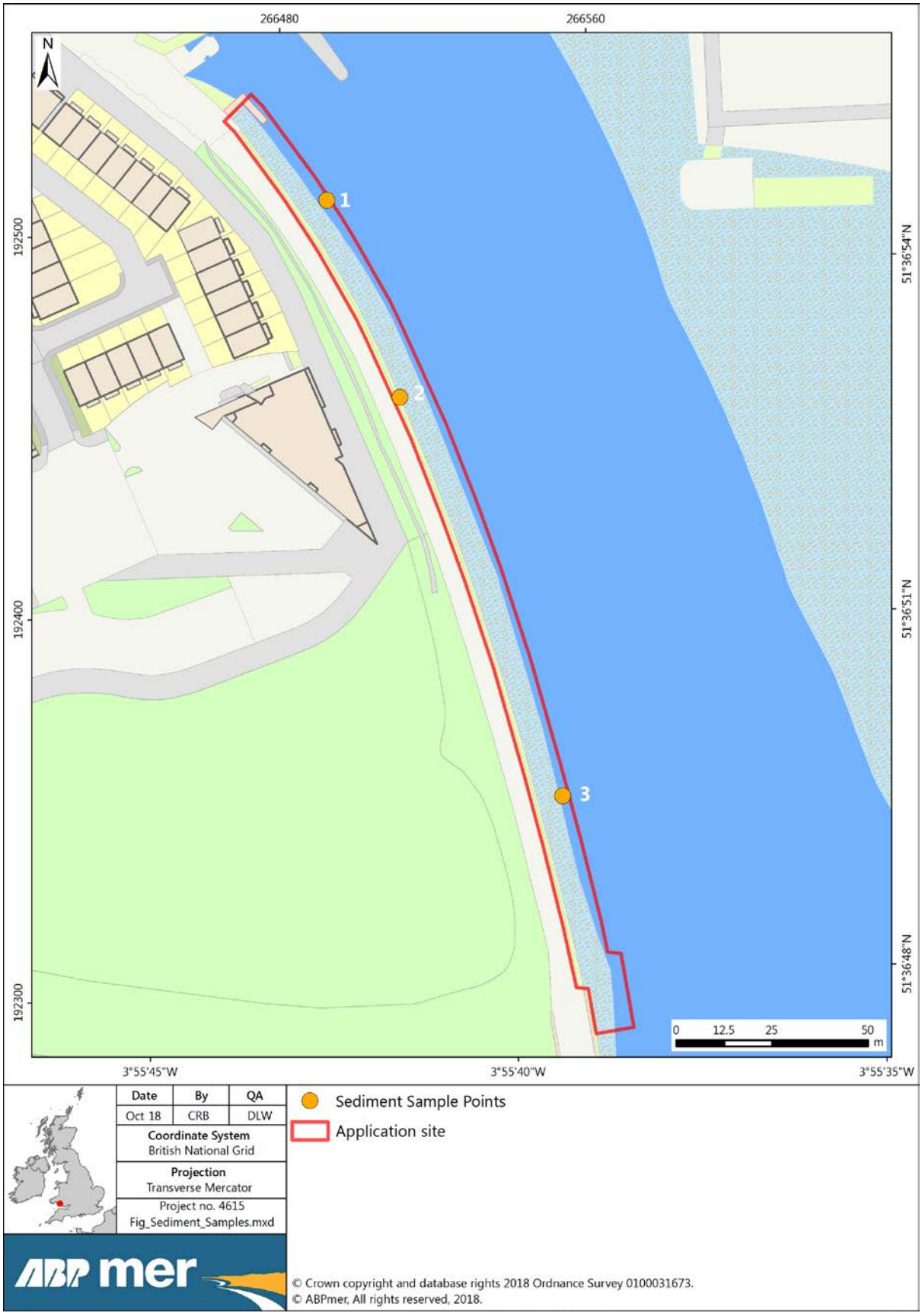

Figure 9. Location of surface sediment samples taken on 14 July 2018

Table 11. Sediment contamination data for samples taken from Swansea West Pier foreshore and Cefas Action Levels (mg/kg)

Parameter	Cefas Action Level		Sediment concentrations		
	AL1	AL2	Sample 1	Sample 2	Sample 3
Arsenic	20	100	16.6	15.4	13.1
Cadmium	0.4	5	0.66	0.56	0.12
Chromium	40	400	28.1	30.9	7
Copper	40	400	39.4	36	10.8
Mercury	0.3	3	0.13	0.13	<0.015
Nickel	20	200	34.1	33.5	7.8
Lead	50	500	79.3	65.3	14.5
Zinc	130	800	278.3	223.1	72
Dibutyltin	0.1	1	0.00128	<0.001	<0.001
Tributyltin			<0.001	<0.001	<0.001
Acenaphthene	0.1	None	0.0785	1.16	0.00319
Acenaphthylene			0.0372	0.847	<0.001
Anthracene			0.0920	0.767	<0.001
Benzo[a]anthracene			0.309	3.30	0.00309
Benzo[a]pyrene			0.372	4.17	0.00417
Benzo[b]fluoranthene			0.481	4.99	0.00469
Benzo[ghi]perylene			0.357	3.51	0.00407
Benzo[k]fluoranthene			0.179	2.37	0.00268
Chrysene			0.325	5.60	0.00418
Diben[ah]anthracene			0.361	3.28	0.0037
Fluoranthene			0.585	15.4	0.00642
Fluorene			0.0961	1.36	<0.001
Indeno[1,2,3-cd]pyrene			0.256	1.62	0.00236
Naphthalene			0.149	0.594	0.00112
Phenanthrene			0.473	10.8	0.00520
Pyrene			0.372	19.0	0.00456
Total Hydrocarbon Content	-	-	5.89	318	<1
PCB 28	0.01	None	0.00361	0.00380	0.00016
PCB 52			0.00242	0.00229	0.00016
PCB 101			0.00157	0.00158	<.00008
PCB 118			0.00194	0.00217	<.00008
PCB 138			0.00203	0.00254	<.00008
PCB 153			0.00206	0.00257	<.00008
PCB 180			0.00158	0.00198	<.00008
Key	**Below AL1**				
	Between AL1 and AL2				
	Above AL2				

Table 12. Particle size analysis size for sediment samples taken from Swansea West Pier foreshore

Sample	Grain size (%)		
	Gravel	Sand	Silt/clay
Sample 1	8.44	33.69	57.87
Sample 2	11.55	17.07	71.39
Sample 3	0.00	99.32	0.68

6.1.3 Impact assessment

The following impact pathways have been assessed with respect to water and sediment quality:

- Potential impacts from redistribution of sediment-bound chemical contaminants during construction; and
- Potential impacts from disposal at sea of sediment-bound chemical contaminants.

Any impacts associated with changes in water quality on marine ecology receptors have been considered in Section 6.2.

Potential impacts from redistribution of sediment-bound chemical contaminants during construction

As sediment is disturbed and re-distributed into the water column, any sediment-bound contaminants may be partitioned from the solid phase (i.e. bound to sediments or suspended matter), to the dissolved or aqueous phase (i.e. dissolved in pore water or overlying water) (Luoma, 1983).

To determine the maximum dissolved fraction of contaminants released into the water column, it is necessary to consider the relative potential for each contaminant to change from one phase to another (i.e. contaminant adsorbed to sediment surfaces to dissolved in the water), referred to as the partition coefficient. Partition coefficients describe the ratio between the freely dissolved concentration in water and another environmental phase (e.g. sediment-bound) at equilibrium. It should be noted that desorption rates of contaminants from suspended sediments into the water column are highly regulated by hydrodynamics, biogeochemical processes, and environmental conditions (redox, pH, salinity and temperature) (Eggleton and Thomas, 2004). Due to the variability in environmental conditions, a wide range of partition coefficients are reported in the literature.

There is potential for sediment-bound contaminants to be re-mobilised in the water column following an increase in suspended sediment concentrations during construction of the Proposed Development. Both piling activities (percussive and vibro) and bed-preparation works may disturb sediments.

During pile insertion, sediment will be disturbed into the water column and then dispersed by the flows before resettling to the bed. The disturbance will be largely confined to the immediate vicinity of the piles and predominantly within the first metre above the bed. Outside of this immediate zone of influence, the suspended sediment concentrations are expected to be within the variation of the natural flows. Given the baseline range of suspended sediment concentrations at this site, and the short-term nature of the impact, sediment disturbance during construction is considered to be negligible.

Bed preparation works require the use of a backhoe dredger. Sediment disturbance will be caused at the bed by the 'ripping' action of the bucket and then from 'wash off 'of sediment from the open bucket as it traverses the water column and breaks the water surface. Additional input of sediment could be from spillage during slewing of the bucket to the barge. An approximate value for the increase in suspended sediment concentrations as a result of the bed preparation works has been calculated as 128 mg/l. This calculation is based on the likely size of the dredger, volume and spatial area of dredged material, and water flows. This value is used in the calculations below.

It is possible to estimate in-water contaminant concentrations as a result of the bed preparation works based on a number of simple assumptions. Using the maximum concentration of contaminants in sediment samples and the estimated increase in suspended sediment concentrations of 128 mg/l, the dissolved fraction of contaminants released into the water column can be estimated. To do this, it is

necessary to use contaminant partition coefficients. This assessment is presented in Table 13 for contaminants that exceed AL1, and for those contaminants where EQSs have been defined.

Due to the variability in environmental conditions, the partition coefficient values used here are indicative only and subject to uncertainty. However, for each contaminant, the lower end of any range has been used to provide a conservative approach. The sediment-water partition coefficient for most contaminants has been sourced from the relevant EQS dossier, prepared by the Sub-Group on Review of the Priority Substances List (2011) under Working Group E of the Common Implementation Strategy for the WFD.

Due to the temporary nature of the construction of the Proposed Development, short-term EQS values, referred to as maximum allowable concentrations (MAC), are reported where possible. However, in cases where this information is not available, the annual average (AA) EQS is presented. As shown in Table 13, the maximum additional dissolved phase concentration for each contaminant is a small percentage of the relevant EQS, suggesting minimal potential for bed preparation works to impact water quality. This is largely due to the relatively small scale of the works.

Table 13. Potential concentration of additional in-water contaminants in the vicinity of the Proposed Development due to piling and bed preparation works

Parameter	Maximum sediment conc. (mg/kg)	Maximum suspended conc. (mg/l)	Partition coefficient (l/kg)	Maximum additional dissolved conc. (µg/l)	EQS (µg/l)*	Percentage increase (%)
Cadmium	0.66	0.084	631	0.000134	0.2 (AA)	0.07
Lead	79.3	10.150	35481	0.000286	14 (MAC)	0.00
Nickel	34.1	4.365	2138	0.002042	34 (MAC)	0.01
Zinc	278.3	35.622	110000	0.000324	9.6 (MAC)	0.00
Anthracene	0.767	0.098	793	0.000124	0.1 (MAC)	0.12
Benzo(a)pyrene	4.17	0.534	20795	0.000026	0.027 (MAC)	0.10
Benzo[b]fluoranthene	4.99	0.639	20795	0.000031	0.017 (MAC)	0.18
Benzo(ghi)perylene	3.51	0.449	25583	0.000018	0.00082 (MAC)	2.14
Benzo[k]fluoranthene	2.37	0.303	19859	0.000015	0.017 (MAC)	0.09
Fluoranthene	15.4	1.971	2444	0.000807	0.12 (MAC)	0.67
Indeno(1,2,3-cd)pyrene	1.62	0.207	58607	0.000004	0.027 (MAC)	0.01
Naphthalene	0.594	0.076	35	0.002172	130 (MAC)	0.00

* As described under the Water Framework Directive (Standards and Classification) Directions (England and Wales) 2015.

The exposure to change is considered Low. This is based on a Small magnitude of change due to the relatively small change in dissolved contaminant concentrations following sediment re-suspension (largely due to the small scale of the works) and the short-term nature of the impact, and a High probability of occurrence.

The vulnerability is considered Low. This is based on a Low exposure to change (above), and a Moderate sensitivity of the feature. The latter is attributed to the good chemical status, moderate ecological potential, and moderate overall status of the Tawe Estuary below barrage including docks' transitional water body.

Overall, the impact is considered **Insignificant** based on a Low vulnerability of feature to the impact (above) and the Low importance of the feature, as the Proposed Development is not within a water body with any WFD protected areas.

Potential impacts from disposal at sea of sediment-bound chemical contaminants

Contaminated sediment disposed of at sea will largely settle to the seabed, and not remain in suspension in the water column for a significant period of time. Any sediment that does remain in suspension may degrade water quality and contaminants may partition into the dissolved phase.

During disposal of dredged material at the Swansea (Outer) licenced disposal ground, there is potential for sediment-bound contaminants to be redistributed into the water column, and impact local water quality within the Bristol Channel Outer North coastal water body.

Assuming a total dredge volume of 1,800 m^3 in situ and a small barge with a 360 m^3 capacity, five loads of sediment will be released by bottom opening barge (maximum 1 load per tide). Based on assumptions on sediment density and the volumetric flow of water the sediment would likely be released into, it is possible to estimate the suspended sediment concentration as a result of the disposal of dredged material. This approximate value is calculated to be 179 mg/l and is used in the calculations below.

In the same way as undertaken for impact pathway 'Potential impacts from redistribution of sediment-bound chemical contaminants during construction', in-water contaminant concentrations can be calculated using maximum sediment contaminant concentrations, partition coefficients and the predicted increase in suspended sediment concentrations. This is shown in Table 14; the maximum additional dissolved phase concentration for each contaminant is a small percentage of the relevant EQS, suggesting minimal potential for bed preparation works to impact water quality.

Table 14. Potential concentration of additional in-water contaminants in the vicinity of Swansea (Outer) licenced disposal ground due to disposal of dredge arisings

Parameter	Maximum sediment conc. (mg/kg)	Maximum suspended conc. (mg/l)	Partition coefficient (l/kg)	Maximum additional dissolved conc. (µg/l)	EQS (µg/l)*	Percentage increase (%)
Cadmium	0.66	0.118	631	0.000187	0.2 (AA)	0.09
Lead	79.3	14.195	35481	0.000400	14 (MAC)	0.00
Nickel	34.1	6.104	2138	0.002855	34 (MAC)	0.01
Zinc	278.3	49.816	110000	0.000453	9.6 (MAC)	0.00
Anthracene	0.767	0.137	793	0.000173	0.1 (MAC)	0.17
Benzo(a)pyrene	4.17	0.746	20795	0.000036	0.027 (MAC)	0.13
Benzo[b]fluoranthene	4.99	0.893	20795	0.000043	0.017 (MAC)	0.25
Benzo(ghi)perylene	3.51	0.628	25583	0.000025	0.00082 (MAC)	2.99
Benzo[k]fluoranthene	2.37	0.424	19859	0.000021	0.017 (MAC)	0.13
Fluoranthene	15.4	2.757	2444	0.001128	0.12 (MAC)	0.94
Indeno(1,2,3-cd)pyrene	1.62	0.290	58607	0.000005	0.027 (MAC)	0.02
Naphthalene	0.594	0.106	35	0.003038	130 (MAC)	0.00

* As described under the Water Framework Directive (Standards and Classification) Directions (England and Wales) 2015.

The exposure to change is considered Low. This is based on a Small magnitude of change due to the relatively small change in dissolved contaminant concentrations following disposal (largely due to the small volume of disposed material) and the short-term nature of the impact, and a High probability of occurrence.

The vulnerability is considered Low. This is based on a Low exposure to change (above), and a Low sensitivity of the feature. The latter is attributed to the already disturbed nature of the site, and the

good chemical status, moderate ecological status, and moderate overall status of the Bristol Channel Outer North coastal water body.

Overall, the impact is considered **Insignificant** based on a Low vulnerability of feature to the impact (above) and the Low importance of the feature, as the disposal ground is not within or near any WFD protected areas.

6.1.4 Mitigation measures and residual effects

No impact pathways are expected to give rise to significant adverse effects. Nevertheless, good practice measures, such as those described in 'Guidance for Pollution Prevention: Works and maintenance in or near water (GPP5)', will be used to prevent/reduce the potential for accidental spillages[15] during construction. Such measures will be included in the CMP (Section 4.4.8).

6.1.5 Summary and conclusions

This section reports the assessment of potential impacts on water and sediment quality receptors during the construction phase of the Proposed Development. With the adoption of good practice measures, it is considered that significant adverse effects can be avoided. A summary of the impact pathways that have been assessed is presented in Table 15.

[15] http://www.netregs.org.uk/media/1418/gpp-5-works-and-maintenance-in-or-near-water.pdf?utm_source=website&utm_medium=social&utm_campaign=GPP5%2027112017 (Accessed April 2018).

Table 15. Summary of potential impact, mitigation measures and residual impacts for water and sediment quality

Receptor	Impact pathway	Impact significance	Mitigation measures/Monitoring	Residual impact	Confidence
Water and sediment quality	Potential impacts from redistribution of sediment-bound chemical contaminants during construction	Insignificant	N/A	Insignificant	Medium
	Potential impacts from disposal at sea of sediment-bound chemical contaminants	Insignificant	N/A	Insignificant	Medium

6.1.6 References

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6.2 Marine Ecology

This section presents the assessment of potential impacts of the Proposed Development on marine ecology receptors.

6.2.1 Consultation and scope

Based on the Screening and Scoping Report, and the subsequent advice provided by NRW and statutory consultees (see Section 5.1), Table 16 presents the marine ecology receptors, impact pathways, and further work that has been carried out to inform the marine licence application.

Table 16. Impact pathways and summary of further work for marine ecology

Receptor	Impact Pathway	Requires Further Assessment?	Justification	Summary of Further Work
Benthic habitats and species	Direct habitat loss as a result of the Proposed Development	Yes	There is the potential for impacts to benthic habitats and species as a result of habitat loss due to the footprint of the Proposed Development.	The impact of any bed preparation works and scour protection (an addition to the construction methodology since the Screening and Scoping Report) has been considered within this impact pathway assessed.
	Smothering of benthic habitats from sediment redistribution during construction	No	There is potential for the construction of the Proposed Development to disturb sediments, and cause smothering to benthic habitats and species in the vicinity of the Proposed Development. However, effects are likely to be relatively small as most benthic invertebrates are capable of migrating up through the deposited sediments (Budd, 2004). An expert workshop that convened to assess the sensitivity of marine features considered that subtidal sediment was not sensitive (high resistance and high resilience) to the deposition of 5 cm of fine material in a single event (Tillin *et al.*, 2010). A previous review by the University of Hull also concluded that benthic invertebrates in sediments are able to adapt and readjust if sediment laid is placed as thin veneers over several days although they can also tolerate moderate amounts (20 cm) of material being deposited at one time (IECS, 2001). Furthermore, if smothering were to result in benthic species fatalities, recovery is likely to fairly rapid given nearby species are able to migrate into new areas.	No further assessment work has been undertaken for this impact pathway.
	Deposition of sediments at the disposal ground	Yes	The disposal of dredge arisings from the bed preparations works (an addition to the construction methodology since the Screening and Scoping Report) will cause disturbance and smothering at the disposal ground (Swansea (Outer) licenced disposal ground (LU130)).	The impact of the disposal of dredge arisings from any bed preparation works (an addition to the construction methodology since the Screening and Scoping Report) has been assessed.
	Change in transport of sand to coastline due to disposal activity	No	NRW has previously expressed concerns with other marine licence applications that involve disposal of dredge material at Swansea (Outer) licenced disposal ground (LU130). This is related to the potential for this disposal activity to change the transport pathways and supply of sand from offshore areas to the Kenfig foreshores and dune system along the hinterland. A review of available data indicates that there is no evidence (either historic or contemporary) to suggest a link between material deposited at the LU130 disposal ground and sand transport pathways to the Kenfig frontage (ABPmer, 2016). Furthermore, the volume of	No further assessment work has been undertaken for this impact pathway.

Receptor	Impact Pathway	Requires Further Assessment?	Justification	Summary of Further Work
			dredge material that will need to be disposed at this site is very small (up to1,800 m^3) and is considered negligible in the context of the quantities of maintenance dredge arisings deposited at this disposal site. For example, the maximum tonnage deposited by ABP alone from the Port of Swansea and Port Talbot between July 2017 and June 2018 was approximately 1.7 million tonnes.	
	Underwater noise during construction	No	During construction, there is the potential for noise disturbance to benthic species. Piling will produce underwater noise above background conditions. The understanding of the potential effects of underwater noise on invertebrates is relatively underdeveloped (Hawkins *et al.,* 2015). There is, however, increasing evidence to suggest that benthic invertebrates respond to sediment vibration (Roberts *et al.,* 2016). For example, blue mussels *Mytilus edulis* vary valve gape, oxygen demand and clearance rates (Spiga *et al.*, 2016; Roberts *et al.*, 2016) and hermit crabs *Paganus bernhardus* shift their shell and at very high amplitudes, leave their shell, examine it and then return (Roberts *et al.,* 2016). The vibration levels at which these responses were observed generally correspond to levels measured near anthropogenic operations such as pile driving and up to 300 m from explosives testing (blasting) (Roberts *et al.,* 2016). A range of behavioural effects have also been recorded in decapod crustaceans, including a change in locomotion activity, reduction in antipredator behaviour and change in foraging habits (Tidau and Briffa, 2016). However, population level and mortality effects are considered unlikely.	No further assessment work has been undertaken for this impact pathway.
	Introduction of non-native species during construction	Yes	The risk of invasive non-native species is deemed the second largest threat to biodiversity worldwide, after habitat loss and destruction (IUCN, 2018). Vessels used during the construction of the Proposed Development risk introducing or spreading invasive non-native species.	Following advice from NRW, an invasive species assessment has been undertaken on marine craft or floating pontoons used in construction. Mitigation measures to manage the risk of introducing invasive non-native species will be identified in a Biosecurity Plan as set out in Section 6.2.4.
	Introduction of non-native species during operation	No	The new pier will introduce a new substrate into the marine environment that has the potential to be colonised by invasive non-native species. However, given the small and localised scale of the works and the widespread presence of existing artificial infrastructure in the area (e.g. dock walls), the exposure to change is likely to be low.	No further assessment work has been undertaken for this impact pathway.

Receptor	Impact Pathway	Requires Further Assessment?	Justification	Summary of Further Work
Fish	Direct habitat loss as a result of the Proposed Development	No	There is the potential for impacts to fish as a result of habitat loss due to the footprint of the Proposed Development. However, the footprint of the proposed works only covers a highly localised area that constitutes a very small fraction of the known ranges of local fish populations.	No further assessment work has been undertaken for this impact pathway.
	Underwater noise and vibration during construction	Yes	During construction, there is the potential for noise disturbance to fish. Percussive (impact) piling will produce underwater noise above background conditions and at a level that may cause a risk of injury and behavioural changes to fish and marine mammals in the vicinity of the Proposed Development.	A detailed Underwater Noise Assessment has been undertaken for the Proposed Development (Appendix G). Sensitive fish spawning seasons in the River Tawe and Swansea Bay have been investigated further as per NRW advice.
Marine mammals	Direct habitat loss as a result of the Proposed Development	No	There is the potential for impacts to marine mammals as a result of habitat loss due to the footprint of the Proposed Development. However, the footprint of the proposed works only covers a highly localised area that constitutes a very small fraction of the known ranges of local marine mammal populations.	No further assessment work has been undertaken for this impact pathway.
	Underwater noise and vibration during construction	Yes	During construction, there is the potential for noise disturbance to marine mammals. Percussive (impact) piling will produce underwater noise above background conditions and at a level that may cause a risk of injury and behavioural changes to marine mammals in the vicinity of the Proposed Development.	A detailed underwater noise assessment has been undertaken for the Proposed Development (Appendix G). Impacts on marine mammals have been considered at the relevant Marine Mammal Management Unit scale (IAMMWG, 2015) as per NRW advice. Oakley *et al.* (2015; 2017) has been reviewed and included in the description of species distribution as per SCC advice.
	Collision risk and visual disturbance during construction	No	Vessel movement in construction is unlikely to produce visual disturbance stimuli which will be discernible above the already high levels of anthropogenic activity in the Tawe Estuary. Vessels will also mainly be stationary or travelling at low speeds making the risk of collision very low. Furthermore, through regular exposure to vessel movements, marine mammals utilising the area will routinely need to avoid collision and are also expected to be habituated to high levels of disturbance stimuli.	No further assessment work has been undertaken for this impact pathway.
Coastal birds	Direct habitat loss as a result of the Proposed Development	No	There is the potential for impacts to coastal birds as a result of habitat loss due to the footprint of the Proposed Development. However, the footprint of the proposed works only covers a highly localised area that constitutes a very small fraction of the known ranges of local bird populations within Swansea Bay.	No further assessment work has been undertaken for this impact pathway.
	Airborne noise and visual disturbance during	Yes	During construction, there is the potential for airborne noise and visual disturbance to affect coastal birds. A number of coastal bird species utilise Swansea Bay that may be affected by noise	This impact pathway has been assessed in the context of local coastal bird populations that are known to use the area in the vicinity of the Proposed Development.

Receptor	Impact Pathway	Requires Further Assessment?	Justification	Summary of Further Work
	construction		and the visual presence of construction workers and machinery on and near the foreshore.	
All marine ecology receptors	Changes in water quality during construction	No	The expected negligible, highly localised and temporary changes in suspended sediment levels (and related changes in sediment bound contaminants and dissolved oxygen) associated with bed disturbance during construction works (outlined in Section 6.1) is considered unlikely to produce adverse effects in any species. The potential for accidental spillages will also be negligible during construction through following established industry guidance and protocols.	As per NRW advice, this impact pathway has been reviewed in light of the sediment contamination sampling results and analysis (see Section 6.1). The impact of the dredging and disposal of dredge arisings from any bed preparation works (an addition to the construction methodology since the Screening and Scoping Report) has also been considered in the assessment (see Section 6.1). This assessment gave rise to insignificant impacts, and therefore no further assessment with respect to marine ecology is required.
	Indirect changes in benthic habitat extent and quality due to changes in hydrodynamics as a result of the Proposed Development	No	Marine physical processes are not considered to require any further assessment work (as considered in the Screening and Scoping Report). This is because while the Proposed Development is anticipated to extend seaward around the existing structure, this will only marginally narrow the channel to the Swansea Barrage. Such a small change is unlikely to affect marine processes to the extent that it will cause significant erosion, accretion or changes to sediment transport. Indirect changes to marine habitats and species in the channel, because of these small changes to marine processes, are also expected to be negligible. On this basis such changes to habitats and prey resources for mobile species (fish, waterbirds and marine mammals) will also be negligible.	No further assessment work has been undertaken for this impact pathway.

6.2.2 Baseline review

Data sources

The principal data sources that have informed this assessment are as follows:

- MAGIC (Multi-Agency Geographic Information for the Countryside) Interactive Map (http://www.magic.gov.uk) provides the location of all designated conservation sites in the area;
- Joint Nature Conservation Committee (JNCC) website (http://jncc.defra.gov.uk/page-4) which provides definitions of designated sites and their respective features;
- Natura 2000 standard data forms/information sheets for each designation, as well as related GIS shapefiles;
- South East Wales Biological Records Centre (SEWBReC) and Aderyn;
- Swansea Bay Tidal Lagoon EIA; and
- Scientific journal articles on the marine ecology of Swansea Bay.

Nature conservation sites

No international nature conservation sites (i.e. Special Areas of Conservation (SACs), Special Protection Areas (SPAs) or Ramsar sites) overlap with the Proposed Development footprint or Swansea (Outer) licenced disposal ground (LU130).

The nearest site to the Proposed Development with marine components is Limestone Coast of South West Wales SAC (approximately 10 km west of the Proposed Development). This site is designated for Vegetated sea cliffs of the Atlantic and Baltic Coasts. The nearest international nature conservation site to the Swansea (Outer) licenced disposal ground is Kenfig SAC (approximately 10 km east of the disposal site). This site is designated for its sand dunes and saltmarsh.

The nearest internationally designated site with mobile features is the Camarthen Bay and Estuaries SAC and is located approximately 18 km and 15 km west of the Proposed Development and disposal site respectively. Twaite shad *Alosa fallax* is an Annex II species that is a primary reason for its designation. Sea lamprey *Petromyzon marinus*, river lamprey *Lampetra fluviatilis*, Allis shad *Alosa* and otter *Lutra* are Annex II species that are present as qualifying features. Bristol Channel Approaches Candidate SAC (cSAC) is located approximately 25 km west of the Proposed Development and the disposal site. This site has been identified for the protection of harbour porpoise *Phocoena phocoena*. Other SACs and cSACs for marine mammal interest features that occur further afield and fall within relevant Marine Mammal Management Units are identified below in the Marine Mammal baseline sub-section.

With respect to nationally designated sites, Blackpill SSSI is located 3 km southwest of the Proposed Development and 6 km northwest of the disposal site. This site is designated for several marine features including muddy gravel, and a number of overwintering wading birds, such as Sanderling and Ringed Plover (Figure 10). Crymlyn Burrows SSSI is located approximately 4 km east of the Proposed Development and 9 km northeast of the disposal site. With respect to marine features this site is designated for saltmarsh and populations of small waders during winter (Figure 10).

Sites of local importance include Swansea Bay Site of Importance for Nature Conservation (SINC) which is located west and adjacent to the Proposed Development (see Section 6.3). This site is designated for its sand dune and intertidal habitat as well as having a marine and ornithological interest.

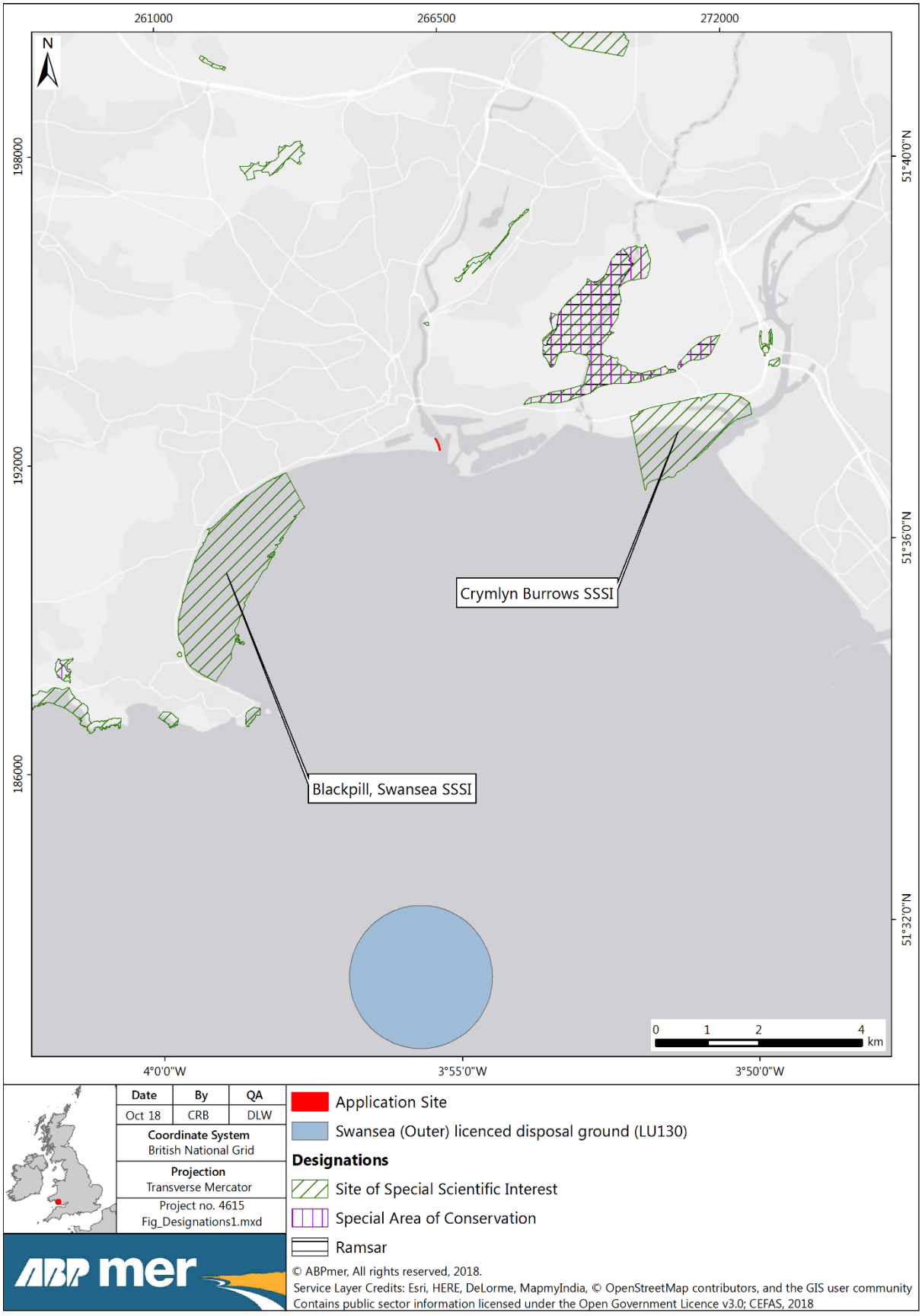

Figure 10. Designated sites with marine components in the wider area

Benthic habitats and species

Swansea Bay supports a range of intertidal habitats including mudflat, clay exposures, saltmarsh, gravel and rocky shore. Swansea Bay also supports areas of biogenic reef (consisting of honeycomb worm *Sabellaria alveolata* reef and blue mussel *Mytilus edulis* beds) (Tidal Lagoon Swansea Bay, 2014a). These habitats (or components of the habitats) are UK biodiversity action plan (BAP) Priority Habitats or listed as Habitats of Principle Importance in Wales under Section 7 of the Environment (Wales) Act 2016.

Commonly occurring benthic species occurring in soft sediment intertidal habitats in Swansea Bay include polychaetes (such as the ragworm *Hediste diversicolor*) and bivalves (such *as Macoma balthica*). Rocky shore and other hard substrate habitats (such as man-made structures) have been colonised by a range of algae species, the limpet *Patella vulgata,* barnacles, gastropods (such as periwinkle *Littorina* spp.) and anemones. In addition, the native oyster *Ostrea edulis* has also been recorded in low numbers (Tidal Lagoon Swansea Bay, 2014a). This species (and associated habitat) is a UK BAP species as well as listed under Section 7 of the Environment (Wales) Act 2016 and is also on the OSPAR list of threatened or declining habitats and species.

Within the Swansea (Outer) licenced disposal ground, the seabed is already conditioned to extensive disposal activities that have taken place historically (Tidal Lagoon Swansea Bay plc, 2014a). As described in Section 6.1, eleven sediment samples taken in the vicinity of the disposal ground indicated 'poor' or 'bad' ecological status (Callaway, 2016). The seabed within the disposal ground is shown as a mixture of circalittoral coarse sediment, circalittoral fine sand or muddy sand, and circalittoral sandy mud according to EUSeaMap2 Broad-Scale Predictive Habitat Map. The dominance of more mobile sandy and muddy substrates means the overall biodiversity of subtidal habitats in Swansea Bay are low (Shackley and Collins, 1984). Within Swansea Bay, common subtidal benthic species include the bivalves *Nucula nitidosa* and *Spisula elliptica*, the polychaetes *Nephtys hombergii* and *Spiophanes bombyx*, and the cumacean *Diastylis rathkei* (Tidal lagoon Swansea Bay plc, 2014b; Callaway, 2016). These species are adapted to living in mobile sediments coping with erosion and sedimentation (Callaway, 2016).

Phase 1 Intertidal Habitat Survey

A Phase 1 intertidal habitat survey was undertaken by ABPmer on 14 July 2018 to characterise the intertidal community on the foreshore fronting the Proposed Development.

The foreshore consists of the current pier structure which comprises both rock and timber, boulders and cobble substrate towards the upper shore, and muddy to sandy/gravelly sediment towards the lower shore. There is a transition from predominantly muddy sediment to predominantly sandy sediment from the northern to the southern half of the Proposed Development footprint.

The current pier structure is predominantly covered in knotted wrack *Ascophyllum nodosum* (Figure 11). There are also small bands of channelled wrack *Pelvetia canaliculata* and spiral wrack *Fucus spiralis* on upper sections off the wall (above the knotted wrack). There were also some aggregations of bladder wrack *Fucus vesiculosus* on the lower part of wall. On boulders below the current pier wall, there was knotted wrack, bladder wrack and occasional toothed wrack *Fucus serratus*. Other algae recorded included purple laver *Porphyra umbilicalis* and gutweed *Ulva intestinalis*.

Figure 11. Biotope present on the foreshore at Swansea Inner West Pier characterised by knotted wrack *Ascophyllym nodosum* as the dominant species (July 2018)

Barnacles including the acorn barnacle *Perforatus perforates* were recorded during the survey covering boulders in large densities. The beadlet anemone *Actinia equina* was commonly recorded on the mid to lower shore, with other less common species including plumose anemones *Metridium dianthus*, anemone *Actinothoe sphyrodeta* and *Sagartia* spp.. Other epifaunal invertebrate species recorded included the common starfish *Asterias rubens*, common periwinkle *Littorina littorea*, blue mussels *Mytilus edulis,* common prawn *Palaemon serratus* and shore crab *Carcinus maenas* were recorded. Lugworm *Arenicola marina* casts were also occasionally found in the sand.

In some areas boulders are less colonised, mainly covered by seaweeds *Ulva intestinalis* and *Porphyra umbilicalis* and barnacle species (Figure 12). It is possible these areas have been subjected to recent disturbance (possibly collapse of the structure or emergency repair works undertaken in December 2017 and July 2018).

Figure 12. Boulders on the foreshore at Swansea Inner West Pier mainly covered by seaweeds *Ulva intestinalis* and *Porphyra umbilicalis,* and barnacle species (July 2018)

In terms of protected species and habitats, a single native oyster *Ostrea edulis* was observed attached to a rock near the pontoon. Only several very small patches of degraded honeycomb worm *Sabellaria alveolata* tube growth were observed (consisting of a thin crust layer with worn apertures). No tube structures characteristic of *Sabellaria alveolata* reefs were observed (i.e. raised mounds).

A biotope map of the foreshore fronting the Proposed Development is shown in Figure 13. The list of the biotopes identified during the survey are as follows:

- LR.LLR.FVS.PelVS *Pelvetia canaliculata* on sheltered variable salinity littoral fringe rock
- LR.LLR.FVS.FspiVS *Fucus spiralis* on sheltered variable salinity upper eulittoral rock
- LR.LLR.FVS.AscVS *Ascophyllum nodosum* and *Fucus vesiculosus* on variable salinity mid eulittoral rock
- LR.FLR.Eph.BLitX Barnacles and *Littorina* spp. on unstable eulittoral mixed substrata
- LR.FLR.Eph.EphX Ephemeral green and red seaweeds on variable salinity and/or disturbed eulittoral mixed substrata
- LS.LMu.MEst Polychaete/bivalve-dominated mid estuarine mud shores
- LS.LSa.FiSa.Po Polychaetes in littoral fine sand

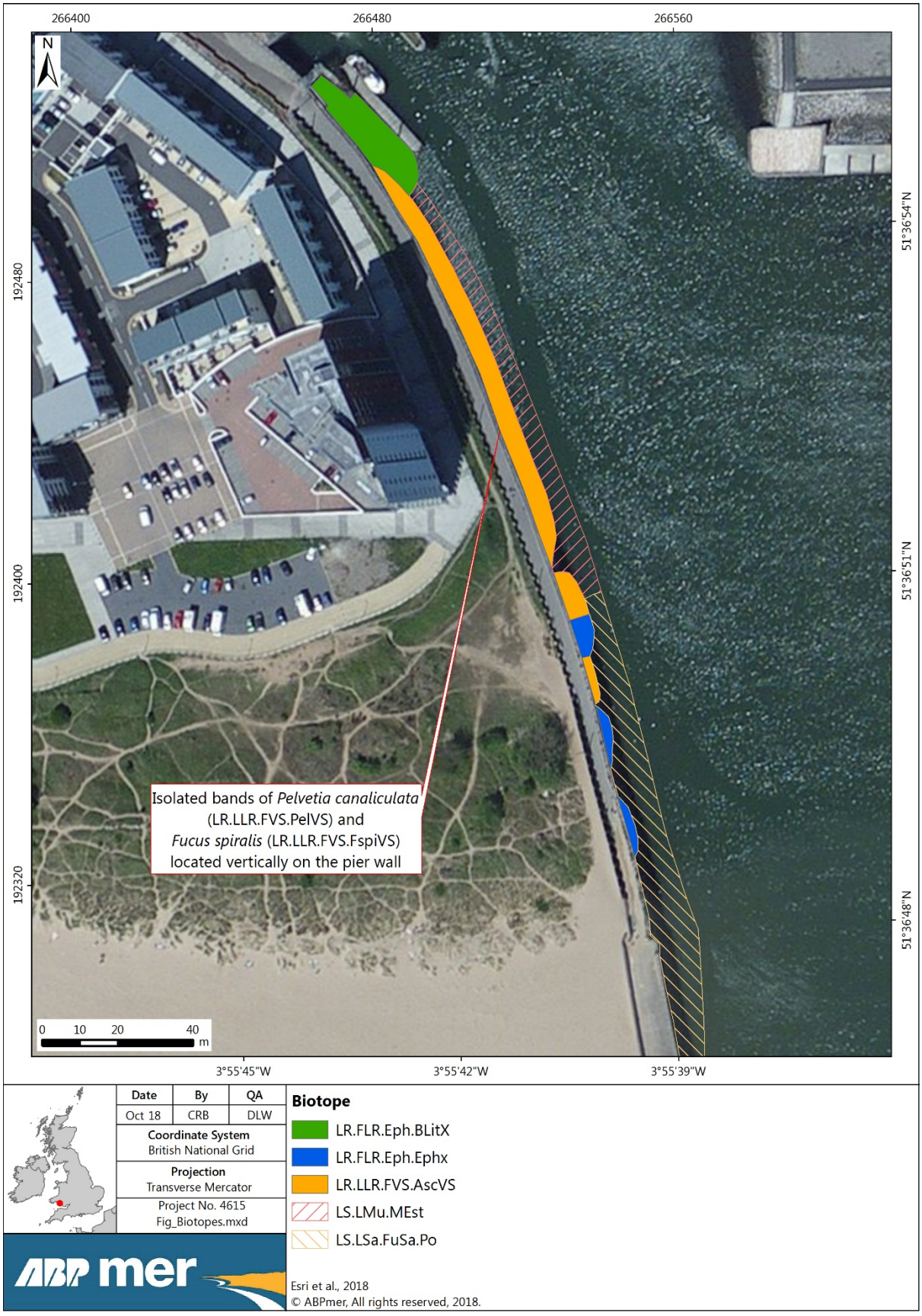

Figure 13. Biotope map of foreshore fronting Swansea Inner West Pier

Non-native species

A number of marine invasive non-native species are known to feature around Swansea Bay. These include the slipper limpet *Crepidula fornicata*, the stalked sea squirt *Styela clava*, Japanese wireweed *Sargassum muticum* and the Australian tube worm *Ficopomatus enigmaticus* (Tidal Lagoon Swansea Bay, 2014a). The barnacle *Elminus modestus,* mud shrimp *Monocorophium sextonae*, and sand gaper *Mya arenaria* have also been recorded in Swansea Bay.

The American slipper limpet *Crepidula fornicata* forms large beds observed at the edge of *S. alveolata* beds. This species is known to compete for food and space with other filter feeding species, and can displace mussel beds (NNSS, 2018; Rayment, 2008). It is possible that slipper limpets have outcompeted mussels in Swansea Bay, and *S. alveolata* have expanded into the vacated space.

Japanese wireweed *Sargassum muticum* is fast growing and reproduces within the first year of life by self-fertilisation. Floating assemblages enable its rapid spread. The abundance of wireweed is correlated with a reduction in diversity of native species, and is a nuisance in harbours, beaches and shallow waters impairing recreational water-based activities.

The Australian tube worm *Ficopomatus enigmaticus* is known to occur in Swansea Marina, as it inhabits warm shallow waters such as docks. It forms reefs on hard substrata such as rocks, pipes, ship hulls, buoys and harbour structures.

Within the UK, pathways of introduction involving vessel movements (fouling of hulls and ballast water) have been identified as the highest potential risk routes for the introduction of non-native species (Carlton, 1992; Defra, 2003; Pearce *et al*., 2012), which correlates with the fact that areas with a high volume of shipping traffic are hotspots for non-native species in British waters (Pearce *et al*., 2012).

Fish

The fish community of Swansea Bay is categorised as demersal, pelagic and benthopelagic. Common demersal species include plaice *Pleuroectes platessa,* common sole *Solea,* flounder *Platichthys flesus,* dab *Limanda,* ray *Raja* spp. and small bodied species such as dragonet *Callionymus lyra,* grey gurnard *Eutrgla urnardus* and goby *Pomatoschistus* spp.. The pelagic fish community is characterised by an abundance of herring *Clupea harengus* and sprat *Sprattus sprattus,* whilst sandeel Ammodytidae are amongst the most common benthopelagic species.

Herring are indicated to spawn near the entrance of the River Tawe in an area called Swansea Rough (Horsfall, I., pers. comm. 2013). Herring most likely use the *Sabellaria* reef and shore defences in the Swansea Bay area for spawning (Tidal Lagoon Swansea Bay plc, 2014c).

Surveys carried out in 2013 as part of the Swansea Bay Tidal Lagoon project found the Swansea Bay fish community to show seasonal fluctuations relating to movements of species between feeding, spawning and nursery areas. A variety of species moved to shallow intertidal areas to feed in summer, whilst during winter fish moved offshore into deeper subtidal waters. These movements are likely a consequence of temperature, ontogenic development and prey availability.

Migratory fish

The River Tawe is important for migratory fish namely European eel *Anguilla anguilla*, Atlantic salmon *Salmo salar*, sea trout *Salmo trutta*, river lamprey *Lampetra fluviatilis* and sea lamprey *Petromyzon marinus*. These fish migrate past the Proposed Development between Swansea Bay and the River

Tawe during their migration to and from their spawning grounds. Possible residency and spawning periods of fish found within Swansea Bay are identified in Table 17.

The River Tawe has the greatest number of salmon in the area and numbers have been steadily increasing since 1976 (Environment Agency, 2002 cited in Tidal Lagoon Swansea Bay plc, 2014c). Inter-annual variation in salmon and sea trout numbers is evident based on rod catch data, though broad scale estimates suggest fairly stable populations (Tidal Lagoon Swansea Bay plc, 2014c). However, anecdotal accounts from the Environment Agency suggest migratory fish numbers have declined over the last ten years, and numbers are in decline across the rest of the UK (Environment Agency, 2011; Tidal Lagoon Swansea Bay plc, 2014c).

European eel migrates from oceanic locations towards rivers as glass eels (juveniles) during spring and early summer (Tidal Lagoon Swansea Bay plc, 2014c). They then migrate upstream as elvers and stay in freshwater environments for several years as adults (or yellow eels). They migrate to sea towards the end of their life span as silver eels to spawn. Oceanic migrations begin between August and December, but predominantly from October (Righton *et al*., 2016). They reproduce offshore in the western-central Atlantic Ocean (Sargasso Sea).

River and sea lamprey are qualifying features of Carmarthen Bay and Estuaries SAC. Lamprey spend their adult lives at sea and return to rivers to spawn. Typically, river lamprey show fidelity to their spawning grounds, whereas sea lamprey undertake significant oceanic movements (Tidal Lagoon Swansea Bay plc, 2014c). Sporadic catches of lamprey have been reported in the Tawe in Environment Agency electric fishing data. There is limited evidence to indicate the extent of lamprey spawning grounds in the rivers flowing into Swansea Bay, however, fishery surveys undertaken by NRW and Environment Agency between 2001 and 2012 found juvenile lamprey in the River Tawe (and in the River Neath and River Kenfig) at low densities. Furthermore, spawning of river lamprey is observed by the Environment Agency on an annual basis in most rivers proximate to Swansea Bay (Evans, H., pers. comm., 15th February 2013; Tidal Lagoon Swansea Bay plc, 2014c). No evidence is available to indicate significant sea lamprey spawning occurs in the locality of the Proposed Development (Tidal Lagoon Swansea Bay plc, 2014c).

Twaite shad is a primary feature and allis shad *Alosa alosa* is a qualifying feature of Carmarthen Bay and Estuaries SAC. No spawning populations of twaite shad *Alosa fallax* or allis shad *Alosa alosa* are found in Swansea Bay (Table 17).

Evidence suggests that following construction of the Swansea Barrage migratory fish incurred some delay during their movements between tidal and non-tidal reaches of the estuary. However, following modification to improve energy dissipation levels within the pools in 2001, the fish pass now allows fish to migrate under a wide range of environmental conditions (Tidal Lagoon Swansea Bay plc, 2014c).

Table 17. Possible residency (green) and spawning periods (red) of key fish and shellfish species found within Swansea Bay[16]

Species	J	F	M	A	M	J	J	A	S	O	N	D	Life Stage
Non-diadromous fish													
Herring													
Lesser sand eel													
Sole													
Sprat													
Thornback ray													
Diadromous fish													
Allis shad													
Atlantic salmon										*	*		RA
													KE
													SM
European eel			*										G/E
													A
River Lamprey													
Sea Trout													RA
													KE
													SM
Shellfish													
Common mussel													
Native oyster													

RA Returning adult; KE Kelt; SM Smolt;
G/E Glass eel or elver; A Adult.
* NRW in their screening opinion has advised that the peak migration times for RA Atlantic Salmon should include October and November, and for G/E European eel should include March

Source: Tidal Lagoon Swansea Bay plc, 2014c

Marine mammals

Relatively high densities of harbour porpoise *Phocoena phocoena* have been recorded in Swansea Bay. The Proposed Development is located in the Celtic and Irish Seas (CIS) Management Unit which contains the Bristol Channel Approaches cSAC, as well as the North Anglesey Marine cSAC and West Wales Marine cSAC (which have all been identified for the protection of harbour porpoise). Harbour porpoise occur within the Bristol Channel Approaches cSAC year-round but during the winter, persistently higher densities of harbour porpoise occur in this site compared to other parts of the CIS Management Unit[17].

[16] The possible residency periods of Twaite Shad and sea lamprey in Swansea Bay are unknown.
[17] http://jncc.defra.gov.uk/page-7241

Oakley *et al.* (2016) report a continuous presence of harbour porpoise within Swansea Bay and the Gower for 12 months of the year and a density of 0.58 harbour porpoise (hp) km^2. Predominantly summer observations of females with calves and regional strandings records suggest breeding takes place within Swansea Bay and the Gower (Oakley *et al.*, 2016). Data suggests that Swansea Bay is important for both foraging and also potentially as a calving and nursery area for harbour porpoise (Evans *et al.*, 2015; Jenkins and Oakley 2013; Baines and Evans, 2012). Data reviewed and collected by Oakley *et al.* (2016) indicates that Swansea Bay is used as nursery area, whereas areas further west around the Gower are used for calving. Harbour porpoise hotspots for feeding and foraging exist throughout Swansea Bay, particularly surrounding Port Talbot and the Mumbles (Oakley *et al.*, 2016). Despite this, it is considered relatively unlikely that harbour porpoise regularly use the area in the direct vicinity of the Proposed Development (i.e. within the channel adjacent to Swansea West Pier). This is because it is deemed too shallow at certain phases of the tide, and nearshore estuarine environments are not normally associated with cetacean species. They also tend to be cautious of anthropogenic activity.

Other cetaceans such as bottlenose dolphin *Tursiops truncatus* and short-beaked common dolphin *Delphinus delphis* are recorded infrequently in Swansea Bay (Tidal Lagoon Swansea Bay plc, 2014d). The relevant Marine Mammal Management Unit for bottlenose dolphin is the Offshore Channel, Celtic Sea & South West England (OCSW) Management Unit. No SACs fall within this unit that are designated for bottlenose dolphin as a primary reason for selection and qualifying feature respectively. Common porpoise *Phocoena phocoena* has been recorded within 1 km of the Proposed Development in 2007.

Grey seals *Halichoerus grypus* are recorded relatively frequently in low numbers in Swansea Bay. The nearest established colony is at Worms Head on the Gower Peninsula (approximately 30 km from Swansea Bay) although small numbers have also been occasionally observed hauling out at the Mumbles. Grey seals have been observed foraging in the Tawe Estuary, particularly around the Swansea Barrage fish ladders[18,19] which are located around 50 m from the Proposed Development. The South and West England and Wales Management Unit contain the Pen Llyn a'r Sarnau SAC, Cardigan Bay SAC and Pembrokeshire Marine SAC. Grey seal is a qualifying feature of Pen Llyn a'r Sarnau SAC and Cardigan Bay SAC, and a primary reason for the selection of Pembrokeshire Marine SAC.

Coastal birds

Coastal birds, particularly overwintering birds, are an important feature of Swansea Bay and a detailed assessment was undertaken for Swansea Bay Tidal Lagoon project (Tidal Lagoon Swansea Bay plc, 2014e). Targeted bird surveys encompassing the River Tawe were carried out during high and low tides between 2011 and 2013. A total of 31 and 29 coastal bird species were identified during winter surveys at low tide and high tide respectively. This included Sanderling as the only species regularly recorded in nationally important numbers and Ringed Plover, Oystercatcher and Dunlin were recorded in regionally important numbers.

There is a limited amount of information on the abundance and distribution of waterbirds specifically using the foreshore in the vicinity of the Proposed Development. SCC has advised that Ringed Plover and other species are known to occasionally use the area for feeding and foraging, and autumn/winter migrants recorded in the vicinity include Dunlin, Grey Plover, Curlew, Whimbrel, Bar-tailed Godwit, Great Crested Grebe, Velvet Scoter and Great Skua. Species record data obtained from SEWBReC and the Aderyn system revealed species including Lapwing, Slavonian Grebe, Common Scoter, Scaup, Black-throated Diver, Great Northern Diver, Common Black-headed Gull, Little Gull, and

[18] http://www.mylifeoutside.co.uk/2011/09/swansea-seals.html;
[19] https://www.youtube.com/watch?v=_NADorxXURc

Mediterranean Gull occur within 1 km of the Proposed Development. However, the intertidal mudflat in the immediate locality of the Proposed Development is considered unlikely to be a key foraging habitat for birds due to the abundance of alternative foraging habitat is Swansea Bay. In addition, given the high levels of existing anthropogenic activity adjacent to the foreshore, the area is unlikely to be an important roosting location. Nevertheless, based on an understanding of waterbird distribution in the wider area, it is considered likely that the foreshore is used by a range of species (mainly waders and gulls) during overwintering and passage periods.

6.2.3 Impact assessment

The following impact pathways have been assessed with respect to marine ecology:

- Direct habitat loss as a result of the Proposed Development;
- Deposition of sediments during construction;
- Introduction of non-native species during construction and operation;
- Underwater noise and vibration during construction;
- Airborne noise and visual disturbance during construction; and
- Changes in water quality during construction.

Direct habitat loss as a result of the Proposed Development

The impact of direct habitat loss due to bed preparation works, piling and the new retaining wall relates to the permanent physical removal of intertidal substratum and associated organisms. Intertidal habitats are vulnerable to physical loss at locations where new structures are introduced onto the seabed (i.e. within the Proposed Development 'footprint').

The construction of the Proposed Development will involve bed preparation works covering an area of 1,200 m^2 in front of Swansea Inner West Pier (within the footprint of the Proposed Development). This will cause a direct physical removal of intertidal sediments, causing a modification of the existing intertidal habitat. The fauna associated with the removed material will therefore be damaged or killed.

The new retaining wall will extend up to 5 m into intertidal zone compared to current position, comprising 0.265 hectares. Within these areas, intertidal marine habitat will be lost, as well as habitat on the current Swansea Pier wall. Steel piles (both tubular and sheet) are considered poor for species attachment due to its smooth surface. Therefore, although the new steel piles will be recolonised by benthic species following construction of the Proposed Development, species assemblages are likely to be less abundant and diverse than the current structure.

Should any scour protection be required at the toe of the new retaining wall (likely to be in the form of loose rip-rap), this will cause loss of mud and sand sediment which is available to intertidal benthic species. However, this will also provide an alternative hard substratum for recolonisation by benthic species following construction of the Proposed Development. Hard defences such as rip-rap offer more habitat complexity (compared with sediment or smooth featureless walls) due to crevices between blocks and large rough surfaces for attachment (Davis *et al.*, 2002; Chapman and Underwood, 2013).

The footprint of intertidal habitat loss is considered negligible in the context of the overall amount of similar marine habitats found locally in Swansea Bay and ABP land. In addition, most of the habitats and species recorded are generally considered commonly occurring and are not listed as nationally rare or protected under conservation designations. Although, a single native oyster *Ostrea edulis* was observed and isolated small patches of degraded honeycomb worm *Sabellaria alveolata* (thin layer

rather than reef) were present, these were not in significant numbers and were largely absent from the area.

The exposure to change is considered Low. This is based on a Small magnitude of change due to the relatively small footprint of intertidal habitat that will be lost, and a High probability of occurrence.

The vulnerability is considered Low. This is based on a Low exposure to change, and a Low sensitivity of the feature. This is attributed to the relative tolerance of benthic habitats and species to change and the relatively fast recolonisation of space following disturbance.

Overall, the impact is considered **Insignificant** based on a Low vulnerability of feature to the impact (above) and the Low importance of the feature, as species are generally commonly occurring and not protected under legislation.

Deposition of sediments at the disposal ground

Dredged sediments from the bed preparation works are proposed to be deposited at the Swansea (Outer) licenced disposal ground (LU130)[20]. Therefore, there is potential for smothering of benthic ecology at this location and surrounding area.

An estimated 1,800 m^3 of material is proposed to be disposed of at the disposal ground. This disposal ground is an active site and is used annually for the disposal of maintenance material from the region.

Maximum sedimentation across the extent of the sediment plume will principally occur within and in close vicinity to the disposal ground (Tidal Lagoon Swansea Bay, 2014e). Deposition is expected to be in the order of millimetres due to the small scale of deposited material. Sedimentation of this scale is unlikely to result in significant smothering effects to most faunal species. Furthermore, the subtidal habitats and species within and around the disposal ground have been subject to changes brought about by regular disturbance for many years (by ongoing maintenance dredging and intermittent capital dredge campaigns as well as natural variability). This is reflected by a relatively sparse faunal assemblage that is expected to be tolerant and highly recoverable to the proposed levels of disposal.

The magnitude of change is considered to be Negligible, given the small scale of dredged material that is proposed to be deposited at sea. The probability of occurrence is considered high, resulting in a Negligible exposure to change.

The sensitivity of the feature is considered Low, which when combined with a Negligible exposure to change (above), results in a vulnerability of None.

As such, the impact of smothering benthic ecology at the disposal ground is assessed as **Insignificant**, based on a Low importance of the feature and a vulnerability of None (above).

Introduction of non-native species during construction

Non-native, or invasive, species are described as 'organisms introduced by man into places outside of their natural range of distribution, where they become established and disperse, generating a negative impact on the local ecosystem and species' (International Union for Conservation of Nature (IUCN), 2011). The ecological impacts of such 'biological invasions' are considered to be the second largest threat to biodiversity worldwide, after habitat loss and destruction. In the last few decades marine and

[20] If disposal at sea is not deemed appropriate by NRW, and disposal of dredged material on land is required, this will be subject to separate consenting and permissions.

freshwater systems have suffered greatly from invasive species as a result of increased global shipping (Carlton and Geller, 1993; Seebens *et al*., 2013).

The main pathway for the potential introduction of non-native species is via fouling of vessels' hulls, transport of species in ballast or bilge water and the accidental imports from materials brought into the system as a result of the development. Pathways involving vessel movements (fouling of hulls and ballast water) have been identified as the highest potential risk routes for the introduction of non-native species (Carlton, 1992; Pearce *et al*., 2012), which agrees with the fact that areas with a high volume of shipping traffic are hotspots for non-native species in British waters (Pearce *et al*., 2012). For the Proposed Development, the use of marine craft during construction has the potential to introduce and spread non-native species.

The fouling of a boat hull and other below-water surfaces can be reduced through the use of protective coatings applied to the hull. These coatings usually contain a toxic chemical (such as copper) or an irritant (such as pepper) that discourages organisms from attaching. Other coatings, such as those that are silicone-based, provide a surface that is more difficult to adhere to firmly, making cleaning of the hull less laborious. The type and concentration of coatings that can be applied to a boat hull is regulated and can vary from country to country. Maintenance of hulls through regular cleaning will minimise the number of fouling organisms present. Hull cleaning can take place on land or in-water. In both cases, care should be taken to prevent the organisms from being released into the water. By following best management practices, the impact of the cleaning procedure on the environment can be minimised.

Non-native invasive species also have the potential to be transported via ship ballast water. Seawater may be drawn into tanks when the ship is not carrying cargo, for stability, and expelled when it is no longer required. This provides a vector whereby organisms may be transported long distances. However, no vessels that use ballast water will be used during the construction of the Proposed Development (see Section 6.4). In 2004 the International Maritime Organisation (IMO) adopted the 'International Convention for the Control and Management of Ships' Ballast Water and Sediments', which introduced two performance standards seeking to limit the risk of non-native invasive species being imported (including distances for ballast water exchange and standards for ballast water treatment). The Convention came into force in September 2017.

The UK is bound by international agreements such as the Convention on Biological Diversity, the United Nations Convention on the Law of the Sea, the Convention on the Conservation of Migratory Species of Wild Animals (Bonn Convention 1979), the Convention on the Conservation of European Wildlife and Natural Habitat (Bern, 1979) and the Habitats and Birds Directives. All of these include provisions requiring measures to prevent the introduction of, or control of, non-native species, especially those that threaten native or protected species (JNCC, 2004). Additionally, Section 14(1) of the Wildlife and Countryside Act (WCA) (1981) makes it illegal to release, or allow to escape into the wild, any animal which is not ordinarily resident in Great Britain and is not a regular visitor to Great Britain in a wild state or is listed in Schedule 9 to the Act. These commitments are expected to be subject to greater international enforcement over time.

In view of binding international agreements and legislation, the probability of the introduction and spread of non-native species from construction phase of the Proposed Development is considered to be Low. Given that the magnitude of change ranges from Negligible to Large depending upon the scale and nature of any non-native species introduction, the exposure to change ranges from Negligible to Low at worst.

The sensitivity of benthic habitat and species to non-native species introductions is expected to range from Low to Moderate. Vulnerability is therefore considered to be Low at worst.

The importance of the benthic community is considered to be Low given the habitats and species are commonly occurring in the local area and generally of low conservation concern. The overall impact is therefore considered to be **Insignificant**.

Underwater noise and vibration during construction

Elevated underwater noise and vibration levels during piling operations can potentially disturb marine animals by causing physiological damage and/or inducing adverse behavioural reactions.

A detailed underwater noise assessment has been undertaken for the Proposed Development (Appendix G) and is summarised in this section. For most piling activities, the main source of noise and vibration relates to where piles are hammered or vibrated into the ground. Percussive piling involves hammering the pile into the seabed resulting in an impact blow and high levels of noise. Vibro-piling produces lower levels of noise as piles are vibrated into the seabed.

Fish

There is a wide diversity in hearing structures in fish which leads to different auditory capabilities across species (Webb *et al.*, 2008). All fish can sense the particle motion component of an acoustic field via the inner ear (Radford *et al.*, 2012; Hawkins and Popper, 2016), and noise detection ('hearing') becomes more specialised with the addition of further hearing structures. Particle motion is especially important for locating sound sources through directional hearing (Popper *et al.*, 2014; Hawkins *et al.*, 2015; Nedelec *et al.*, 2016). Although many fish are also likely to detect sound pressure, particle motion is considered equally or potentially more important (Hawkins and Popper, 2016).

Since it is not possible to determine the hearing sensitivity for all fish species, one approach to understand hearing has been to distinguish functional hearing groups on the basis of differences in their anatomy and what is known about hearing in other species with comparable anatomy. Categories proposed by Popper *et al.* (2014) for each of the key fish species found in the study area are presented in Table 18. Essentially fish with swim bladders, and particularly fish with swim bladders/air cavities that aid hearing, are more sensitive to sound pressure.

Table 18. Categorisation of key fish species in the study area according to Popper *et al.* (2014) criteria

Swim bladder or air cavities aid hearing	Swim bladder does not aid hearing	No swim bladder
Herring (*Clupea harengus*) Sprat (*Sprattus sprattus*)	Atlantic salmon (*Salmo salar*) European eel (*Anguilla anguilla*) Sea trout (*Salmo trutta*)	Dab (*Limanda limanda*) Flounder (Platichthys flesus) Gobies (*Gobius* spp.) Plaice (*Pleuronectes platessa*), River lamprey (*Lampetra fluviatilis*) Sandeels e.g. lesser sandeel (*Ammodytes tobianus*) Sea lamprey (*Petronmyzon marinus*) Sole (*Solea solea*) Thornback ray (*Raja clavata*)

Particle motion rather than sound pressure is considered to be potentially more important to fish without swim bladders and salmonids. Acoustic particle motion in the water and seabed, for example, has been shown to induce behavioural reactions in sole (Mueler-Blenkle *et al.*, 2010). However, there is no published literature on the levels of particle motion generated during construction activities (e.g. pile-driving and dredging) and the distance at which they can be detected. Direct measurements of particle motion have also been hampered by the lack of guidance on data analysis methods. As such, the scope for considering particle motion in underwater noise assessments is currently limited (Faulkner *et al.*, 2018).

The noise exposure criteria that have been applied to this assessment are presented in Table 19. The Popper *et al.* (2014) cumulative Sound Exposure Level (SEL) criteria for percussive piling have been used to determine the potential for mortality, injury and temporary hearing damage (temporary threshold shift, TTS) for each of the fish hearing categories identified in Table 18.

The onset of behavioural responses is much more difficult to quantify as reactions are likely to be strongly influenced by behavioural or ecological context and the effect of a particular response is often unclear and may not necessarily scale with received sound level (Hawkins and Popper, 2014; Hawkins *et al.*, 2015; Faulkner *et al.*, 2018). An empirical behavioural threshold could be adopted using *in situ* observed responses of fish to similar sound sources (Faulkner *et al.*, 2018). Hawkins *et al.* (2014) reported behavioural responses of schools of wild sprat and mackerel to playbacks of pile driving. At a single-pulse SEL of 135 dB re 1 μPa^2 s, schools of sprat and mackerel were observed to disperse or change depth on 50 % of presentations. Sprat and mackerel have specialised hearing structures and are likely to have similar acoustic characteristics to the clupeid species in the study area, namely herring and sprat. This threshold should therefore be applicable to these clupeid species. Other species in the study area lack any hearing specialisations and therefore this threshold is likely to be an indicator of subtler behavioural responses in these fish. In the absence of similar data for other species, this threshold has been applied for all fish species.

Table 19. Fish noise exposure criteria applied in this assessment

Fish hearing category	Mortality/potential mortal injury	Recoverable injury	TTS	Behaviour/ displacement
Swim bladder involved in hearing	> 207 dB SEL_{cum}	> 203 dB SEL_{cum}	> 186 dB SEL_{cum}	135 dB SEL_{single}
Swim bladder is not involved in hearing	> 210 dB SEL_{cum}	> 203 dB SEL_{cum}	> 186 dB SEL_{cum}	135 dB SEL_{single} ^
No swim bladder	> 219 dB SEL_{cum}	> 216 dB SEL_{cum}	> 186 dB SEL_{cum}	135 dB SEL_{single} ^
Eggs and larvae	> 210 dB SEL_{cum}	Not available	Not available	Not available

SEL_{cum} denotes cumulative SEL with a reference value of 1 μPa^2 s over a 24 hour period.
SEL_{single} denotes single pulse SEL with a reference value of 1 μPa^2 s over a 1 second period.
All criteria are presented as sound pressure even for fish without swim bladders since no data for particle motion exist (Popper *et al.*, 2014).

Elevated levels of noise above background are predicted to be limited to the area between the Swansea Barrage and the Eastern Breakwater, with no changes occurring in the wider Swansea Bay area. The maximum distance of predicted changes from piling one pile, or two piles concurrently, is 770 m (on the western edge of the Eastern Breakwater). This relatively localised area of change or "effects zone" is due to the physical boundaries and constrained nature of the study area.

The potential exists for any fish species to be killed or physiologically damaged should they remain in the predicted effects zone for 24 hours during percussive piling. This is considered highly unlikely

given that fish can move away if necessary. Assuming, as a worst case, that fish do not attempt to avoid the piling and that they are passively transported by the tide they would be within the effects zone for up to 12% of the time (up to 2.8 hours) that would be required for an injury to occur. Fish are, therefore, not anticipated to be at risk of injury from the percussive piling.

Any fish species present within the effects zone during percussive piling are anticipated to elicit a behavioural reaction, the scale of which will be largely dependent on the hearing sensitivity, size and swimming ability of the fish, as well as their behavioural or ecological context. In this way, migratory fish may have such a strong urge to migrate through the Swansea Barrage fish pass that they do not actively avoid this area despite the elevated levels of noise. Should this be the case, as discussed above, the levels of noise during percussive piling are not anticipated to result in a risk of injury in any fish species. Should migratory fish, however, actively avoid the area during percussive piling, a delay or change in the pattern of migration could have population level consequences. However, percussive piling is only estimated to be required for up to 37% of the installation time for each tubular pile and therefore there will be periods in the night time and during pile positioning and set up when fish will not be affected and can migrate freely.

The exposure to change is assessed as Medium for migratory fish. This is based on a High probability of occurrence and a Medium magnitude of change. The former is attributed to the fact that piling operations will overlap with the migratory periods for key migratory species that use the River Tawe, including Atlantic salmon and European eel. The latter is attributed to the fact that elevated noise levels are constrained to a relatively localised area, are unlikely to cause injury to fish and will not be continuous, whilst recognising there is potential for a delay or a change in migration patterns.

For non-migratory fish (i.e. resident or spawning fish species), the exposure to change is assessed as Low. This is because there is a High probability of occurrence and the magnitude of change is considered Small due to the constrained noise levels and lack of important fish foraging, nursery or spawning habitat (in comparison with the rest of Swansea Bay) in the vicinity of the Proposed Development.

The vulnerability is considered Moderate for migratory fish. This is based on a Medium exposure to change (above) and a Moderate sensitivity of the feature given the fact Atlantic salmon and European eel have a swim bladder where the organ does not appear to play a role in hearing.

The vulnerability is also considered Moderate for non-migratory fish, based on a Low exposure to change (above) and a worst case High sensitivity of the feature given non-migratory fish in the Swansea Bay area, include herring and sprat which are clupeid species that have a swim bladder or air cavities that aid hearing.

Overall, the impact of underwater noise without the application of any mitigation measures is considered **Moderate Adverse** for migratory fish based on a Moderate vulnerability of feature to the impact (above) and the High importance of the feature, given their nature conservation protection. For non-migratory fish, the impact of underwater noise in advance of the application of mitigation measures is considered **Minor Adverse/Insignificant** based on a Moderate vulnerability of feature to the impact (above) and generally Low importance in terms of nature conservation status.

Marine mammals

In comparison to fish, marine mammals are more sensitive to noise at higher frequencies and generally have a wider range of hearing than fish (i.e. their hearing ability spans a larger range of frequencies). The hearing sensitivity and frequency range of marine mammals varies between

different species and is dependent on their physiology. For example, odontocete cetaceans (toothed whales, porpoises and dolphins) are particularly sensitive to high frequencies.

The key marine mammals species found in the study area comprise harbour porpoise and grey seal. According to NOAA (2018), harbour porpoise fall into the high-frequency cetaceans (HF) hearing category and grey seal fall into the phocid pinnipeds (PW) hearing category. The NOAA (2018) acoustic thresholds for the onset of TTS and permanent threshold shift (PTS) due to impulsive sound sources (i.e. impact pile drivers) are presented in Table 20.

Behavioural reactions to acoustic exposure are less predictable and difficult to quantify than effects of noise exposure on hearing or physiology as reactions are highly variable and context specific (Southall *et al.*, 2007). Whilst recognising these limitations, Southall *et al.* (2007) reviewed a number of studies to determine possible SEL behavioural response criteria for individual marine mammals exposed to single pulses (Table 20). There are no equivalent SEL behavioural response criteria for multiple pulses that would represent the percussive piling that is required for the Proposed Development. The single pulse SEL criteria have therefore been compared to the weighted model outputs for high-frequency cetaceans and phocid pinnipeds to provide a high level indication of the potential scale of disturbance.

Table 20. Marine mammal noise exposure criteria applied in this assessment

Hearing group	PTS	TTS	Behaviour/ displacement
High-frequency cetacean (HF)	155 dB SEL_{cum}	140 dB SEL_{cum}	183 dB SEL_{single}
Phocid pinniped (PW)	185 dB SEL_{cum}	170 dB SEL_{cum}	171 dB SEL_{single}
SEL_{cum} denotes cumulative SEL with a reference value of 1 μPa^2 s over a 24 hour period. SEL_{single} denotes single pulse SEL with a reference value of 1 μPa^2 s over a 1 second period. These thresholds should be applied to weighted levels.			

As described for fish, elevated levels of noise above background are predicted to be limited to the area between the Swansea Barrage and the Eastern Breakwater, and the maximum distance of predicted changes from piling one pile, or two piles concurrently, is 770 m.

Temporary and/or permanent hearing injury could occur in both harbour porpoise and grey seal if marine mammals were to remain stationary within this predicted effects zone for 24 hours during percussive piling. This area is not a key foraging area for marine mammals and does not have a seal haul out and therefore any marine mammals that happen to be present are likely to evade the area. Assuming a worst case low swim speed, they will be able to leave the effects zone within 10 minutes. This is 0.7% of the time that would be required for an injury to occur and therefore marine mammals are not considered to be at risk of any permanent or temporary injury during percussive piling.

Behavioural disturbance in marine mammals is predicted to occur within a maximum distance of 130 m from the source of piling two piles concurrently for harbour porpoise and 350 m for grey seal. As for fish, periods of disturbance will occur intermittently and for more than 63 % of the installation time, specifically in the night and during pile positioning and set up, marine mammals will not be affected and can continue to use the area.

The exposure to change is considered to be Low for marine mammals, given a High probability of occurrence and a Small magnitude of change. The latter is based on the constrained nature of elevated noise levels arising from the Proposed Development and the generally low value habitat for marine mammals compared to Swansea Bay and the wider area. Harbour porpoises are considered

unlikely to occur within the channel adjacent to the Proposed Development, with grey seal foraging movements expected to be infrequent.

Marine mammals are considered to have a Moderate to High sensitivity to lower frequency impulsive noise (e.g. percussive piling), and therefore the vulnerability is assessed as Moderate, taking into account a Low exposure to change (above).

Based on a Moderate vulnerability (above), and a High importance of the feature given the level of protection marine mammals are afforded, the impact of underwater noise on marine mammals without mitigation is considered to be **Moderate/Minor Adverse**.

Airborne noise and visual disturbance during construction

Coastal birds

Evidence suggests that waterbirds generally show a flight response to construction activities and a presence of people on the foreshore at distances of between 20 m and 100 m. However, distances over 200 m have been recorded for some sensitive species (IECS, 2009).

Habituation of birds to human activities is known to occur, with birds regularly subjected to such activities showing more tolerance. Evidence also suggests that birds can further habituate to the regular noise resulting from piling activity after a short period (ERM, 1996; ABP Research, 2001) and disturbance due to construction activities has been shown to cause similar or less disturbance than that of other existing nearby activities (such as human presence on the foreshore or vessels) (ERM, 1996; IECS, 1997).

It has been assumed that piling and other construction activities will overlap with the overwintering and passage bird periods. Within a construction site the level of disturbance stimuli is dependent on the type of activity being undertaken.

Based on the above information, construction activity is expected to generally cause infrequent, mild behavioural responses in a localised area in the vicinity of the works. The responses observed are likely to range from increased vigilance, avoidance walking and short flights with birds rapidly resettling and resuming feeding or roosting near their original location. Nevertheless, localised avoidance and larger disturbance events (causing birds to flush and temporarily disperse from the vicinity of the construction zone) could occur. Rather than evacuating the area completely, birds would be expected to redistribute to other nearby adjacent mudflats in Swansea Bay. It should be noted, however, that waterbirds present in the area will already be habituated to the presence of human activity and vessel movements.

The probability of occurrence is considered High with a Small magnitude of change given the temporary and localised nature of the impact, with no permanent displacement of birds from the area predicted. Therefore, a Medium exposure to change is expected.

The vulnerability is assessed as Low, based on a Medium exposure to change (above) and a Low to Moderate sensitivity of the feature (depending upon species and the degree of established habituation). The latter is attributed to the infrequent, mild behavioural responses expected from coastal birds as a result of construction works for the Proposed Development, and likely habituation of coastal birds in the area to the presence of human activity and vessel movements.

The importance of the feature is scored as High because of the protection afforded to overwintering birds. Therefore, the impact of temporary disturbance during construction has been assessed as **Minor Adverse** taking into account a Low vulnerability (above).

6.2.4 Mitigation measures and residual effects

In order to avoid and/or minimise significant adverse impacts (i.e. those that are Moderate or Major Adverse, see Section 5.2.4), a number of mitigation measures are proposed. These are set out below together with the assessment of residual effects following the application of mitigation measures.

Introduction of non-native species during construction

Despite an insignificant impact, in order to manage potential non-native species risks as a result of the Proposed Development a Biosecurity Plan will be produced.

In November 2015, Marine Biosecurity Planning Guidance for England and Wales was published. This document provides guidance on developing site-based biosecurity plans for a number of activities, including construction programs. Current legislation in England and Wales does not require biosecurity plans to be in place for construction activities; however, the development of such a document may be a condition of the marine licence for the proposed plans. The Marine Biosecurity Planning Guidance for England and Wales is therefore a best practice guidance document only (Payne *et al.,* 2015). This guidance will be followed when developing the Biosecurity Plan.

Underwater noise and vibration during construction

Fish

In order to reduce noise disturbance impacts to fish during piling, the following mitigation measures will be implemented:

- Soft start: The gradual increase of piling power, incrementally, until full operational power is achieved will be used as part of the piling methodology. This will give fish the opportunity to move away from the area before the onset of full impact strikes. The duration of the soft start is proposed to be 20 minutes in line with the JNCC "Statutory nature conservation agency protocol for minimising the risk of injury to marine mammals during piling" (JNCC, 2010).
- Vibro piling: Vibro piling is proposed to be used where possible (which produces lower source noise levels than percussive piling) and is likely to constitute the majority of the piling operations. However, in order to drive the piles to the required design level in certain circumstances percussive piling will be required.
- Piling restrictions: All piling activities are proposed to take place between mid-September and mid-March to reduce overlap with the key sensitivity periods for migratory fish. These timings also allow the new retaining wall to be constructed over a single construction period and avoid the need to re-mobilise the marine works a second year which would extend the overall construction programme and increase the risk of further pier collapse in the interim.

The above proposed mitigation measures are likely to reduce the exposure to change from Medium to Low for migratory fish, and from Low to Negligible for non-migratory, resident/spawning fish. Therefore, the significance of the residual effects for underwater noise and vibration during construction is assessed as **Minor Adverse** and **Insignificant** for migratory fish and non-migratory, resident/spawning fish, respectively.

Marine mammals

As discussed above, vibro piling and soft start procedures will be used where possible to reduce noise disturbance impacts to marine mammals. The soft start procedure highlighted in the JNCC "Statutory nature conservation agency protocol for minimising the risk of injury to marine mammals during piling" (JNCC, 2010) will be adhered to.

The above proposed mitigation measures are likely to reduce the significance of the impact of underwater noise and vibration during construction on marine mammals. Therefore, the significance of the residual effects for underwater noise and vibration during construction on marine mammals is assessed as **Minor Adverse**.

6.2.5 Summary and conclusions

This section reports the assessment of potential impacts on marine ecology receptors during the construction and operational phase of the Proposed Development. With the adoption of appropriate mitigation measures, it is considered that significant marine ecology effects can be avoided and/or minimised. A summary of the impact pathways that have been assessed and the residual impacts following the application of mitigation measures is presented in Table 21.

Table 21. Summary of potential impact, mitigation measures and residual impacts for marine ecology

Receptor	Impact pathway	Impact significance	Mitigation measures/Monitoring	Residual impact	Confidence
Benthic habitats and species	Direct habitat loss as a result of the Proposed Development	Insignificant	N/A	Insignificant	High
	Deposition of sediments at the disposal ground	Insignificant	N/A	Insignificant	High
	Introduction of non-native species during construction	Insignificant	Development of a Biosecurity Plan.	Insignificant	Medium
Fish	Underwater noise and vibration during construction	Moderate Adverse (migratory fish) Minor Adverse/ Insignificant (non-migratory fish)	Soft start piling procedures; Vibro piling as much as possible; and Piling restrictions.	Minor Adverse (migratory fish) Insignificant (non-migratory)	Medium
Marine mammals	Underwater noise and vibration during construction	Moderate/Minor Adverse	Soft start piling procedures; and Vibro piling as much as possible.	Minor Adverse	Medium
Coastal birds	Airborne noise and visual disturbance during construction	Minor Adverse	N/A	Minor Adverse	Medium

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6.3 Terrestrial Ecology

This section presents the assessment of potential impacts on terrestrial ecology receptors during the construction and operation of the Proposed Development.

6.3.1 Consultation and scope

Based on the Screening and Scoping Report (ABPmer, 2018), and the subsequent advice provided by NRW and statutory consultees (see Section 5.1), Table 22 presents the receptors relevant to terrestrial ecology, the impact pathways and further work that has been carried out to inform the marine licence application.

Table 22. Impact pathways and summary of further work for terrestrial ecology

Receptor	Impact Pathway	Requires Further Assessment?	Justification	Summary of Further Work
Habitats	Disturbance/damage to open dune habitat (Section 7 Priority Habitat) during construction	No	Landward access to the Proposed Development and to the adjacent landside works could potentially result in the disturbance and/or damage of open dune habitat. In order to mitigate for this potential effect, this habitat will be avoided during the construction phase and only existing access along the hard standing areas and bare ground will be used. This mitigation measure will be detailed in a CMP (see Section 4.4.8). On this basis, this impact pathway is not considered to require any further assessment work.	No further assessment work has been undertaken for this impact pathway.
Habitats	Maintenance of open dune habitat during operation	No	The Proposed Development will result in a new retaining wall and will cease the current loss of sand through the failed sections of the existing pier structure. The Proposed Development will also maintain the beach and dune in their current positions. The Proposed Development is therefore considered to have a beneficial effect on open dune habitat. On this basis, this impact pathway is not considered to require any further assessment work.	No further assessment work has been undertaken for this impact pathway.
Habitats	Disturbance/damage to locally designated site, Swansea SINC, during construction	No	Landward access to the Proposed Development and to the adjacent landside works could potentially result in the disturbance and/or damage of open dune habitat and bare sand habitats within the SINC. In order to mitigate for this potential effect, this habitat will be avoided during the construction phase as much as possible and only existing access along the hard standing areas and bare ground will be used. This mitigation measure will be detailed in a CMP (see Section 4.4.8). This impact pathway is therefore not considered to require any further assessment work.	No further assessment work has been undertaken for this impact pathway.
Native Species	Spread of invasive non-native species into the wild during construction	Yes	There is potential, without mitigation, for the Proposed Development and adjacent landside works to cause the spread of invasive non-native species. In order to manage any potential risks of introducing non-native species during the works, a Biosecurity Plan will be prepared and included within a CMP (see Section 4.4.8). This plan will include best practice measures to avoid or minimise the risk of introducing any invasive	SCC has advised that invasive non-native species located on the Swansea Bay sand dunes include New Zealand flax (*Phormium* sp.) and the potential spread of this species has therefore been assessed.

Receptor	Impact Pathway	Requires Further Assessment?	Justification	Summary of Further Work
			non-native species during construction.	
Rare Plants and plant species of conservation concern	Damage to or removal of rare plants and/or plant species of conservation concern during construction	Yes	SCC has advised that in recent years, prickly saltwort *Salsola kali* subsp. *Kali* has colonised and spread across the sand dune trials areas located west of the Civic Centre, with some plants also recorded at Swansea Point dunes, close to the Proposed Development. It is noted that no plants were found during the Phase 1 habitat survey, but nonetheless, there are recent records and therefore this will require further assessment. Other Section 7 species which occur on the Swansea Bay sand dunes include the nationally scarce /IUCN Endangered classification small-flowered catchfly *Silene gallica* and the nationally rare / IUCN Vulnerable classification sea stock *Matthiola sinuata*. The impacts on these rare species will require further assessment.	This impact pathway has been assessed as per SCC advice.
Invertebrates	Habitat disturbance/damage for generalist and Priority invertebrate species during construction	No	Landward access to the Proposed Development and to the adjacent landside works could potentially result in the disturbance and/or damage of habitat that supports generalist and Priority invertebrate species, namely open dune and grassland habitats. In order to mitigate for this potential effect, this habitat will be avoided during the construction phase and only existing access along the hard standing areas and bare ground will be used. This mitigation measure will be detailed in a CMP (see Section 4.4.8). On this basis, this impact pathway is not considered to require any further assessment work.	No further assessment work has been undertaken for this impact pathway.
Invertebrates	Disturbance to Priority invertebrate species from external lighting during construction	No	There is potential, without mitigation, for any external lighting used during construction to impact on Priority invertebrate species. In order to mitigate for this potential effect, the use of lighting will be minimised and if required, directional lighting will be used during the construction phase. This mitigation measure will be detailed in CMP (see Section 4.4.8). On this basis, this impact pathway is not considered to require any further assessment work.	No further assessment work has been undertaken for this impact pathway.
Invertebrates	Disturbance to Priority invertebrate species from	No	No lighting is proposed on the new pier structure during operation and therefore this impact is not	No further assessment work has been undertaken for this impact pathway.

Receptor	Impact Pathway	Requires Further Assessment?	Justification	Summary of Further Work
	external lighting during operation		relevant and does not require any further assessment work.	
Reptiles	Disturbance/damage to habitat supporting reptiles or injury/killing of reptiles during construction	No	Reptile surveys of the ecology study area (Thomson Ecology 2017a) did not identify any reptiles present on site and desk study records did not return any results of reptiles within 1 km of the Proposed Development. A search was carried out on SEWBReC Aderyn (as per SCC advice) which returned one result of common lizard (*Zootoca vivipara*), however, this was dated from 2002 and is therefore outside of the ten years considered as current records. Therefore, it is considered that reptiles are likely absent from the application site. The 'eastern site compound' will be located on disused port ground at Swansea Docks and the 'western site compound' will be located in the car park to the west of the Proposed Development (Figure 1). The site compounds are therefore confined to hard standing and as such should not impact on suitable reptile habitat and it is unlikely reptiles will be present. Good practice working methods will be used during construction, which will provide precautionary mitigation. These will be detailed CMP (see Section 4.4.8). This impact pathway is therefore not considered to require any further assessment work.	No further assessment work has been undertaken for this impact pathway.
Terrestrial birds	Disturbance/damage to open dune and dune scrub habitats supporting breeding birds	No	Landward access to the Proposed Development and to the adjacent landside works could potentially result in the disturbance and/or damage of habitat that supports breeding birds, namely open dune and dune scrub habitats. The construction works are anticipated to commence in autumn/winter 2019 which would be outside of the spring breeding season. These areas of habitat will be avoided as detailed above. Best practice measures will be detailed in a CMP (see Section 4.4.8). On this basis, this impact pathway is not considered to require any further assessment work.	No further assessment work has been undertaken for this impact pathway. Coastal birds are addressed within the marine ecology section (Section 6.2).
Terrestrial birds	Disturbance from external lighting during construction	No	There is potential, without mitigation, for any external lighting used during construction to impact on terrestrial breeding birds. The construction works are anticipated to commence in autumn/winter 2019 which would be outside of the spring breeding season.	No further assessment work has been undertaken for this impact pathway. Coastal birds are addressed within the marine ecology section (Section 6.2).

Receptor	Impact Pathway	Requires Further Assessment?	Justification	Summary of Further Work
			Furthermore, best practice measures will be detailed in a CMP (see Section 4.4.8). On this basis, this impact pathway is not considered to require any further assessment work.	
Terrestrial birds	Disturbance from external lighting during operation	No	No lighting is proposed on the new pier structure. This impact pathway is therefore not relevant and does not require any further assessment work.	No further assessment work has been undertaken for this impact pathway. Coastal birds are addressed within the marine ecology section (Section 6.2).
Terrestrial birds	Disturbance from noise and vibration during construction	No	There is potential, without mitigation, for the landside works to impact on terrestrial breeding birds. The construction works are anticipated to commence in autumn/winter 2019 which would be outside of the spring breeding season. Furthermore, best practice measures will be detailed in a CMP (see Section 4.4.8). On this basis, this impact pathway is therefore not considered to require any further assessment work.	No further assessment work has been undertaken for this impact pathway. Coastal birds are addressed within the marine ecology section (Section 6.2).
Bats	Disturbance from external lighting during construction	Yes	Roosting bats are considered likely to be absent from the vicinity of the Proposed Development and adjacent landside works. Low numbers of bats are likely to use the application site for foraging. There is potential, without mitigation, for any external lighting used during construction to impact on bats using open dune and grassland habitat for foraging. In order to mitigate for this potential effect, the use of lighting will be minimised and if required, directional lighting will be used during the construction phase. This mitigation measure will be detailed in a CMP (see Section 4.4.8). Despite this, SCC has advised that the impact of construction lighting on bats should be assessed.	As per SCC advice, this impact pathway has been assessed and a species action plan for European Protected Species (including bat) has been prepared (Appendix F).
Bats	Disturbance from external lighting during operation	No	No lighting is proposed on the new pier structure. This impact pathway is therefore not relevant and does not require any further assessment work.	No further assessment work has been undertaken for this impact pathway.
Bats	Disturbance from noise and vibration during construction	Yes	Roosting bats are considered likely to be absent from the vicinity of the Proposed Development and adjacent landside works. There is potential, without mitigation, for any construction noise to impact on bats using open dune and grassland habitat for foraging. SCC has advised that the impact of construction noise on bats should be assessed and mitigation measures detailed in a CMP.	As per SCC advice, this impact pathway has been assessed and a species action plan for European Protected Species (including bat) has been prepared (Appendix F).

Receptor	Impact Pathway	Requires Further Assessment?	Justification	Summary of Further Work
Otter	Disturbance from external lighting during construction	Yes	SCC has advised that otters are present in the vicinity of the Proposed Development and therefore the impact of lighting during construction should be assessed.	As per SCC advice, this impact pathway has been assessed and a species action plan for European Protected Species (including otter) has been prepared (Appendix F).
Otter	Disturbance from external lighting during operation	No	No lighting is proposed on the new pier structure. This impact pathway is therefore not relevant and does not require any further assessment work.	No further assessment work has been undertaken for this impact pathway.
Otter	Disturbance from noise and vibration during construction	Yes	SCC has advised that otters are present in the vicinity of the Proposed Development and therefore the impact of noise and vibration during construction should be assessed.	As per SCC advice, this impact pathway has been assessed and a species action plan for European Protected Species (including otter) has been prepared (Appendix F).

6.3.2 Baseline review

Data sources

The principal data sources that have informed this assessment are as follows:

- South East Wales Biological Records Centre (SEWBReC); and
- Swansea City Council (SCC) for data on sites of importance for nature conservation (SINCs);
- SEWBReC Aderyn database[21] (a freely available data source) for additional protected species records within 1 km of the application site following SCC advice.

An ecology study area was defined which encompassed the Proposed Development and an area to the west of the Proposed Development (Figure 14). The locations of the designated sites are also shown on Figure 14.

Preliminary ecological appraisal (PEA)

A preliminary ecological appraisal (PEA) was carried out by Thomson Ecology in August 2017 which comprised a Phase 1 habitat survey of the ecology study area (Thomson Ecology, 2017a). During the survey, it was not possible to access the channel of the River Tawe, east of the seawall for health and safety reasons and Heras fencing along the top of the sea wall prevented a visual inspection from above. Therefore, it was not possible to identify plant species present within this area of the application site. Photographs of the area were provided by ABPmer and no plant species were visible within these photos. The habitats identified during the Phase 1 habitat survey of the ecology study area are described below and shown on Figure 15:

Semi-improved Grassland

There is a strip (approximately 0.05ha) of semi-improved grassland (SI1 on Figure 15, Photograph 1 on Figure 16) in the east of the survey area. The semi-improved grassland is dominated by perennial rye-grass (*Lolium perenne*) and cock's foot (*Dactylis glomerata*).

Open Dune

The survey area is dominated by open dune (approximately 3.1ha, OD1 on Figure 15). The open dune has abundant marram grass (*Ammophila arenaria*) and bramble (*Rubus fruticosus agg.*) with frequent sea spurge (*Euphorbia paralias*) and ragwort (*Senecio jacobaea*). There is a boardwalk across part of the dunes in the east (see Photograph 2 on Figure 16). Additionally in the east of the site there is an area of open habitat which consists of sand (BG1/TN1 on Figure 15 and Photograph 3 on Figure 16) and a slim walkway along the beach between the dunes and the edge of the sea wall (approximately 2m wide).

Amenity Grassland

In the north-east of the survey area are two areas (approximately 0.08ha combined) of amenity grassland (AM1 and AM2 on Figure 15 and Photograph 4 on Figure 16).

[21] The SEWBReC Aderyn site excludes records of sensitive species from the database including bats and otters.

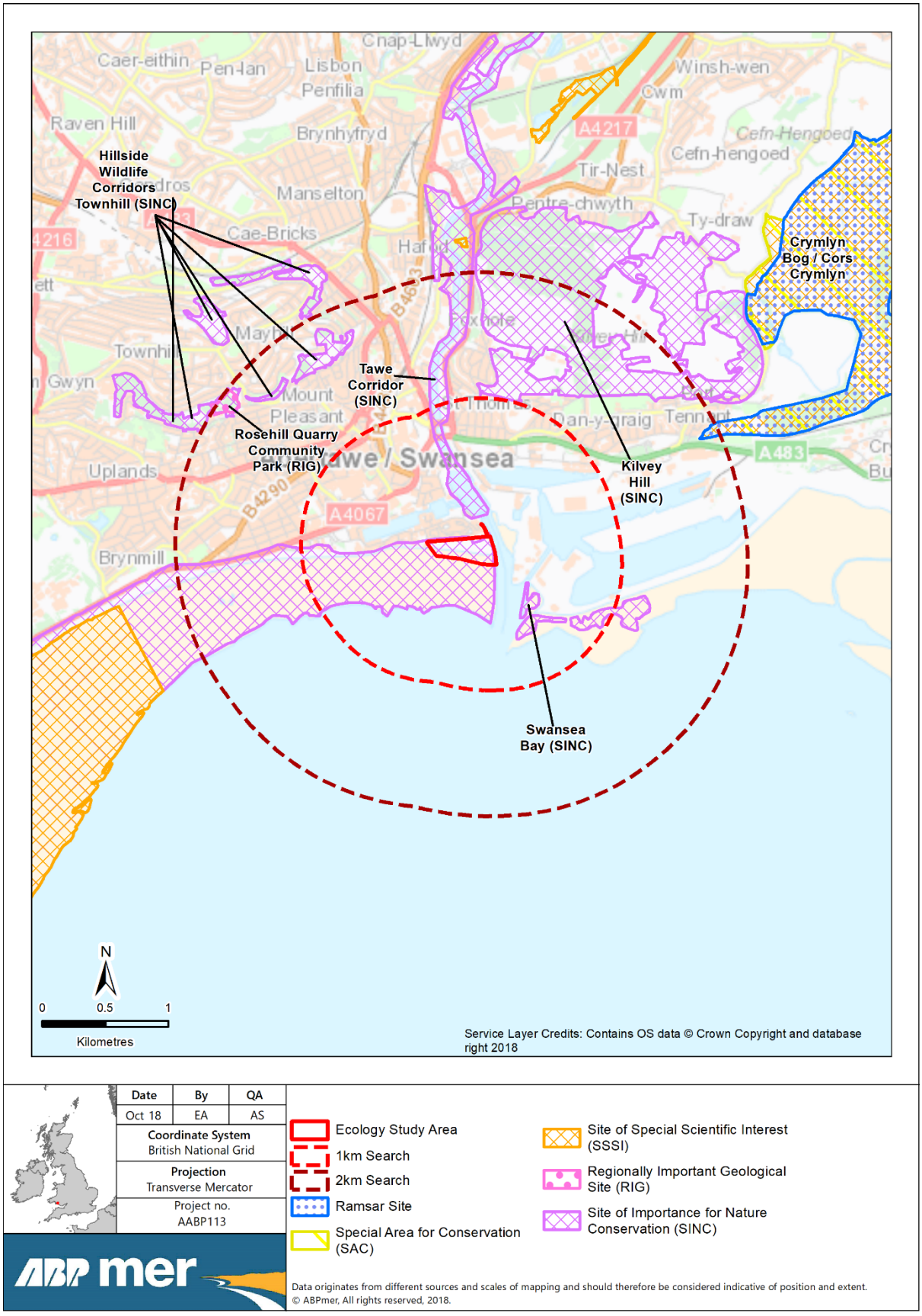

Figure 14. Site location, study area and desk study results

Running Water

There is brackish running water (RWB1 on Figure 15) in the east of the site (approximately 0.2ha). The running water is the River Tawe, it was not possible to access this area to identify whether any vegetation was present.

Sea Wall

There is a sea wall (approximately 0.2ha) that extends along the entire east of the site (SWALL on Figure 15). There is no flora along the sea wall.

Bare Ground

There are two areas of bare ground on site (BG1/TN1 and BG/TN2 on Figure 15 and Photographs 4 and 5 on Figure 16). BG1/TN1 is approximately 0.1ha and consists of sand in the east of the site amongst OD1. BG2/TN2 covers an area of approximately 4.6ha and consists of sand. There is no flora within this habitat.

Hardstanding

There is an area of hardstanding in the north of the site which consists of a car park to the east and paved footpaths. There is no flora within this habitat.

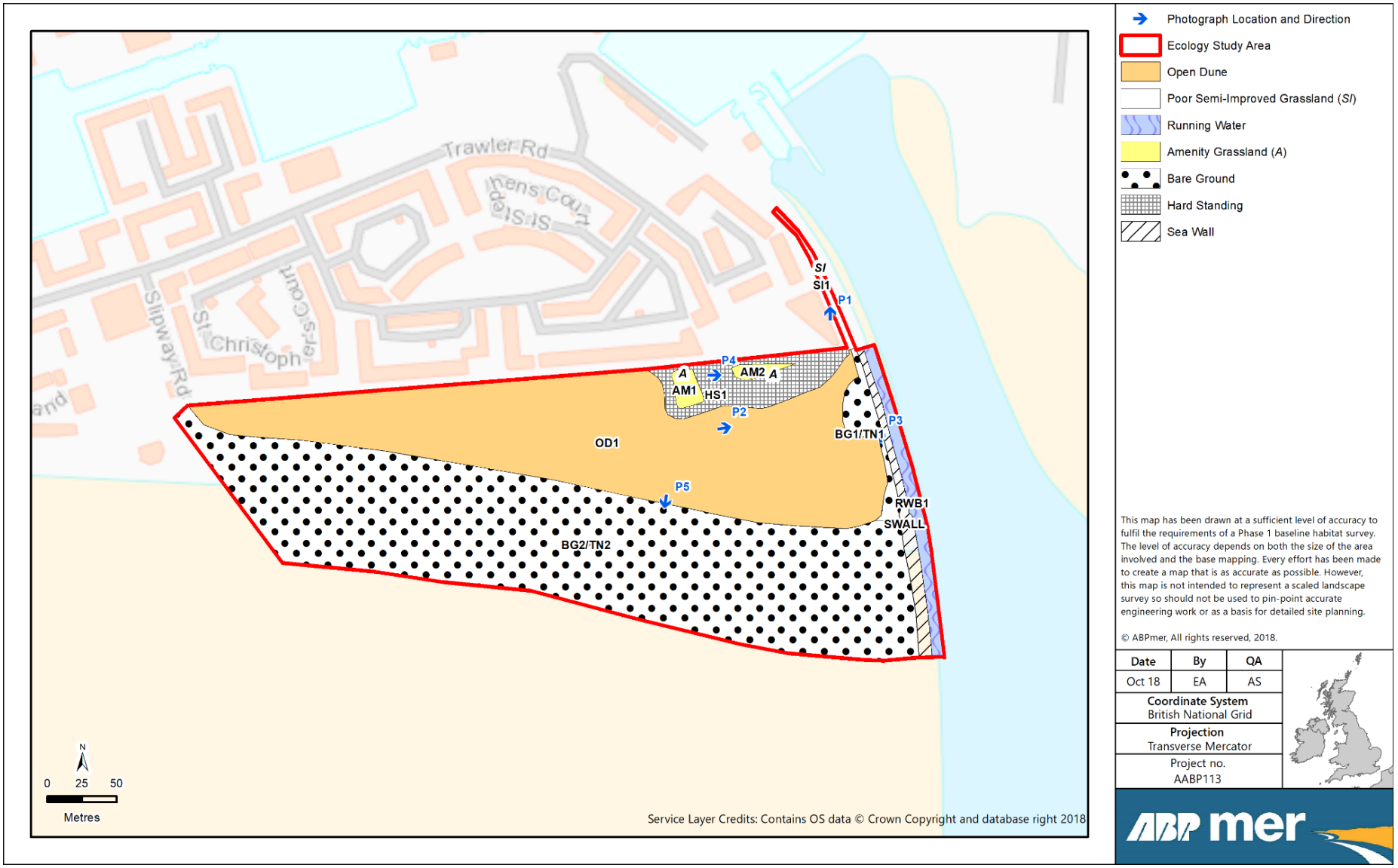

Figure 15. Extended Phase 1 habitat survey results

Figure 16. Photographs of the site

Rare plants

The desk study identified records of prickly saltwort (*Salsola kali subsp. Kali*) within the vicinity of the Proposed Development (Thomson Ecology, 2017a). Prickly saltwort is a Section 7 Priority Species under the Environment (Wales) Act 2016. Prickly saltwort grows on the upper drift line of beaches, just above the high tide mark and typically at the seaward edge of developing sand dunes. No prickly saltwort plants were identified as part of the Phase 1 habitat survey. On the basis of habitat suitability, prickly saltwort is considered likely to be absent from the Proposed Development and unlikely to occur in the vicinity of the works, as these are above mean high water springs (MHWS). A targeted search for this plant species has therefore not been undertaken.

Small-flowered catchfly (*Silene gallica*) are known to exist within Swansea Bay Site of Interest for Nature Conservation (SINC), however no records of this species were returned within 1 km of the ecology study area and no plants were identified as part of the Phase 1 habitat survey. Small-flowered catchfly is a Schedule 7 Priority Species and is an endangered Red Data Book species (IUCN[22]). This plant species is typically found along the margins of agricultural fields and favours sandy and sandy loam soils and can be found in coastal habitats. It is considered unlikely to be present within the Proposed Development as no desk study records exist and no plants were identified during the Phase 1 habitat survey. A dedicated search for this plant species has therefore not been undertaken.

Sea stock (*Matthiola sinuata*) is a Schedule 7 Priority Species and a Vulnerable Red Data Book species. No records of this species were returned within 1 km of the Proposed Development and no plants were identified as part of the Phase 1 habitat survey. Sea stock is considered likely to be absent from the Proposed Development and unlikely to occur in the vicinity of the works as sea stock typically grows in early successional mobile sand or strand line shingle communities and the Proposed Development is above MHWS. A targeted search for this plant species has therefore not been undertaken.

Plant species of conservation concern

Desk study records were purchased from SEWBReC in July 2017, species records were sought for the ecology study area including the application site and the area within 1 km of the site. Table 23 below gives the results of the desk study of plants that are of conservation concern.

Of the thirteen records listed in Table 23 only six are likely to occur within the ecology study area: bladder campion, dune fescue, oak-leaved goosefoot, sand's cats-tail, sand feather-moss and sea buckthorn. Although these plants are of conservation concern they do not currently receive legal protection.

Table 23. Plants of conservation concern within 1 km of the ecology study area

Common name	Latin name	Status	Habitat
Autumn Lady's-tresses	*Spiranthes spiralis*	RD1 (UK), LBAP (CON, GWY, TRA), LI(SEWBReC)	Short grassland and damp slacks. Dry grassy habitats, meadows, garrigue, pine woodland and calcareous soils
Bladder Campion*	*Silene vulgaris*	WVP	Meadows, gardens, cultivated lawns, fields, banks, roadsides, wasteland,

[22] http://www.iucnredlist.org/

Common name	Latin name	Status	Habitat
			seashores and cracks in waterside rocks
Charlock	*Sinapis arvensis*	WVP	Arable fields, waste and disturbed ground, roadsides
Dune Fescue*	*Vulpia fasciculata*	RD2 (UK), LBAP (CON, FLI, GWY), LI(SEWBReC),	Sandy soils
Dwarf Spurge	*Euphorbia exigua*	RD1 (UK), LI(SEWBReC), WVP	Arable and particularly calcareous soils
Golden-samphire	*Inula crithmoides*	RD2 (UK), LBAP (ANG, BRG, GWY, NEW, NPT), LI(SEWBReC)	Upper saltmarshes, shingle banks and sea cliffs
Nicholson's Beard-moss	*Didymodon nicholsonii*	RD2 (UK), LI(BIS)	Flood zones of rivers and streams, stones, tree roots and around structures e.g. bridges
Oak-leaved Goosefoot*	*Chenopodium glaucum*	RD1 (UK), RD2 (UK), WVP	Wasteland, docks and coastal areas
Sand cat's-tail*	*Phleum arenarium*	Not given	Sand dunes
Sand Feather-moss*	*Brachythecium mildeanum*	RD2 (UK)	Moist grassland, marshes and dunes
Sea Bindweed	*Calystegia soldanella*	RD1 (UK), LBAP (CON), LI(SEWBReC)	Sand dunes
Sea-buckthorn*	*Hippophae rhamnoides*	RD2 (UK), LBAP (CON)	Coastal areas and sand dunes
Variegated Horsetail	*Equisetum variegatum*	RD2 (UK), LBAP (ANG, BRG, CON, DEN, FLI, GWY), LI(SEWBReC)	Fen, marsh and swamp

LBAP (xxx)** = Local Biodiversity Action Plan Species **xxx denotes initials of Local Biodiversity Action Plan County (CON = Conwy, GWY = Gwynedd, TRA = Trunk Roads Estate, FLI = Flintshire, ANG = Isle of Anglesey, BRG = Bridgend, NEW = Newport, NPT = Neath Port Talbot, DEN = Denbighshire).
BIS = Biodiversity Information Service for Powys and Brecon Beacons National Park
LI (SEWBReC) = Locally Important Species (as identified by local specialists) in SEWBReC area.
RD1 (UK) = UK Red Data Book listing based on IUCN guidelines
RD2 (UK) = UK Red Data Book listing not based on IUCN guidelines (Nationally Rare and Scarce)
WVP = IUCN Threat Listing of Welsh Vascular Plants
*Species that are considered likely to occur within the ecology study area.

Invasive non-native plant species

A data search of the SEWBReC Aderyn site revealed one result of lesser New Zealand flax (*Phormium cookianum*) which is a non-native plant species. This plant species is not listed as a Schedule 9 invasive species under the Wildlife and Countryside Act 1981, as amended, however it is listed as non-native by the GB non-native secretariat and therefore, its spread in the wild should be avoided.

Bats

Suitable foraging habitat for bats exist within and adjacent to the application site, namely the River Tawe, and open dune and semi-improved grassland. The River Tawe provides the only 'landscape corridor' to the application site due to the absence of green linear features such as tree lines, hedgerow or open green spaces in the area surrounding the Proposed Development. The desk study returned records of common pipistrelle (*Pipistrellus pipistrellus)*, soprano pipistrelle (*Pipistrellus pygmaeus)* and Noctule bat (*Nyctalus noctule)* (Thomson Ecology, 2017a) which could be present

within the Proposed Development. Bats and their roosts are protected under the Conservation of Habitats and Species Regulations 2017 and Wildlife and Countryside Act 1981, as amended. Common pipistrelle, soprano pipistrelle and noctule bats are also Schedule 7 Priority Species under the Environment (Wales) Act 2016. There are no suitable potential roost locations within the application site.

Otter

No desk study results were returned of otter within 1 km of the Proposed Development however, following feedback from SCC, records of otter exist within 1.3 km of the Proposed Development. Otters are also known to be present on the River Tawe, however this is likely to be further north upstream of Swansea Barrage where there is less disturbance from the public and vessel movements. No suitable potential habitat to support otter holts exists within the ecology study area however suitable foraging habitat is present in the form of the River Tawe and Swansea Bay. Otters are not a designator feature of the Swansea Bay SINC or of any other protected sites located within 2 km of the Proposed Development. Otters are protected under Conservation of Habitats and Species Regulations 2017, Wildlife and Countryside Act 1981, as amended and the Environment (Wales) Act 2016.

6.3.3 Impact Assessment

The following potential impact pathways require consideration with respect to terrestrial ecology:

- Spread of invasive species during construction.
- Loss of rare plants and/or plant species of conservation concern during construction; and
- Disturbance due to increased lighting, noise and vibration during construction;

It is not anticipated that there will be any post-construction impacts on terrestrial ecology.

Spread of invasive species during construction

Human and plant traffic within the Proposed Development and adjacent areas could encourage the spread of lesser New Zealand flax. Lesser New Zealand flax is not listed under Schedule 9 of the Wildlife and Countryside Act 1981, however, it is listed as an invasive non-native species. This invasive plant lives in dune habitats, however, it has not been identified in the ecology study area.

As described above, there will not be any increase in people or plant movements within the dune habitat with access routes being planned along areas of existing bare ground or within Swansea Docks to the east. Therefore, it is anticipated that the potential to spread invasive species during construction is **Insignificant**.

Loss of rare plants and/or plant species of conservation concern during construction

The plant species described within the baseline review (Section 6.3.2) are considered important on a local scale, however, they do not receive any specific legal protection. Loss of these locally significant plant species could occur as a result of vehicles or people tracking over the dune habitat or the storage of materials within the dune habitat.

The majority of deliveries will take place to Swansea Docks where they will be transported to the application site by barge, therefore limiting any access required via the dunes. Access to the Proposed Development will take place using the following:

- The single lane access track to the east of the dunes (see BG1/TN1 on Figure 15 and Photograph 3 on Figure 16);

- The Southern end of Trawler Road;
- The Slipway; or
- A combination of these options.

Potential change to the habitat and impact on rare plant species and those of conservation concern is considered to be **Insignificant**. This is due to the route of the proposed access routes. Option one listed above has the highest possibility of impacting the dunes however there is an existing track alongside the dunes and access would be restricted to this route. This route will be marked out to ensure people or plant do not stray on to the dune area. Access via either road would follow a route along the sandy beach to the Proposed Development therefore avoiding the dune habitat.

As aforementioned the majority of deliveries will be to Swansea Docks and therefore the storage of materials will be on unused port land which comprises hard standing and will not impact on the protected or locally important plant species.

Disturbance due to increased lighting, noise and vibration during construction

Increased light, noise and vibration as a result of construction activities have the potential to impact on bats and otters. Increased light and noise could discourage bats from using the River Tawe as a commuting and foraging route. Additional lighting as well as noise and vibrations could deter otter from the area.

Bats

The piling works are planned to take place between mid-September and mid-March to reduce overlap with the key sensitivity periods for migratory fish (Section 6.2.4), and between the hours of 7am and 7pm. The bat hibernation period is between November and March, depending on weather and geographical location (Collins, 2016) therefore, the majority of the construction works will take place during the hibernation period. There is no suitable habitat for roosting bats within the Proposed Development therefore the timing of the works during the hibernation period should avoid potential impacts on bats. Bats can be active in September, October and April. During these months, daylight hours are shorter and therefore the additional lighting used during construction (between 7am and 7pm) could have an impact on bats. However, it is anticipated that the application site does not support high levels of foraging bats due to higher wind speeds associated with the coastal location, and high levels of artificial lighting present within the residential areas. The limited area (approx. 3.3ha) of habitat which would support invertebrates (the food source of bats) further reduces the potential for use by foraging bats.

The River Tawe is the main commuting corridor within the ecology study area and therefore the increase in light and noise within the application site could have a **Moderate Adverse** impact on bat behaviour.

Otters

Otters do not tolerate disturbance well and therefore increases in light levels, noise and vibration can deter otters from an area (Smal, 2008). No records of otter exist within 1 km of the development however SCC provided information that they have been recorded within 1.3 km of the Proposed Development. Otters have a large mobile range of around 16 km to 20 km with rare records showing they can travel up to 40 km (Chanin, 2013). Otters may therefore be present within and around the Proposed Development. Otters are generally nocturnal therefore the timing of the works between 7am and 7pm should avoid the main active period when otters may be foraging.

Due to the large mobile range of otters and the existing levels of disturbance within Swansea Bay and the River Tawe from commercial vessels, boats, fisherman, residents, dogs and tourists, it is anticipated that the impact of the Proposed Development on otters will be **Low to Moderate Adverse**.

6.3.4 Mitigation measures and residual effects

Spread of invasive species during construction

Although this impact pathway is considered insignificant, in order to manage potential non-native species risks as a result of the Proposed Development a Biosecurity Plan will be produced. This will include best practice measures to avoid or minimise the risk of introducing any invasive non-native species during construction.

Loss of rare plants and/or plant species of conservation concern during construction

Despite this impact pathway being assessed as insignificant, measures for minimising impact on sand dune habitat and associated plants will be included in the CMP (Section 4.4.8). These will include avoiding trekking over dune habitat and using existing routes which comprise bare ground. Access routes will also be clearly marked so people and plant do not stray on to dune habitat.

Disturbance due to increased lighting, noise and vibration during construction

Without mitigation there is the potential for a moderate adverse impact on bats and otters. A Species Protection Plan has been prepared for bats and otters which is provided in Appendix F. The Species Protection Plan details mitigation measures to ensure any potential adverse impacts are minimised with regards to bats and otters. A toolbox talk should be given to site workers and contractors describing the potential impacts of the Proposed Development on European Protected Species, the methods of working to minimise the impacts of lighting, noise and vibrations on bat and otter, how to identify an otter and what to do if an otter is seen during the works.

If the recommended mitigation measures detailed in the Species Protection Plan are implemented, the likely residual impact on bats and otters should be **Insignificant**.

6.3.5 Summary and Conclusions

This section reports the assessment of potential impacts on terrestrial ecology receptors during the construction and operational phase of the Proposed Development. Following the application of the mitigation measures as detailed in a Species Protection Plan (Appendix F), disturbance impacts on bats and otters during construction will be minimised. A summary of the impact pathways that have been assessed and the identified residual impacts following the application of mitigation measures is presented in Table 24.

Table 24. Summary of potential impacts, mitigation measures and residual impacts for terrestrial ecology receptors

Receptor	Impact pathway	Impact significance	Mitigation measures/Monitoring	Residual impact	Confidence
Native Species	Spread of invasive non-native species into the wild during construction	Insignificant	Development of a Biosecurity Plan.	Insignificant	High
Rare Plants and plant species of conservation concern	Damage to or removal of rare plants and/or plant species of conservation concern during construction	Insignificant	Avoidance of dune habitat; Using existing routes which comprise bare ground; and Clearly marking access routes.	Insignificant	High
Bats	Disturbance from external lighting, noise and vibration during construction	Moderate Adverse	A range of mitigation measures are included in the Species Protection Plan (Appendix F).	Insignificant	High
Otter	Disturbance from external lighting, noise and vibration during construction	Moderate Adverse		Insignificant	High

6.3.6 References

ABPmer (2018). Swansea Inner West Pier Works: Screening and Scoping Report. Document reference: R.2985.

Chanin, P. (2013). Otters. Whittet Books Ltd.

Collins, J. (2016). Bat Surveys, Good Practice Guidelines 3rd Edition. Bat Conservation Trust, London.

Smal, C. (2008). Guidelines for the treatment of otters prior to national road schemes. National Roads Authority.

Swansea City Council (2018). Ecological Report: Consents for the Swansea Inner West Pier Works – Screening and Scoping Report May 2018.

Thomson Ecology (2017a). Preliminary Ecological Appraisal, West Pier, Swansea Docks. Report Associated British Ports. September 2017 Thomson Ecology Report Ref: AABP113/001/001/001.

Thomson Ecology (2017b). Reptile Survey West Pier Swansea Docks. Associated British Ports. October 2017 Thomson Ecology Report Ref AABP113/002

6.4 Commercial and Recreational Navigation

This section presents the assessment of potential impacts of the Proposed Development on commercial and recreational navigation receptors.

6.4.1 Consultation and scope

Based on the Screening and Scoping Report (ABPmer, 2018), and the subsequent advice provided by NRW and statutory consultees (see Section 5.1), Table 25 presents the commercial and recreational navigation receptors, the impact pathways and further work that has been carried out to inform the marine licence application.

Table 25. Impact pathways and sumary of further work for commercial and recreational navigation

Receptor	Impact Pathway	Requires Further Assessment?	Justification	Summary of Further Work
Vessel navigation	Accident or incident involving commercial or recreational vessels during the construction works	Yes	The marine elements of the Proposed Development present an additional hazard for vessels navigating in the area. There is potential for vessels to make contact with the construction works or be involved in accidents or incidents following interaction with construction craft. This impact pathway will therefore require some further assessment work.	A Navigational Risk Assessment (NRA) has been carried out which considered all potential impacts on vessel navigation associated with the Proposed Development (Appendix E). The NRA considered vessels making contact with the Proposed Development and vessel collision between craft associated with the Proposed Development and other vessels.
	Displacement of vessels during construction	Yes	There is potential for the width of the navigable channel to be reduced during construction. This will lead to the displacement of vessels which in turn has the potential for accidents or incidents involving grounding, contact or collision with other vessels. This impact pathway will therefore require some further assessment work.	The NRA considered the potential incidents which may occur due to the presence of the Proposed Development. This included vessels avoiding the works and vessels being unaware of the Proposed Development.
	Accident or incident involving construction craft during construction	Yes	Construction craft will be operating in close proximity to the Proposed Development during construction. This close proximity reduces the time available for vessels and crew to react to situations that may lead to an accident or incident. This impact pathway will therefore require some further assessment work.	The NRA has considered the risk associated with construction craft operating at the application site.
	Vessel movement in the navigational channel during operation	No	The new wall will be constructed as close to the existing wall as possible which will result in a marginal reduction in the width of the channel adjacent to the Proposed Development. This change is considered negligible and it is not envisaged that this will pose significant risks to	No further work has been undertaken for this impact pathway.

Receptor	Impact Pathway	Requires Further Assessment?	Justification	Summary of Further Work
			navigation during operation of the Proposed Development. This impact pathway is therefore not considered to require any further assessment work.	
	Disruption to vessels during lock closure	No	Due to the location of the works and the inability to undertake the piling works from the landside, there will be a period where the jack-up barge will be blocking the Tawe Lock entrance. During this operation, the Lock will not be accessible. To limit disruption to the businesses operating in the area and recreational users, it is planned to coordinate the Proposed Development to coincide with the scheduled periods where the Lock is closed for maintenance. Clear and effective communication between the project team and Swansea Marina and Tawe Lock operators will be maintained to ensure disruption is minimised and any issues are resolved. The possibility of providing an alternative berth to commercial fisherman during the period of closure will also be explored.	No further work has been undertaken for this impact pathway.
	Dredger incident whilst on passage between application site and disposal area	Yes	There is the possibility of interaction between vessels involved with dredging at the application site and other vessels navigating in the area. This interaction is most likely to occur when the dredge vessel is transiting to or from the disposal site (Swansea (Outer) licenced disposal ground (LU130)). This impact pathway is therefore considered to require some further assessment work.	The NRA has considered the risk associated with dredge vessels transiting between the application site and the disposal site.
Water quality	Water quality impacts from pollutants	Yes	The fuel and oil carried on power driven vessels has the potential to be released into the water following an accident, incident or during	The NRA has considered water quality impacts associated with marine incidents involving vessels and operations which may result in substances

Receptor	Impact Pathway	Requires Further Assessment?	Justification	Summary of Further Work
	resulting from accidents, incidents or spillages during construction		operations. This release may be significant depending on the type and size of vessel involved. This impact pathway will therefore require some further assessment work.	entering the water.

6.4.2 Baseline review

Data Sources

The principal data sources that have informed this assessment are as follows:

- National Automatic Identification System (AIS) dataset 2015 (http://vision.abpmer.net/maritime/AIS2015/);
- Tawe Lock vessel statistics;
- Admiralty Chart 1161 and 1179;
- RNLI incident data; and
- ABP Maritime Navigation and Information Services (MarNIS) incident data.

Navigational environment

This section presents a description of the navigational features in the study area (Figure 17). The West Pier is situated adjacent to the port approach channel for Swansea Docks and the Tawe Lock which provides access to the River Tawe and Swansea Marina.

The marine works associated with the Proposed Development are located past the entrance to the commercial docks. The only commercial berth in the area is for Roll on, Roll off (RoRo) vessels and is not currently in use.

In the study area, there are a number of aids to navigation. These include a traffic light system to indicate the status of the Tawe Lock and that it is safe to enter. There are also lights to identify the southerly point of both the Eastern Breakwater and West Pier.

The aids to navigation for the entrances to Tawe Lock use a traffic light system with the meanings for the combinations of lights published on the Swansea Marina website. When the lights show that it is not safe to proceed, vessels are required to wait until the lights indicate that the vessel may proceed.

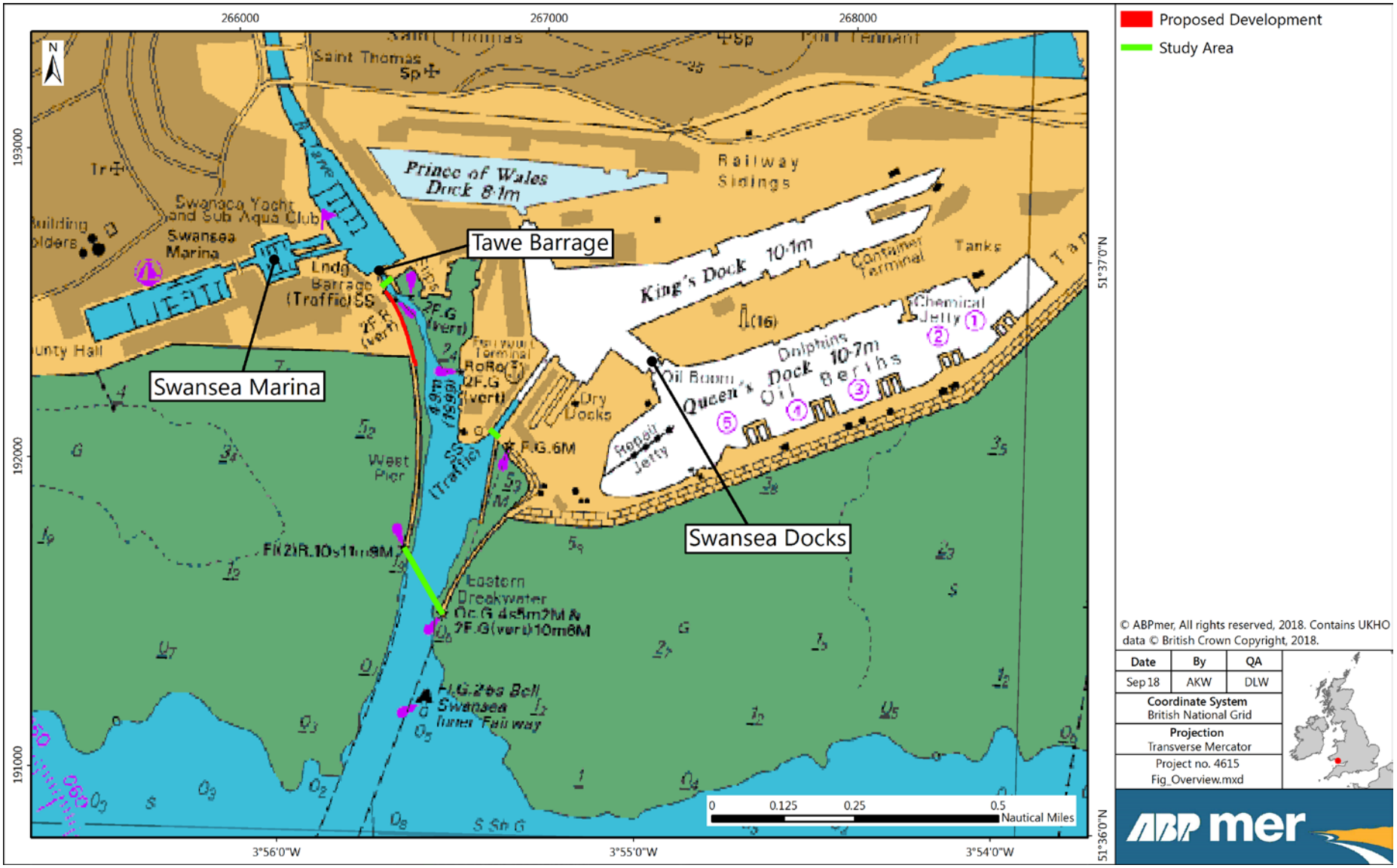

Figure 17. Area overview

Statutory responsibilities and management procedures

The study area is wholly contained within the Statutory Harbour Authority (SHA) area of ABP Swansea. Underpinning the powers of an SHA is a range of national legislation which places statutory responsibility on the Harbour Authority to ensure navigation and safety within the harbour limits; this includes the 'Harbours, Docks and Piers Clauses Act 1847' and the 'Harbours Act 1964'. This legislation means that ABP Swansea is the competent authority in relation to navigational safety and has responsibility under the Port Marine Safety Code (PMSC) and accompanying Guide to Good Practice on Port Marine Operations.

The Tawe Lock is operated by Swansea Council who requires that all vessels approaching Tawe Lock to pass the Swansea Barrage should contact the duty lockmaster for approach instructions via Very High Frequency (VHF) radio. Vessels transiting the channel on approach to the marina are required to wait until appropriately signalled by the traffic signals located at the Tawe Lock entrance.

Recreational facilities

Swansea Marina is located north of the Swansea Barrage and has 550 vessel berths. This marina regularly receives visiting vessels with up to 500 vessels per year. There are a further 200 recreational berths provided between the Tawe Lock and the entrance to the Swansea Marina. These berths are used by Swansea Yacht Club and Sub-Aqua Club (SYCSAC), as well as approximately 20 fishing boats.

The Tawe Lock is operated between the hours of 0700 and 2200 hrs, throughout the summer and 0700 to 1900 hrs, throughout the winter with the exception of weekends where they remain at summer operation times.

Emergency response

In the case of emergencies, ABP Swansea as SHA will implement its Regional Port Emergency Plan. This plan specifies the means for raising the alarm, summoning assistance and establishing the role of organisations involved. This allows the co-ordination of the activities necessary in safeguarding life, property and the environment and to ensure that everyone is aware of the procedures to be adopted in the event of an emergency. ABP Swansea will contact the Coastguards should a marine emergency require on-site assistance from the emergency services.

Marine incidents

To characterise maritime incidents occurring within the study area, available data have been collated from Royal National Lifeboat Institution (RNLI) callout data and ABP records to represent a 10-year period. The resulting data set has been presented spatially in Figure 18 and summarised in Table 26.

Table 26. Marine Incidents

Incident Category	Year											Annual Frequency
	2008	2000	2010	2011	2012	2013	2014	2015	2016	2017	Total	
Equipment failure (vessel)		3	2	3		1	2	2		1	14	1.4
Grounding	4						2	3	2		11	1.1
Impact with Structure							3	1	4		8	0.8
Other nautical safety	1		1				1		1		4	0.4
Person in distress			1					2	1		4	0.4
Total	**5**	**3**	**4**	**3**	**0**	**1**	**8**	**8**	**8**	**1**	**41**	**4.1**

Table 26 shows that there are on average 4.1 incidents per year with the most common incident type being equipment failure (vessel) with 17 reported incidents over the 10-year period. The majority of these incidents involved recreational vessels having problems with engines. The next most common incident type is that of grounding with 13 occurrences in the period. It can be seen from Figure 18 that these incidents occur in the intertidal areas and are most likely due to the masters/skippers of vessels being unaware of the banks in the area.

There were four incidents within the period which occurred in close vicinity to the Proposed Development. One of these involved a fouled propeller on a sailing vessel when attempting to leave the Tawe Lock, the other three incidents involved groundings. All of the groundings involved recreational vessels transiting to or from the Tawe Lock.

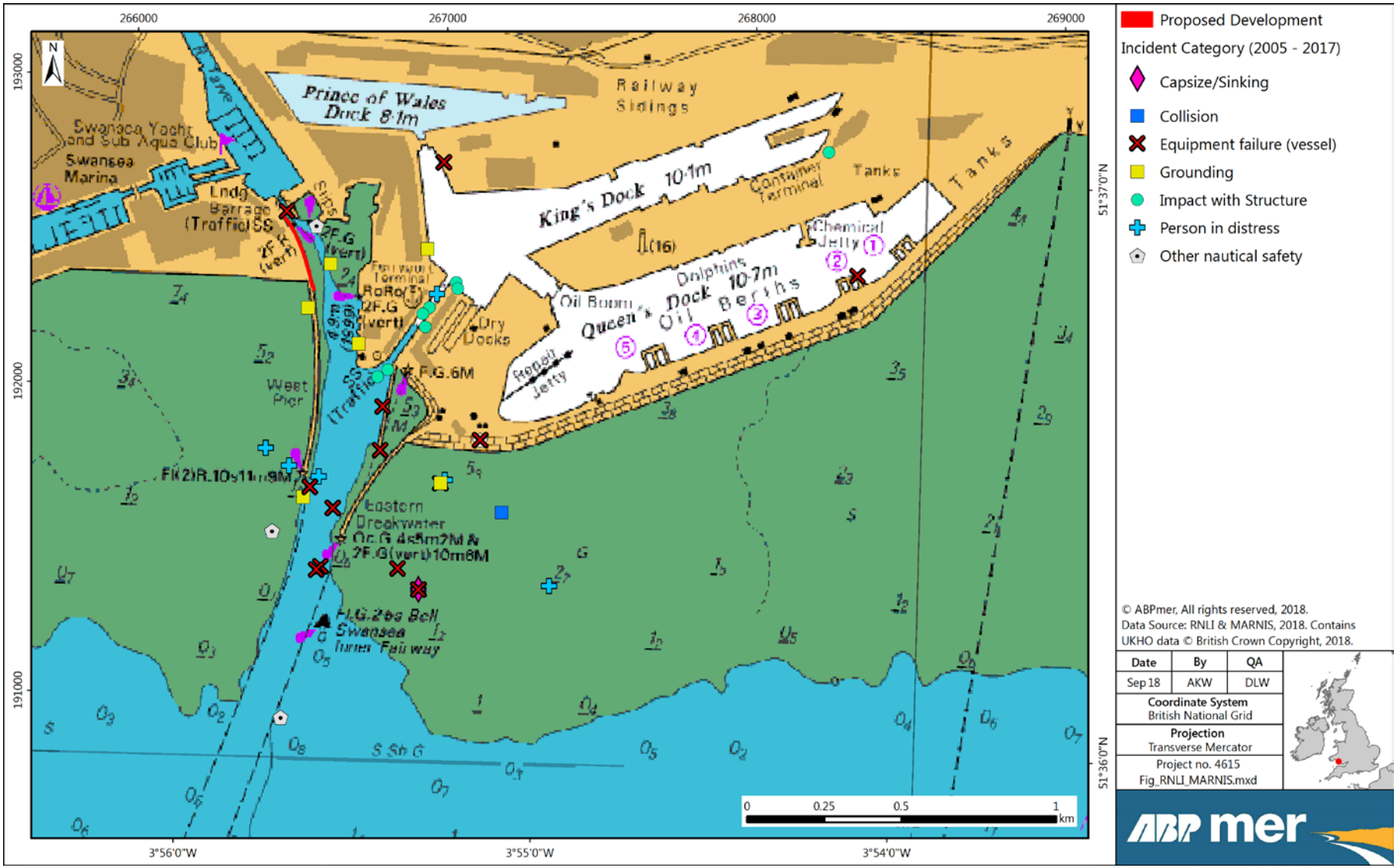

Figure 18. Marine incidents

Marine Traffic Analysis

This section presents both recreational navigation and commercial shipping traffic within the study area, using information collated from vessel AIS transit analysis and records from the Tawe Lock. The AIS data represent a composite of 84 days of AIS data collected in 2015. The following periods of time form the dataset:

- 1 to 7 from each of the following: January, February, March, April, May, June, July, August and November 2015;
- 8 to 14 of October 2015;
- 29 August to 4 September 2015; and
- 3 to 9 December 2015.

The AIS vessel transits are shown in Figure 19 and have been split by vessel type in Figure 20 to Figure 23. Tawe Lock data has been presented for the period from January 2014 to December 2017.

AIS vessel transits

AIS transits in the area have been split to show a count of all vessels passing the Outer West Pier and Eastern Breakwater (Transect 2) and all vessels passing Swansea Docks to, or from, Tawe Lock (Transect 1). These counts have been split into the categories used to identify the different vessel types and is presented in Table 27 and Table 28.

Table 27. Vessel transits by ship type group passing Outer West Pier and Eastern Breakwater

Vessel Category	Transit Line Count (84 days)	Uplifted (Yearly) Transit Count	Transit Count Percentage
Unknown*	11	48	2.8
Non-port service	15	65	3.9
Port service	203	882	52.5
Dredging/underwater	38	165	9.8
Military/law	21	91	5.4
Passenger	2	9	0.5
Cargo	17	74	4.4
Fishing	8	35	2.1
Recreational	71	309	18.4
Grand Total	**386**	**1678**	**100**

* Vessel type 'unknown' is an AIS record which is not correctly transmitting its vessel type at the time of data collection and cannot therefore be assigned a vessel type. It is included in the dataset to ensure full representation of known vessel activity.

Data Source: Data is representative of 84 days of AIS-A and AIS-B data from MCA terrestrial AIS receivers:
1 to 7 from January, February, March, April, May, June, July, August, November 2015;
29 August to 04 September 2015;
08 to 14 October 2015; and
03 to 09 December 2015.

The most frequent vessel type passing the Outer West Pier and Eastern Breakwater is that of port service craft, which represents 52.5% of vessel traffic in the data sampling period (Table 27). Port service vessels include pilot vessels and tugs, so a large proportion of these vessel transits will include the towage operators based in the commercial docks operated by ABP. The next most frequent vessel type is recreational, comprising 18.4% of vessel transits. Most of these vessels proceed towards or from Tawe Lock and Swansea Marina.

Table 28. Vessel transits by ship type group transiting to/from the Tawe Lock

Vessel Category	Transit Line Count (84 days)	Uplifted (Yearly) Transit Count	Transit Count Percentage
Unknown*	5	22	3.4
Non-port service	12	52	8.3
Port service	47	204	32.4
Military/law	20	87	13.8
Recreational	61	265	42.1
Grand Total	**145**	**630**	**100**

* Vessel type 'unknown' is an AIS record which is not correctly transmitting its vessel type at the time of data collection and cannot therefore be assigned a vessel type. It is included in the dataset to ensure full representation of known vessel activity.

Data Source: Data is representative of 84 days of AIS-A and AIS-B data from MCA terrestrial AIS receivers:
1 to 7 from January, February, March, April, May, June, July, August, November 2015;
29 August to 04 September 2015;
08 to 14 October 2015; and
03 to 09 December 2015.

There were 145 vessel transits to or from Tawe Lock during the 84-day period of AIS (Table 28). A large proportion of vessels transiting the area of the Proposed Development are recreational vessels (42.1%). These vessels are predominantly going to, and from, Swansea Marina and to access the River Tawe. The next highest proportion of vessel traffic was port service vessels (32.4%) which are likely to be workboats accessing the area.

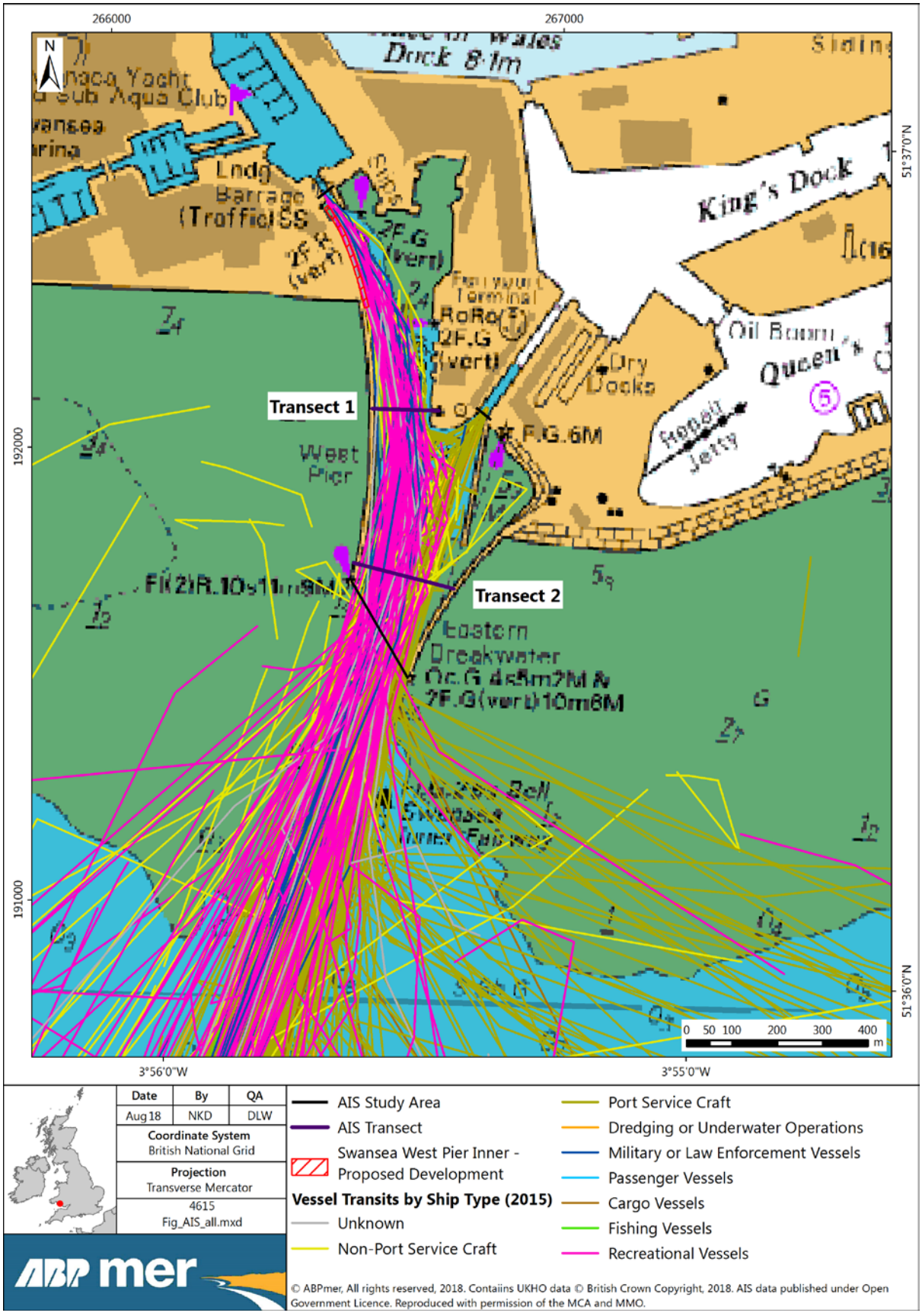

Figure 19. AIS transits – All vessels

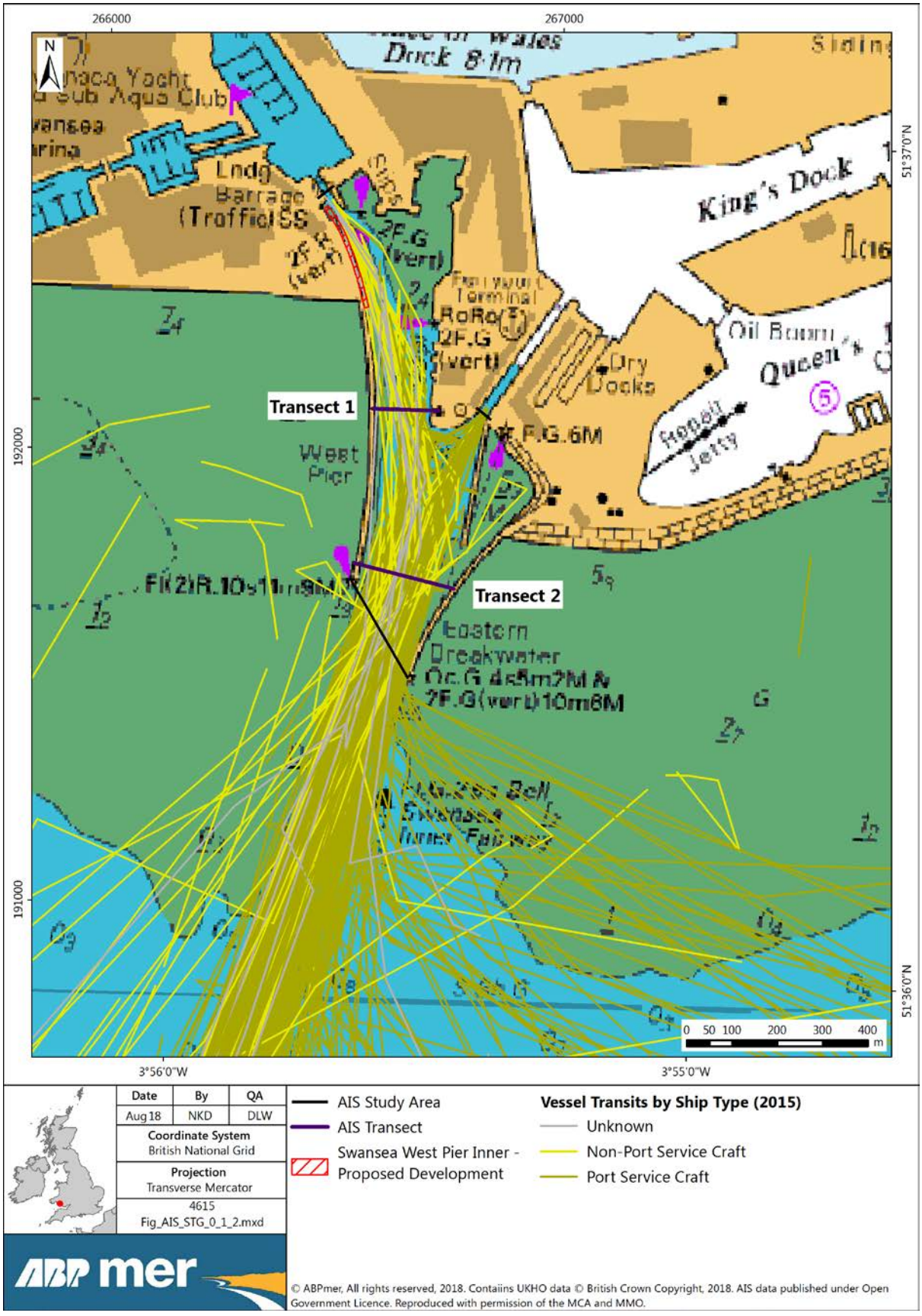

Figure 20. AIS transits – Port service and non-port service

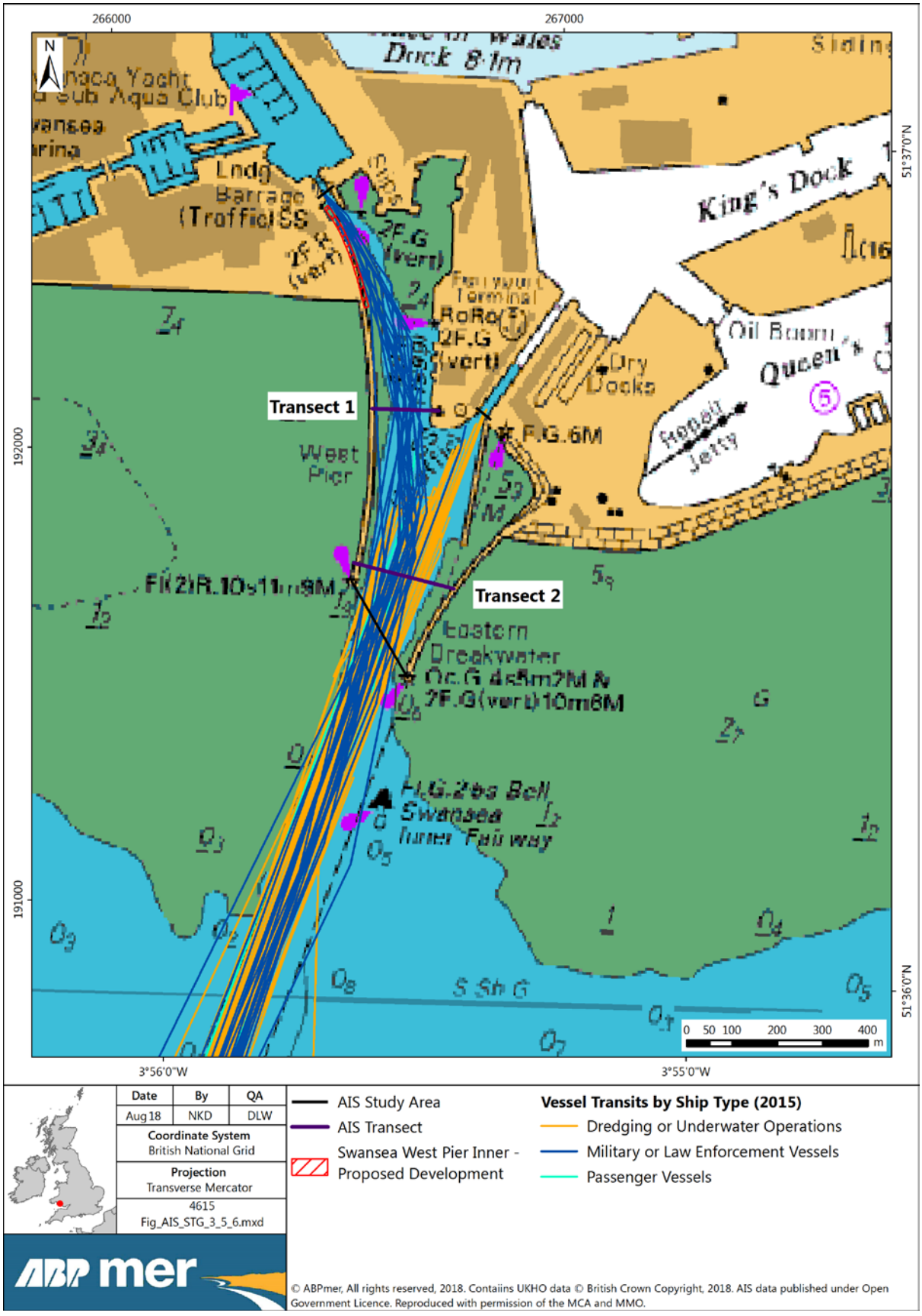

Figure 21. AIS transits – Dredging, military and passenger vessels

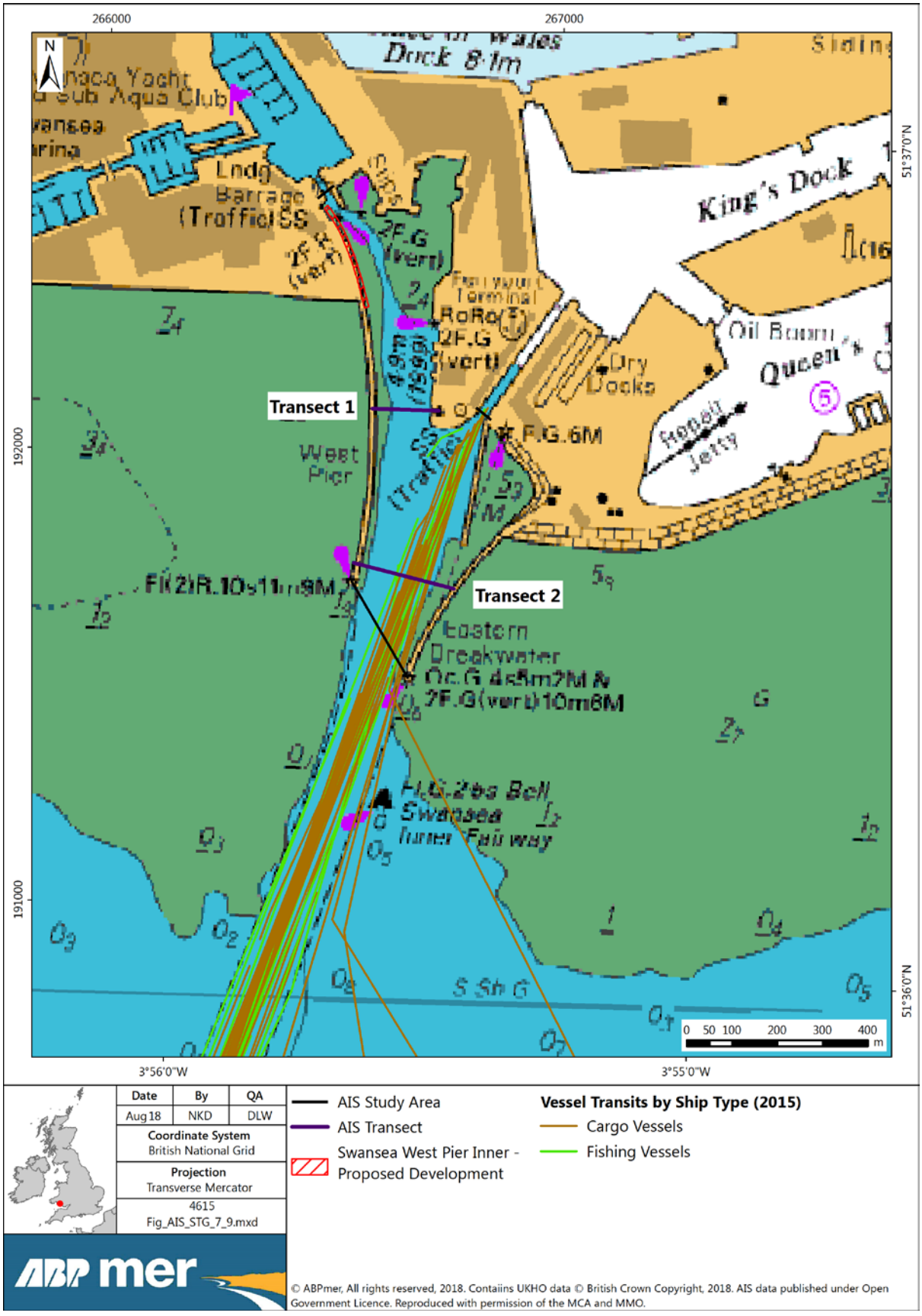

Figure 22. AIS transits – Cargo and fishing vessels

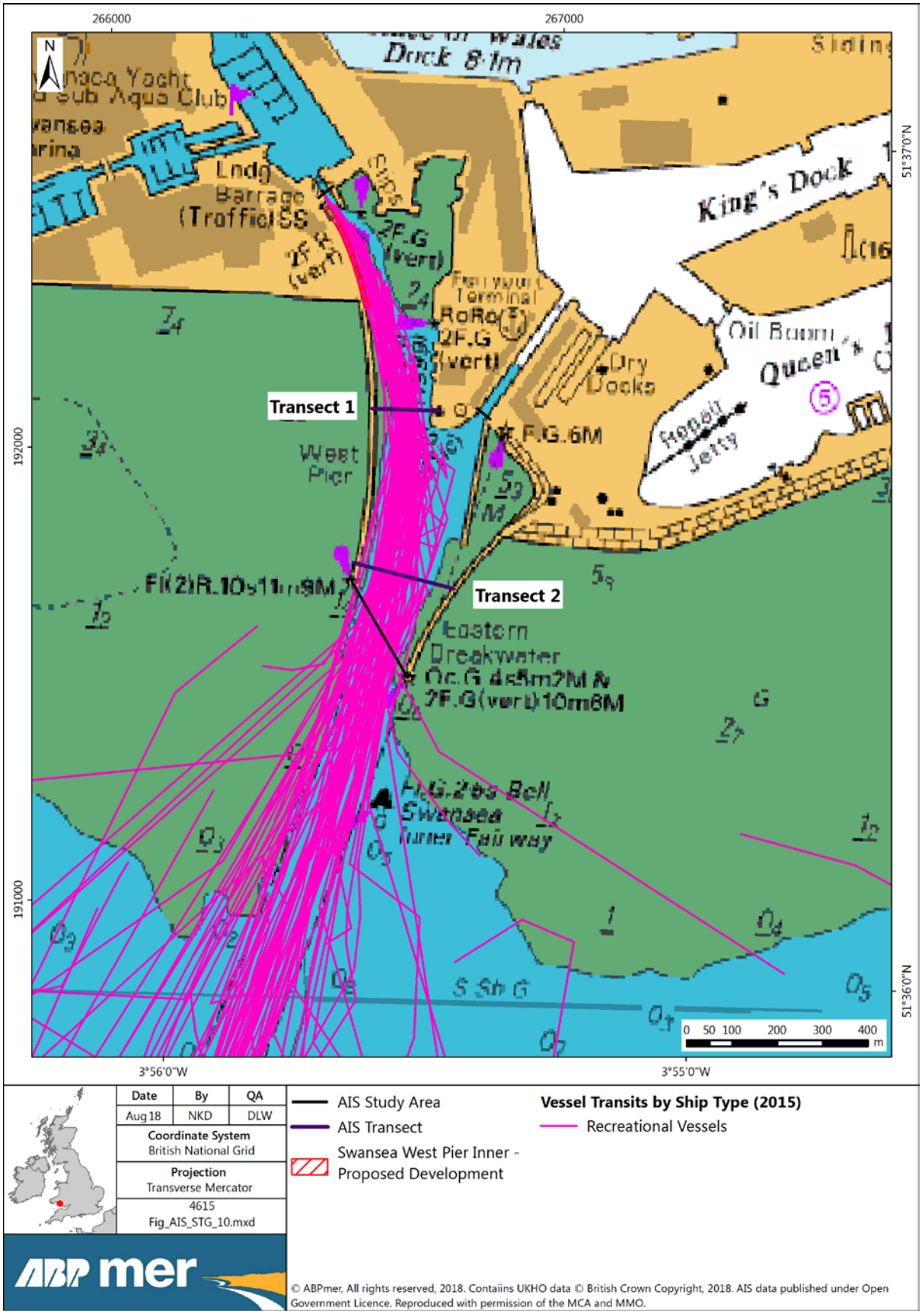

Figure 23. AIS transits – Recreational vessels

Tawe Lock statistics

Swansea City Council (SCC) records the number of vessels using Tawe Lock. These statistics are presented monthly in Table 29 for the period from 2014 to 2017.

Table 29 Number of movements through the Tawe Lock

Month	2014	2015	2016	2017
January	459	399	422	292
February	130	484	224	236
March	242	239	555	194
April	1,071	1,125	686	1,116
May	1,527	1,126	1,635	1,223
June	2,418	1,827	1,367	1,420
July	2,364	1,923	1,888	1,837
August	1,636	2,118	2,123	1,834
September	2,167	1,534	984	988
October	597	1,113	960	630
November	722	404	517	489
December	399	85	486	280
Total	**13,732**	**12,377**	**11,847**	**10,539**

The period with the highest frequency of vessels using Tawe Lock is during the summer months between April to September (Table 29). The majority of vessels using the Lock are recreational; hence the frequency of use is mainly dependent on weather conditions.

6.4.3 Impact Assessment

The following impact pathways have been assessed with respect to commercial and recreational navigation:

- Accident or incident involving commercial or recreational vessels during the construction works;
- Displacement of vessels during construction;
- Accident or incident involving construction craft during construction;
- Water quality impacts from pollutants resulting from accidents, incidents or spillages during construction.

Accident or incident involving commercial or recreational vessels during the construction works

The Proposed Development will involve vessel movements including workboats, jack-up barges and other barges. The movements of these craft can lead to interaction with other vessels navigating in the area. These interactions can lead to collisions, groundings or impact with structures.

The application site and marine works area are located along the western edge of the channel where there are relatively low water levels and areas which are intertidal. This means that vessel movements associated with the works will be restricted to periods with sufficient depth of water for vessels to safely navigate. During these periods, there is increased sea room for vessels to manoeuvre to avoid

interaction, so the probability of occurrence is assessed to be Low and the magnitude of change is Medium leading to a Low/Negligible exposure to change.

Vessels can manoeuvre and will be transiting the area at relatively slow speed, so the sensitivity is considered to be Low leading to a vulnerability of Low. Vessels transits in this area are considered to be of Moderate importance due to the contribution to the local economy.

Overall, the significance of an accident or incident involving commercial or recreational vessels during the construction works is therefore considered to be **Minor Adverse/Insignificant**.

Displacement of vessels during construction

The extent of the marine works and any associated craft means that there will be periods where vessels are unable to navigate where the baseline conditions would allow. Through the NRA process, it was identified that the period when the Tawe Lock waiting pontoon will be removed will result in the displacement of vessels (Appendix E). Vessels use the waiting pontoon as a safe means of access to shore following an incident or period of adverse conditions when the Tawe Lock is not manned. The removal of the pontoon for piling operations means that there will be no access to the shore for vessels when the Tawe Lock is not in operation. This may lead to vessels grounding or being involved in an impact with a structure.

The probability of occurrence is considered to be Medium based on the level of recreational activity in the area. The magnitude of change is Large as there are few alternative actions that could be taken by vessels in this situation. This leads to a Medium exposure to change. The sensitivity of the receptor is Medium due to the limited actions that can be taken if there is no safe access to shore. This means that the vulnerability of the receptor is assessed as Moderate.

Swansea is considered to be a place of refuge for small recreational vessels experiencing difficulties in the Severn Estuary. This means that navigation in the area for these vessels is assessed to be of High importance. Overall, therefore, the significance of displacement of vessels during construction is assessed as **Moderate Adverse**.

Accident or incident involving construction craft during construction

The commercial operations would involve the use of jack-up platforms, barges (for crew and material transfer) and tugs to manoeuvre these vessels into place if they are not self-propelled. These vessels introduce an added risk to the area as they introduce additional traffic and will be navigating in close proximity to the works and nearby infrastructure. When vessels are operating close to the Tawe Barge there is the potential for contact to be made with the Tawe Lock which may result in damage and the Lock being potentially inoperable for a significant period until repairs can be made.

The probability of occurrence for this impact is Medium as there will be periods when barges will be manoeuvred in close proximity to the Tawe Lock, however, this will only occur when piling works are taking place in this area. The magnitude of change is considered to be Large as a minor impact could cause misalignment of the lock gates leaving them inoperable until repairs can be completed. The cost associated with these repairs could be considerable. This means the exposure to change is Medium.

The sensitivity of the feature is Moderate as the Tawe Lock is the only access to Swansea Marina from the Severn Estuary and has frequent use. This sensitivity and a Medium exposure to change results in a Moderate vulnerability. The Tawe Lock has a high importance in the study area and so with a

Moderate vulnerability, the significance of an accident or incident involving construction craft during construction is assessed as **Moderate Adverse**.

Water quality impacts from pollutants resulting from accidents, incidents or spillages during construction

Any marine incident which has the potential to damage a vessel's hull can lead to pollutants entering the water. In addition, construction operations in the marine environment can lead to pollutants entering the water from run off or damaged equipment etc. ABP Swansea has pollution response equipment, a pollution response plan and contracted services for larger events which means that there is a large amount of embedded mitigation.

As there is a range of different scenarios which may result in pollutants entering the water the probability of occurrence is Medium. The area is relatively confined, so any pollutant will not be able to spread to a large area before contained meaning the magnitude is Small and exposure to change is Low/Negligible.

The response available in the area means that the sensitivity of the receptor is Low and so the vulnerability is assessed to be Low.

As the area has a high recreational community the water quality is considered to be a feature of High importance. Overall, the significance of water quality impacts as a result of pollutants from accidents, incidents or spillages during construction is assessed as **Minor Adverse**.

Dredger incident whilst on passage between application site and disposal area

During the dredging activity involved in the bed preparation works, there would be increased vessel movements between the application site and the disposal site (Swansea (Outer) licenced disposal ground (LU130)). The dredge volume is estimated to be in the region of 1,800 m^3 which is anticipated to be disposed at sea requiring vessel moves. The amount of material to be dredged is relatively low and would require up to six loads which would result in 12 vessel movements to and from the deposit site.

These additional transits increase the risk of vessel collision between dredge plant and marine commercial traffic; this risk relates to interaction with other vessels transiting to or from Swansea particularly in the approach channel and inside the breakwaters.

The probability of occurrence is considered to be Low due to the limited number of vessel moves and the relatively short distance of confined waters comprised by the harbour and the approach channel. The magnitude is Small as there is a limited period that the dredger will be operating in the area and limited vessel movements leading to a negligible exposure to change.

The sensitivity of the feature is Low due to the embedded controls for this impact pathway leading to an estimation of vulnerability of None. Commercial and recreational navigation receptors are considered to be of High importance. Overall, the potential for a dredger incident whilst on passage between application site and disposal area is assessed as **Insignificant**.

6.4.4 Mitigation measures and residual effects

In order to minimise or avoid significant impacts, a number of mitigation measures were identified as part of the NRA to reduce the residual impact (Appendix E). These mitigation measures are presented below for each relevant impact pathway and will be included in a CMP (see Section 4.4.8).

Accident or incident involving commercial or recreational vessels during the construction works

The following mitigation measures will be implemented to reduce either the probability of occurrence or the vulnerability of the receptor:

- Notice to Mariners: A Notice to Mariners will be required to be published to provide information on the marine works and proposed timings for all sea users to detail how to navigate in and around the operations area. The Notice to Mariners will be published in advance of the works' commencement to give sufficient prior warning to users;
- Promulgation of information: Information relating to the operations at the West Pier will be published via a range of different media for ease of access for recreational users. As the majority of vessels passing the works will be recreational, it is important to publish information as widely as possible; and
- Exclusion area: Established by the Harbour Authority, to prevent vessels making contact with the marine works and associated plant, a barrier could be deployed to mark the extent of the works and cause less damage to vessels if they make contact with it. It is important that if a barrier is used at the works, it is effectively lit at night.

The above mitigation measures are likely to reduce the probability of occurrence to Negligible and the sensitivity to Low leading to the impact being assessed as **Insignificant**.

Displacement of vessels during construction

In order to reduce the impact associated with the displacement of vessels the following mitigation measures will be implemented:

- Designated point of contact: There will be a representative for the project who coordinates activities with ABP and Swansea Marina. The contact details for the representative will be promulgated to appropriate stakeholders to allow for effective communication;
- Notice to Mariners: A Notice to Mariners will be required to be published to provide information on the marine works and proposed timings for all sea users to detail how to navigate in and around the operations area. The Notice to Mariners will be published in advance of the works' commencement to give sufficient prior warning to users;
- Promulgation of information: Information relating to the operations at the West Pier will be published via a range of different media for ease of access for recreational users. As the majority of vessels passing the works will be recreational, it is important to publish information as widely as possible;
- Shore side signage: During the construction phase, signage can be deployed to inform Sea users, construction workers and visitors of dangerous and restricted areas. This control is relatively simple to implement and will be required when the jack-up barge and operational craft are working in the area;
- Exclusion area: Established by the Harbour Authority, to prevent vessels making contact with the marine works and associated plant, a barrier could be deployed to mark the extent of the works and cause less damage to vessels if they make contact with it. It is important that if a barrier is used at the works, it is effectively lit at night;
- Safe access: Means of access to, or from, the shore will be maintained. This control is particularly important during periods when the jack-up barge is operating close to Tawe Lock meaning that the waiting pontoon will need to be removed. During this period, information on alternative berthing locations will be provided in case of emergency; and
- Designated anchorages: Safe areas for anchoring outside of the port could be designated for vessels waiting to use Tawe Lock. These anchorages would mean that vessels are not waiting in the vicinity of the marine works and will therefore reduce the risk of associated incidents.

Following application of these mitigation measures the sensitivity of the receptor will be Low so the assessed significance will be **Minor Adverse**.

Accident or incident involving construction craft during construction

The following mitigation has been identified to reduce the significance of this impact pathway:

- Designated point of contact: There will be a representative for the project who coordinates activities with ABP and Swansea Marina. The contact details for the representative will be promulgated to appropriate stakeholders to allow for effective communication.
- Notice to Mariners: A Notice to Mariners will be required to be published to provide information on the marine works and proposed timings for all sea users to detail how to navigate in and around the operations area. The Notice to Mariners will be published in advance of the works' commencement to give sufficient prior warning to users;
- Promulgation of information: Information relating to the operations at the West Pier will be published via a range of different media for ease of access for recreational users. As the majority of vessels passing the works will be recreational, it is important to publish information as widely as possible;
- Communications – between project team and Swansea Marina: An open dialog between the Swansea Marina and project team is required to provide information on specific operations and timings. This could take the form of regular briefings of operations taking place and notification by radio before commencement of crew transfer and jack-up barge movements. This will allow for effective coordination and reduce the risk of incidents resulting from a lack of communication. Examples of operations where this communication is important include manoeuvring of the jack-up barge and towage operations;
- Communications – traffic broadcast: Traffic broadcast will be made by either the project designated point of contact or the port Local Port Service (LPS) when towage operations, movement of the jack-up barge or transfers of personnel are taking place. This broadcast will be made over VHF to ensure that vessels navigating in the area are aware of operations; and
- Lighting system: The marine works will be lit during the night to ensure that the extent of any obstacle is visible to vessels transiting the area. If the works are to be left unmanned during the night, sufficient backups will be arranged to prevent the lights from being extinguished.

Following implementation of these mitigation measures, the probability of occurrence will be reduced to Low. This leads to a significance of **Minor Adverse**.

Water quality impacts from pollutants resulting from accidents, incidents or spillages during construction

There have been additional mitigation measures identified which will reduce the magnitude associated with this impact pathway. These are:

- Designated point of contact: There will be a representative for the project who coordinates activities with ABP and Swansea Marina. The contact details for the representative will be promulgated to appropriate stakeholders to allow for effective communication; and
- Availability of pollution response equipment: The marine works area will have pollution response equipment sufficient to respond to a Tier 1 spill available and ready for use. It is important that personnel are appropriately trained to use this equipment in the event of an emergency.

After implementation of these mitigation measures the magnitude will be reduced to Negligible and so the impact will be **Insignificant**.

6.4.5 Summary and Conclusions

This section reports the assessment of potential impacts on recreational and commercial navigation receptors as a result of the Proposed Development. With the adoption of appropriate mitigation, it is considered that significant impacts can be avoided. A summary of the impact pathways that have been assessed and the identified residual impacts following the application of mitigation measures is presented in Table 30.

Table 30. Summary of potential impact and significnace, mitigation measures and residual impacts for Commercial and Recreational Navigation

Receptor	Potential impact pathway	Impact significance	Mitigation measures/Monitoring	Residual impact	Confidence
Vessel navigation	Accident or incident involving commercial or recreational vessels during the construction works	Minor Adverse/ Insignificant	▪ Notices to Mariners; ▪ Promulgation of information; and ▪ Exclusion area.	Insignificant	High
	Displacement of vessels during construction	Moderate Adverse	▪ Designated point of contact; ▪ Notices to Mariners; ▪ Shore side signage; ▪ Exclusion area; ▪ Safe Access; and ▪ Designated anchorages.	Minor Adverse	High
	Accident or incident involving construction craft during construction	Moderate Adverse	▪ Designated point of contact; ▪ Notices to Mariners; ▪ Promulgation of information; ▪ Communications – between project team and marina; ▪ Communications – traffic broadcast; and ▪ Lighting system.	Minor Adverse	High
Water quality	Water quality impacts from pollutants resulting from accidents, incidents or spillages during construction	Minor Adverse	▪ Designated point of contact; and ▪ Availability of pollution response equipment.	Insignificant	High

6.4.6 References

ABPmer (2018). Swansea Inner West Pier Works, Screening and Scoping Report, ABPmer Report No. R.2985. A report produced by ABPmer for ABP, May 2018.

6.5 Coastal and Flood Protection

This section presents the assessment of potential impacts during the construction of the Proposed Development on coastal and flood protection sensitive receptors.

6.5.1 Consultation and scope

Based on the Screening and Scoping Report (ABPmer, 2018), Table 31 presents the coastal and flood protection receptors, the impact pathways and the further work that has been carried out to inform the marine licence application. No comments were received from NRW and statutory consultees in relation to the coastal and flood protection as part of the screening phase (see Section 5.1).

Table 31. Impact pathways and summary of further work for coastal and flood protection

Receptor	Impact Pathway	Requires Further Assessment?	Justification	Summary of Further Work
Coastal and flood protection	Increase in vulnerability of existing pier and construction area to flood events during construction	Yes	The existing Inner West Pier Structure will remain in place during construction, while the new Inner West Pier is constructed immediately seawards. Therefore, this element will not increase vulnerability. Construction activities themselves may be at risk of flooding. This impact pathway will therefore require further assessment.	An assessment of this impact pathway has been undertaken. This has involved preparing a Flood Consequence Assessment (Appendix H).
Coastal and flood protection	Maintained and/or improved level of coastal and flood protection during operation	No	The new pier structure will be designed to be robust in accordance with best practice, so providing some enhanced protection to the land behind it, in terms of protection from erosion and flooding, while securing its primary functions of controlling sediment movement and maintaining navigation. The Proposed Development will not significantly impact the hydrodynamic environment or result in a change in water levels (ABPmer, 2018) and will be designed to maintain the current standard of protection that is provided by Swansea West Pier to the navigational channel and the Swansea Barrage. It will also continue to maintain the current beach to the west of pier which offers coastal protection to landwards areas. Furthermore, the existing surface water discharge outfalls through the Inner West Pier (see Section 3.1.3) will be maintained and therefore the existing level of flood protection to the area will not change.	No further assessment work has been undertaken for this impact pathway.
Coastal and flood protection	Interference with other coastal flood risk management assets during operation	No	The Proposed Development will not interfere with the operation of other flood defences and therefore this impact pathway does not require further assessment.	No further assessment work has been undertaken for this impact pathway.
Coastal and flood protection	Adaptation to future climate change allowing current maritime operations to continue during operation	No	The Proposed Development will be designed with a design life of 50 years, and the design will take into account climate change factors. The Proposed Development will, therefore, contribute to climate change adaption and this impact pathway is not considered to require further assessment.	No further assessment work has been undertaken for this impact pathway.
Coastal and flood protection	Vulnerability of construction activities	Yes	The construction phase of the Proposed Development will mean workers are present on the site for a	An assessment of this impact pathway has been undertaken. This has involved preparing a Flood

Receptor	Impact Pathway	Requires Further Assessment?	Justification	Summary of Further Work
	from tidal sources during a rare storm		temporary period. The occurrence of an extreme tidal event during construction has the potential to threaten the safety of these workers. Therefore, this impact pathway has been investigated further.	Consequence Assessment (Appendix H).
Coastal and flood protection	Vulnerability of the Proposed Development and surrounding area to flood events during operation	Yes	The Proposed Development will alter the height and footprint of the existing pier, which may alter how flood events impact the site and surrounding area	An assessment of this impact pathway has been undertaken. This has involved preparing a Flood Consequence Assessment (Appendix H).

6.5.2 Coastal and flood protection impact assessment methodology

The coastal and flood protection assessment has applied a topic specific impact assessment methodology following recognised best-practice procedures. This methodology is consistent with the methods set out in the environmental assessment guidance within the Design Manual for Roads and Bridges (DMRB) (Highways Agency, 2009) as well as the environmental appraisal guidance within the Transport Analysis Guidance (TAG) (Department of Transport, 2014) related to impacts on the water environment. Whilst these guidance documents were produced to facilitate the comparison of transport schemes, the definitions provided take into account the sensitivity and vulnerability of the water resource and are therefore applicable to the Proposed Development.

Analysis of receptors was based on the source-pathway-receptor model whereby a potential pathway for an impact source to reach a receptor was analysed. Where a pathway to a receptor was identified, this receptor has been included in this topic assessment regardless of its distance from the application site.

Once an impact pathway has been established between the Proposed Development and a receptor, the significance of any resultant effect has been defined by combining the magnitude of the impact and the overall value of the receptor in three stages:

- A level of importance (very high to low) has been assigned to the receptor based on a number of attributes (Table 32);
- The magnitude of the impact/change (classed as high, medium, low or negligible) has been determined based on Table 33 and the assessor's knowledge of the Proposed Development. Specifically, for the assessment of residual effects, mitigation measures have been taken into account in determining the magnitude of change; and
- Comparison of the importance of the receptor and magnitude of the impact (for both potential and residual) results in an assessment of the overall potential effect on the flood risk receptor (Table 34). Each identified effect (both potential and residual) have been classed as Major, Moderate, Moderate/Minor, Minor, Minor/Insignificant or Insignificant and Beneficial or Adverse; significant effects on flood risk or other related receptor are those that have a moderate significance of effect or greater.

Table 32. Importance criteria for flood risk receptors

Importance	Criteria	Example Receptors
Very High	Nationally significant attribute of high value	Human Health Essential Infrastructure & highly vulnerable development*
High	Locally significant attribute of high value	More vulnerable development*
Moderate	Receptor of moderate quality or value with some vulnerability to change	Less vulnerable development*
Low	Receptor of lower quality or value or low vulnerability to change	'Water-compatible' development* Agricultural drainage ditch

* As defined within the National Planning Policy Guidance (MHCLG, 2018)

Table 33. Magnitude criteria for possible flood risk impacts

Magnitude	Criteria	Typical example (Flood Risk)
High	Adverse: Loss of an attribute and/or quality and integrity of an attribute	Change in flood risk to receptor from low/medium to high risk Adverse increase in peak flood level* (>100mm) Loss life / serious harm to human health
	Beneficial: Creation of new attribute or major improvement in quality of an attribute	Change in flood risk to receptor from high to low. Creation of flood storage and decrease in peak flood level* (>100mm) Removal of risk to life / serious harm
Medium	Adverse: Loss of part of an attribute or decrease in integrity of an attribute	Change in flood risk to receptor from low to medium Increase in peak flood level* (> 50mm) Moderate risk to human safety
	Beneficial: Moderate improvement in quality of an attribute	Change in flood risk to receptor from medium to low. Creation of flood storage and decrease in peak flood level* (> 50mm)
Low	Adverse: Some measurable change to the integrity of an attribute	Change in flood risk to receptor from no risk to low risk Increase in peak flood level*(> 10mm)
	Beneficial: Measurable increase, or reduced risk of negative effect to an attribute	Change in flood risk to receptor from low risk to no risk. Creation of flood storage and decrease in peak flood level* (> 10mm)
Very Low	No change to integrity of attribute	Negligible change to peak flood level* (< +/- 10mm)

* Peak flood level for a 1% (1 in 200 year) annual exceedance probability (AEP), including climate change. Where access or egress routes are affected, the magnitude of the impact will be defined by the change in the Flood Hazard Rating as defined in Defra/EA report FD2320.

Table 34. Classification of flood risk effects

Importance of Receptor	Magnitude of Impact			
	High	**Medium**	**Low**	**Very Low**
Very High	Major	Major/Moderate	Moderate	Minor
High	Major	Moderate	Minor	Minor
Medium	Moderate	Moderate / Minor	Minor/insignificant	Insignificant
Low	Minor	Minor/insignificant	Insignificant	Insignificant

6.5.3 Baseline review

Data sources

The principal data sources that have informed this assessment are as follows:

- AECOM (2018) Swansea West Pier Flood Consequence Assessment;
- NRW Website https://naturalresources.wales/?lang=en; and
- NRW Data request (June 2018) covering the site and providing modelled flood levels and extents for a range of return periods.

Flood risk

The Proposed Development is located within the mouth of the River Tawe, which is tidally influenced. Flooding from tidal sources can occur through storm surges, extreme tidal levels, overtopping of defences, breaching of defences and wave action. Still water astronomical tide levels of up to 5.5 m above ordnance datum (AOD) can be expected in the mouth of the River Tawe with wave heights of between 0.57 m and 1.37 m during a 1 in 200 year storm (AECOM, 2018). The maximum surface elevation of joint probability tide and wave modelling (for a 1 in 200 year storm), including allowances for surges, in the study area is between 5.98 m and 7.08 m above AOD. The existing pier is approximately 5.9 m – 6.1 m AOD with a raised upper walkway west of the northern section of the Proposed Development at approximately 7.8 m AOD. The developed land behind the northern section of the Proposed Development is not at risk of flooding from a 1 in 200 year storm, however the pier itself is still at risk as well as some areas of beach and dunes west of the southern section of the Proposed Development.

A rise in sea levels as a result of climate change will further increase the risk of tidal flooding. According to UKCP09, sea levels are predicted to rise 0.35 m over the next 50 years (Lowe *et al.,* 2009) which will increase the height of waves and tidal level during both exceptional storm surges and normal tidal levels within the study area.

The NRW Risk of Flooding from Surface Water mapping indicates the risk of flooding from surface water to the Proposed Development is very low.

Three sewer outfalls exist along the edge of the existing pier, discharging into the sea and require continual operation. These outfalls are unlikely to cause flooding. The risk of flooding from sewers is therefore considered to be very low.

According to the Local Flood Risk Management Strategy (LFRMS) (City and County of Swansea, 2013), groundwater flood risk in Swansea is currently poorly understood and the predicted future impacts are primarily based on generic national geological mapping. The Areas Susceptible to Groundwater Flooding map (found within the LFRMS) indicates that the Proposed Development lies within a 1 km square where >25% is at risk from groundwater flooding.

Historic borehole records indicate that groundwater depths along the edge of the site were variable and were dependent on tidal fluctuations. However, due to the positioning of the Proposed Development within the tidal Tawe, it is unlikely that there would be a pathway for groundwater flooding. The risk of flooding from groundwater is therefore considered to be very low.

The NRW Flood Risk from Reservoirs mapping indicates that the Proposed Development is not at risk from flooding in the event of the failure of a major reservoir. In accordance with mapping produced

by the Canal and River Trust, there are no canals present in the vicinity of the Site. The risk of flooding from artificial sources is therefore considered to be very low.

6.5.4 Impact Assessment

The following impact pathways have been assessed with respect to coastal and flood protection:

- Increase in vulnerability of existing pier and construction area to flood events during construction;
- Vulnerability of construction activities from tidal sources during a rare storm; and
- Vulnerability of the Proposed Development and surrounding area to flood events during operation.

Increase in vulnerability of existing pier and construction area to flood events during construction

During the construction of the Proposed Development, the existing Inner West Pier and construction area may be vulnerable to flooding from tidal sources including waves and high water levels as described in the baseline review (Section 6.5.3).

There is potential that during the construction phase, the existing pier structure may continue to collapse, opening up pathways for flooding to lower lying areas of beach and dunes beyond. The foreshore is considered a receptor of Low importance in relation to flood risk as it is expected to naturally inundate tidally regardless of the Proposed Development.

The overall significance is assessed as **Insignificant** due to the Low importance of the potential receptor and the Very Low magnitude of impact.

Vulnerability to construction activities from tidal sources during a rare storm

The construction of the Proposed Development will involve construction workers being present on the site. During a rare tidal storm, construction workers could potentially be at risk if tidal flooding was to occur. A review of local topographic levels compared with predicted maximum levels in a rare storm (1 in 200 year) indicate any water incursion would impact areas of beach and foreshore only (Low importance receptor) and there would be no increased pathway to homes and businesses west of the northern section of the existing pier.

The health and well-being of construction workers is considered to be a receptor of Very High importance. In a worst case scenario, the magnitude of impact is High where there is a potential for loss of life. However, the likelihood of flooding in an extreme storm is considered Very Low. The risk is therefore assessed as Moderate and the magnitude Medium prior to mitigation.

The overall significance is considered to be **Moderate Adverse**. This is based on a Medium magnitude (as shown above) and a High importance of the receptor.

Vulnerability of the Proposed Development and surrounding area to flood events during operation

The crest level of the Proposed Development will match the raised walkway behind, whilst also incorporating a suitable gradient to allow free drainage into the estuary. This is an increase in crest level of approximately 1.4 m above the existing pier level.

The increased height of the Proposed Development, compared with the existing pier level, means that it is not at risk of flooding from still tidal water levels or combined tide and wave levels. However, the Proposed Development will be subject to moderate overtopping, over short durations from splashing,

during extreme events. The residual overtopping discharge and volumes at the Proposed Development level is considerably lower than that at the existing pier level. As such, there is an improvement to the safety of users of the Proposed Development. As the height of the Proposed Development will match the existing walkway, there is no change to the level of protection to homes and businesses west of the northern section of the existing pier.

The overall significance is assessed to be **Minor Beneficial/Insignificant** due to the low importance of the potential receptor and the medium (beneficial) magnitude of impact.

6.5.5 Mitigation measures and residual effects

Vulnerability to construction activities from tidal sources during a rare storm

If a storm was to occur during the construction period, tidal flood warnings will be in place to inform construction workers that they need to evacuate the construction site. Construction workers would then be able to evacuate the site prior to a storm occurring. This process will be documented in site management plans and would be a key part of the CMP (Section 4.4.8). Following the application of these mitigation measures, significant impacts will be avoided, and the residual impacts are considered to be **Insignificant**.

6.5.6 Summary and Conclusions

This section reports the assessment of potential impacts on coastal and flood risk during the construction and operational phase of the Proposed Development. Adverse effects are anticipated during construction; however, these will only be temporary and mitigation measures will be implemented to ensure that significant impacts are avoided. A summary of the impact pathways that have been assessed and the identified residual impacts following the application of mitigation measures is presented in Table 35.

Table 35. Summary of potential impacts, mitigation measures and residual impacts for coastal and flood protection

Receptor	Impact pathway	Impact significance	Mitigation measures/Monitoring	Residual impact	Confidence
Coastal and flood protection	Increase in vulnerability of existing pier and construction area to flood events during construction	Insignificant	N/A	Insignificant	High
Coastal and flood protection	Vulnerability of construction activities from tidal sources during a rare storm	Moderate Adverse	Tidal flood warnings; and Evacuation procedures.	Insignificant	High
Coastal and flood protection	Vulnerability of the Proposed Development and surrounding area to flood events during operation	Minor Beneficial/ Insignificant	N/A	Minor Beneficial/ Insignificant	High

6.5.7 References

Highways Agency (2009). Design Manual for Roads and Bridges (DMRB) Vol 11, Environmental Assessment, Section 3, Environmental Assessment Techniques, Part 10L Road Drainage and the Water environment, The Stationery Office.

Department of Transport (2014). Transport Analysis Guidance (TAG) Unit A3 – Environmental Impact Appraisal, Section 10 'Impacts on the Water Environment'

MHCLG (2018) National Planning Policy Framework. Ministry of Housing, Communities and Local Government. July 2018.

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City and County of Swansea (2013) Swansea Local Flood Risk Management Strategy. December 2013. Available at: https://www.swansea.gov.uk/floodstrategy

AECOM (2018) Swansea West Pier Flood Consequence Assessment

6.6 Airborne Noise and Vibration

This section presents the assessment of potential impacts during the construction of the Proposed Development on airborne noise and vibration sensitive receptors.

6.6.1 Consultation and scope

Based on the Screening and Scoping Report (ABPmer, 2018), and the subsequent advice provided by NRW and statutory consultees (see Section 5.1), Table 36 presents the receptors relevant to airborne noise and vibration, the impact pathways and further work that has been carried out to inform the marine licence application.

Table 36. Impact pathways and summary of further work for airborne noise and vibration

Receptor	Impact Pathway	Requires Further Assessment?	Justification	Summary of Further Work
Residential receptors at Marine Villas and Aurora	Airborne noise during construction	Yes	The preferred design option for the Proposed Development is a driven combination pile wall, which involves a large weight or "ram" being dropped or driven onto the top of a foundation pile, forcing it into the seabed. This method can generate high levels of noise and, due to the close proximity of works to residential receptors, could result in significant noise effects on nearby sensitive receptors. This impact pathway will therefore require some further assessment work.	An assessment of this impact pathway has been undertaken. As per advice from the Environmental Health team at Swansea Council, baseline noise monitoring and predictions of noise levels of the construction activities at each receptor location have been calculated. Mitigation measures in accordance with best practice have also been identified (Section 6.6.4). These will also be included in a CMP (Section 4.4.8).
Residential receptors at Marine Villas and Aurora	Ground-borne vibration during construction	Yes	The construction of the Proposed Development is likely to generate high levels of vibration at nearby sensitive receptors. This impact pathway will therefore require some further assessment work.	An assessment of this impact pathway has been undertaken. As per advice from the Environmental Health team at Swansea Council, predictions of vibration levels of the construction activities at each receptor location have been calculated. Mitigation measures in accordance with best practice have also been identified (Section 6.6.4). These will also be included in a CMP (Section 4.4.8).
Residential receptors at Marine Villas and Aurora	Traffic noise during construction	Yes	Changes in road traffic noise as a result of construction traffic may result in adverse increases in noise at nearby sensitive receptors. Changes in road traffic noise may be significant during peak vehicle movement periods and will therefore require some further assessment work.	An assessment of this impact pathway has been undertaken. Mitigation measures in accordance with best practice have also been identified (Section 6.6.4). These will also be included in a CMP (Section 4.4.8).

6.6.2 Baseline review

Data sources

This section has been informed by construction information provided by ABP and their early engagement with potential contractors.

Baseline noise survey

Baseline noise surveys were undertaken on 22 and 23 May 2018 at two locations near to the application site to determine baseline noise levels during typical weekday core working hours. The purpose of the survey was to define existing baseline noise levels at nearby sensitive receptors. The noise monitoring locations are presented in Figure 24. The baseline noise surveys were undertaken in accordance with industry standard practice as specified in BS 7445-2: 1991 (British Standards Institute, 1991).

Figure 24. Noise monitoring and sensitive receptor locations

Existing sources of noise

During the noise survey, it was observed that the dominant sources of noise originated from various works going on around Swansea Docks and pedestrians walking in conversation. Other significant sources of noise included the Tawe Lock which when opening and closing caused the noise of water passing through the gate and includes a warning alarm to alert pedestrians crossing the bridge.

Noise monitoring results

The results of baseline noise measurements are presented in Table 37. All presented noise levels are in decibels (dB) re 20 µPa, free-field and fast time-weighting. Due to intermittent construction activities taking place at nearby sites (approximately 160 m from the measurement locations), noise levels were recorded during periods when construction activities were not taking place. It is therefore considered that the results of noise monitoring are representative of the likely noise levels experienced during core daytime working hours.

Table 37. Short-term attended monitoring results summary

Location	Start Date and Time	Duration (T)	Sound Level Parameter dB[23]		
			$L_{Aeq,1h}$ dB	L_{Amax} dB	$L_{A90,1h}$ dB
ST1	22/05/18 17:00	60 mins	57	77	49
	23/05/18 08:40	60 mins	55	68	51
ST2	22/05/18 17:00	60 mins	49	70	46
	23/05/18 08:40	60 mins	48	72	43

Sensitive receptors

Potential sensitive receptors (i.e. buildings whose occupants may be disturbed by elevated noise and vibration levels, and structures that are sensitive to vibration) have been taken into consideration when assessing the effects associated with noise and vibration levels from the construction and of the Proposed Development.

A number of receptors have been considered in this assessment that may potentially be affected. The sensitive receptors considered in this report are the nearest receptors to the application site i.e. the receptors that are likely to experience the highest levels of noise and vibration. Although noise and vibration may be perceptible at other receptor locations, any impacts would be negligible if they are suitably controlled at the identified receptors.

Sensitive receptors have been classed depending on their use and subsequent sensitivity to noise and vibration. The sensitivity of receptors to noise and vibration has been defined in Table 38.

Table 38. Criteria used to define sensitivity of noise and vibration receptors

Sensitivity	Description	Receptor Examples
High	Receptors where noise will significantly affect the function of a receptor	• Auditoria/studios; • Specialist medical/teaching centres; and • Libraries.
Medium	Receptors where people or operations are particularly susceptible to noise	• Residential properties; • Places of worship; • Conference facilities; • Schools in daytime; and • Hospitals/residential care homes.

[23] LAeq,1h is the sound level in decibels equivalent to the total A-weighted sound energy measured over 1 hour. LAmax is the highest noise level reached in a given time period. LA90,1h gives an accurate approximation to the background noise level over 1 hour.

Sensitivity	Description	Receptor Examples
Low	Receptors of low sensitivity to noise, where it may cause some distraction or disturbance	• Offices; • Restaurants; and • Sports grounds when spectator or noise is not a normal part of the event and where quiet conditions are necessary (e.g. tennis, golf).
Very Low	Receptors where distraction or disturbance from noise is minimal	• Residences and other buildings not occupied during working hours; • Factories and working environments with existing high noise levels; and • Sports grounds when spectator or noise is a normal part of the event.

The nearest noise sensitive receptors to the application site have been selected for the assessment and the sensitivity of these receptors has been identified in accordance with the criteria in Table 38. The receptors identified are listed in Table 39 with the locations of existing receptors presented in Figure 24. Each existing receptor location has been assigned a measurement location for the purposes of the assessment, where the intention is to apply appropriate noise level data at each receptor location for assessment purposes.

Table 39. Locations of noise and vibration sensitive residential receptors

Receptor	Receptor Address	Corresponding Measurement Location	Receptor Type	Sensitivity
R1	26 to 32 Marina Villas	ST1	Residential	Medium
R2	33 to 38 Marina Villas	ST1	Residential	Medium
R3	Aurora	ST2	Residential	Medium

In addition to the receptors detailed in Table 39, consideration has also been given to the potential impact of vibration due to piling activities that may affect a utilities tunnel that runs in close proximity to the Swansea Barrage.

6.6.3 Impact Assessment

The following impact pathways have been assessed with respect to airborne noise and vibration:

- Airborne noise during construction;
- Ground-borne vibration during construction; and
- Traffic noise during construction.

Airborne construction noise

Methodology for determining airborne construction noise effects

The proposed works can be split into three work components, which each employ distinct items of plant. The three work stages are as follows:

- Bed preparation works using a backhoe dredger with the arisings deposited at an offshore disposal ground via a split hopper barge;
- Vibration driving of steel tubular piles to resistance and then percussive piling to the required design level; and
- Steel sheets piled by pushing or driving under vibration.

The assessment has been undertaken assuming one piling rig will be deployed; however, consideration has also been given to a potential option for undertaking works with two piling rigs which is considered a worst case scenario.

For the purposes of calculating noise from construction activities, sample noise data for equipment to be used during the construction phase have been sourced from BS 5228-1:2009+A1:2014 (British Standards Institute, 2014). Sample noise data for plant used in the assessment are presented in Table 40.

Table 40. Construction plant noise data

Work Stage	Plant	BS 5228 reference	$L_{Aeq,T}$ dB Noise Level at 10 m
Dredging	Dredger	BS 5228 Table C.7, Item 1	82
	Tug	Noise Mapping and Noise Abatement Plan of Venice (2009)	72
Tubular piling	Tubular steel piling rig – hydraulic hammer	BS 5228 Table C.3, Item 2-4	84
Sheet piling	Vibratory sheet steel piling rig	BS 5228 Table C.3, Item 8	88

BS 5228 provides practical information on construction noise and vibration reduction measures and promotes a 'Best Practicable Means' approach to control noise and vibration. The calculation method provided in BS 5228 is based on the number and type of equipment operating, their associated average sound pressure level ($L_{Aeq,T}$), and the distance to sensitive receptors, together with the effects of any screening structures.

BS 5228 provides further guidance on acceptable levels of construction noise within Annex E and provides example criteria for the assessment of significance of construction noise impacts. One of the potential suggested criteria within BS 5228 refers to the Department of the Environment (DoE) Leaflet AL72: Noise Control on Building Sites from 1976 (DoE, 1976). The leaflet states that, during the daytime period, the noise level outside the nearest occupied room of a residential property or office should not exceed the values in Table 41.

Table 41. AL72 Construction noise limits

Environment	Recommended Daytime Façade Noise Level $L_{Aeq,T}$ dB
Urban areas close to main roads	75
Rural, suburban and urban areas away from main traffic and industrial noise sources	70

The application site overlaps with the Tawe Riverside designated 'quiet area' in the Noise Action Plan for Wales (Welsh Government, 2013). Consequently, a construction noise threshold for an environmental receptor away from main traffic noise sources of 70 dB $L_{Aeq,T}$ (defined in Table 41) is therefore considered applicable to this development.

A semantic scale for the description of the construction noise impacts as measured outside the nearest identified receptor is presented in Table 42.

Table 42. Magnitude of construction noise impacts

Description	Magnitude of Impact
Daytime noise levels not exceeding the dB $L_{Aeq,T}$ ambient noise level	Very Low
Daytime noise levels exceeding $L_{Aeq,T}$ ambient noise level but not exceeding the 70 dB $L_{Aeq,T}$ noise threshold	Low
Daytime noise levels not exceeding the 70 dB $L_{Aeq,T}$ noise threshold by more than 5 dB	Medium
Daytime noise levels exceeding the 70 dB $L_{Aeq,T}$ noise threshold by more than 5 dB	High

Based on the guidance in BS 5228, the criterion for the onset of potentially significant effects at residential receptors is set when noise exceeds the construction noise limit for normal daytime operations. This is considered to be equivalent to the Significant Observed Adverse Effect Level (SOAEL); the Lowest Observable Adverse Effect Level (LOAEL) is set at the measured ambient noise level.

Airborne construction noise assessment

The levels of unmitigated construction noise predicted at the identified receptors during each of the identified key work phases are presented in Table 43. The worst case construction noise levels have been calculated using an approximate distance of 20 m from the receptor building footprint to the river edge of the existing pier with piling works proposed 5 m into the river from the existing pier edge. The best case construction noise levels have been calculated using the approximate distance from the closest point of each receptor to the southernmost point of the inner west pier.

Table 43. Calculated construction noise level and associated impacts

Receptor	Ambient Noise Level $L_{Aeq,T}$ dB	Distance to Receptor	Predicted $L_{Aeq,T}$ dB Noise Level and Impact due to Construction Activities		
			Dredging	Driven Tubular Piles	Vibratory Sheet Piles
R1, R2	55	25 (worst case)	74 Medium	76 High	80 High
R3	48	25 (worst case)	74 Medium	76 High	80 High
R1	55	230 (best case)	55 Very Low	57 Low	61 Low
R2	55	180 (best case)	57 Low	59 Low	63 Low
R3	48	130 (best case)	60 Low	62 Low	66 Low

The subsequent significance of effects for construction activities are presented in Table 44 and have been derived using criteria presented in Table 38.

Table 44. Significance of construction noise effects

Receptor	Receptor Sensitivity	Significance of Effect		
		Dredging	Driven Tubular Piles	Vibratory Sheet Piles
R1	Medium	Negligible to Moderate Adverse	Minor Adverse to Major Adverse	Minor Adverse to Major Adverse
R2	Medium	Negligible to Moderate Adverse	Minor Adverse to Major Adverse	Minor Adverse to Major Adverse
R3	Medium	Minor Adverse to Moderate Adverse	Minor Adverse to Major Adverse	Minor Adverse to Major Adverse

When construction activities are taking place in proximity of receptors, the calculated noise effects due to construction activities range from **Moderate Adverse to Major Adverse**. Noise effects of this magnitude are considered to be significant. When construction activities are at the farthest distance from each receptor, construction noise effects will range from **Negligible to Minor Adverse**.

It should be noted that piling will only take place for approximately one day per eight day period. Due to the short duration of elevated noise levels, sheet piling noise emissions are not considered to be representative of the typical noise conditions during works. Installation of driven piles would last for approximately 50% of the time, so are considered to be more representative of typical noise conditions during piling works.

Calculations indicate that, for highest noise generating sheet piling activity, Major Adverse noise effects are calculated at a distance within 30m and Moderate Adverse noise effects are calculated at a distance within 50m.

The estimated duration of significant effects based on noise emissions from sheet piling activities are presented in Table 45. Time estimations are based on 15 different piling work sites and a duration of five days of high noise generating activities per site.

Table 45. Calculated construction noise level and associated impacts

Receptor	Estimated Duration of Significance Effects	
	Moderate Adverse	Major Adverse
R1	20 days	10 days
R2	35 days	25 days
R3	45 days	35 days

It should be noted that construction noise predictions are based on the highest noise level that an individual property is likely to experience during the identified key phases of works. In reality, for the majority of the works period, noise will likely be lower than the presented levels as activities will take place at different locations along the length of the pier. Consequently, it is likely that the worst case noise levels will only occur for limited periods of time when plant are operational at the closest approach to individual properties.

There is a potential option for undertaking works with two piling rigs (Section 3.2.4). Generally, a doubling of sound energy is equivalent to an increase in noise of 3 dB. Consequently, noise predictions presented in Table 43 may increase by up to 3 dB if two piling rigs are used. Although concurrent use of two piling rigs will result in higher noise levels, the benefit of being able to complete work in half the time and thus substantially reduce the duration of time that receptors are exposed to noise is considered to offset increases in noise level.

Ground-borne construction vibration

Methodology for determining ground-borne vibration effect

The highest level of vibration during the project will originate during piling activities. BS 5228-2:2009+A1:2014 (British Standards Institute, 2014) provides Peak Particle Velocity (PPV) levels for different piling activities at various distances from piling locations. The level of vibration depends on the type of piling, ground conditions, and receptor distance so the likely level of vibration has been calculated based on the sample piling vibration data.

Annex D of BS 5228-2:2009+A1 provides summary of historic case history data on vibration levels measured during driven tubular piling and driven sheet steel piling, which are presented in Table 46 and Table 47. This data is considered suitably representative of proposed piling activities under different conditions. The likely levels of vibration experienced at nearby receptors has been calculated using the distance to the nearest sensitive receptor and a formula derived from the line of best fit from sample data for each piling method.

Table 46. Historic data on vibration levels measured during driven tubular piling

Distance (m)	Measured ppv (m/s)	Distance (m)	Measured ppv (m/s)	Distance (m)	Measured ppv (m/s)
4	8.4	20	2.7	34	2.8
5.5	10.7	20	5	35	2.4
8.5	6.1	21	3.4	35	0.95
8.5	8.3	22	3.1	40	0.66
10	4.2	22.5	3.1	42	1.7
12	2.9	24	0.82	43	1.1
12	5.9	28	2.7	50	1.2
13	3.6	28	3.2	50	1
13	4.4	30	2.3	63	0.72
13	5.6	30	1.05	63	0.83
14	2.2	30	0.88	100	0.96
14	2.2	34	2.6	120	1

Table 47. Historic data on vibration levels measured during driven sheet steel piling

Distance (metres)	Measured ppv (m/s)	Distance (meters)	Measured ppv (m/s)	Distance (metres)	Measured ppv (m/s)
2	10	11	16	30	0.35
2	2	11.7	4	30	0.6
5	13.5	12	0.05	33	0.89
6	1.1	15	0.79	35	3
6	0.44	15	0.48	35	0.5
6	1.9	30	1.1		

Table 48 details PPV vibration levels and provides a semantic scale for description of demolition and construction vibration impacts on human receptors based on guidance contained in BS 5228-2.

Table 48. Magnitude of construction vibration impacts

Peak Particle Velocity Level	Description	Magnitude of Impact
0.14 mm/s	Vibration might be just perceptible in the most sensitive situations for most vibration frequencies associated with construction. At lower frequencies, people are less sensitive to vibration.	Very Low
0.3 mm/s	Vibration might be just perceptible in residential environments.	Low
1.0 mm/s	It is likely that vibration of this level in residential environments will cause complaint, but can be tolerated if prior warning and explanation has been given to residents.	Medium
10 mm/s	Vibration is likely to be intolerable for any more than a very brief exposure to this level.	High

The vibration criteria in Table 48 relates to the typical human response to vibration. To provide a basis for assessing the potential impact on underground utilities, reference has been made to guidance provided by Thames Water (Thames Water, 2016) to protect underground utilities from vibration damage. The document states a maximum PPV of 10 mm/s at the underground utility.

Assessment of ground-borne vibration

The estimated PPV level due to piling activities at the identified sensitive receptors to the application site has been calculated from the best fit characteristics of historical measurement data presented in Table 46 and Table 47 at a distance of 25 m. The results are presented in Table 49. The potential vibration effects are derived from the criteria in Table 48 using the estimated impact of vibration at each existing sensitive receptor and the receptor sensitivity.

Table 49. Calculated construction vibration level and significance of effect

Piling Method	Receptor	Receptor sensitivity	Approximate Distance to Receptor(m)	Estimated PPV mm/s	Magnitude of Impact	Significance of Effect
Tubular driven	R1, R2, R3	Medium	25	2.2	Medium	Moderate Adverse
Sheet driven	R1, R2, R3	Medium	25	1.4	Medium	Moderate Adverse

The estimated vibration effects due to construction activities are likely to be no worse than **Moderate Adverse**. Vibration effects of this magnitude are considered to be significant.

As with construction noise effects, vibration effects are only likely to occur for limited periods of time when works are taking place in the proximity of individual properties. For the majority of the works programme, piling activities are likely to be of sufficient distance from individual properties that vibration effects are unlikely to be significant.

The deployment of two piling rigs may result in cumulative levels of vibration; however, as vibration is dominated by the source generating the highest level, vibration is only likely to be cumulative when piling rigs are operating in close proximity to each other. This is only likely to occur for up to 10 days

so the effect of increased levels of vibration is considered to be suitably offset by the significant reduction in duration of works and exposure to adverse levels of vibration.

In addition to vibration affecting human receptors, consideration has also been given to the potential effect on an underground utilities tunnel that runs in close proximity to the Swansea Barrage. A limit of 10 mm/s has been set for this tunnel, which is unlikely to be exceeded at a distance of greater than 15 m. Due to the potential for damage to underground utilities, examples of mitigation measures that may be adopted to protect underground utilities are covered in Section 6.6.4.

Construction traffic noise

Methodology for determining construction traffic noise effects

The Proposed Development will require a number of deliveries during the works programme. There will be no deliveries during dredging with arisings being removed by water transport. Deliveries are likely to be low during piling activities with approximately 10 to 15 per week anticipated.

The potential impact of construction traffic is typically assessed in comparison to baseline road traffic flows. Given that the access route to the application site is along a road with low traffic density, the absolute level of construction traffic has been calculated using the 'haul route' method in BS 5228-1 and potential impacts derived using criteria in Table 42.

Assessment of construction traffic noise

The calculated construction traffic noise level at affected sensitive receptors to the application site is presented in Table 50 along with the potential effect. Calculations are based on a worst case of 15 deliveries over the course of a ten hour working day with a sound power level of 104 dB. The potential effects are derived from the criteria in Table 42 using the estimated effect of vibration at each existing sensitive receptor and the receptor sensitivity.

Table 50. Calculated construction traffic noise and significance of effect

Receptor	Receptor sensitivity	Ambient Noise Level $L_{Aeq,T}$ dB	Calculated Average $L_{Aeq,1h}$ dB HGV Noise Level	Magnitude of Impact	Significance of Effect
R1, R2,	Medium	55	54	Low	Negligible
R3	Medium	48	54	Low	Minor Adverse

Noise due to construction traffic is calculated as being **Minor Adverse** during peak delivery periods. Noise effects of this magnitude are not considered to be significant.

6.6.4 Mitigation measures and residual effects

Noise and vibration during construction

Good industry standards, guidance and practice procedures (i.e. compliance with the Considerate Contractors scheme) will be followed in order to minimise noise and vibration effects during construction. Noise and vibration arising during the construction works will be managed to avoid and minimise impacts, and mitigation measures will be documented within a CMP (Section 4.4.8), which will take into account the relevant key guidance documents and standards relating to noise and vibration.

Vibration mitigation measures and noise management plans covering best practice management (BPM) will be documented in the CMP to ensure that vibration emissions are minimised at all times throughout the demolition and construction programme. The CMP will also include details on proposed noise and vibration monitoring and action levels, which will be agreed with SCC.

Mitigation measures will be employed to ensure that potential noise and vibration impacts at nearby sensitive receptors due to construction activities are minimised. The preferred approach for controlling construction noise is to reduce source levels where possible, but with due regard to practicality. The simplest and most effective method of reducing noise at nearby receptors is to ensure that noisy plant is located as far from receptors as practicable and screened using temporary barriers; however, it is unlikely that piling activities can be effectively screened due to the height of adjacent receptors.

Noise and vibration will also be minimised through the adoption of BPM as standard working practices across the application site to ensure that noise and vibration are reduced whenever practicable. The following provisions, although not exhaustive, will be adhered to where practicable throughout the demolition and construction programme:

- Vehicles and mechanical plant used for the purpose of the works will be fitted with effective exhaust silencers, maintained in good and efficient working order and operated in such a manner as to minimise noise emissions. The contractor will ensure that all plant complies with the relevant statutory requirements;
- Machines in intermittent use will be shut down or throttled down to a minimum when not in use;
- No part of the works nor any maintenance of plant will be carried out in such a manner as to cause unnecessary noise except in the case of an emergency when the work is absolutely necessary for the saving of life or property or the safety of the works; and
- Plant will be maintained in good working order so that extraneous noise from mechanical vibration, creaking and squeaking is kept to a minimum.

It would be possible to reduce noise levels during piling activities by using a quieter drilling method; however, this method may take up to twice as long to apply and involve at least two separate construction periods given timing restrictions that will need to be adhered to in relation to avoiding sensitive fish migration periods (Section 6.2.3). Similarly, noise can also be reduced by limiting the daily time that noisy equipment is operated; however, it is acknowledged that sometimes a greater noise level may be acceptable if the duration of the construction activity, and therefore length of disruption, is reduced. Consequently, adopting a quieter piling method or limiting the duration of works per day would likely cause additional disruption due the significant extension to the work schedule that would be required.

The effect of noise and vibration on nearby sensitive receptors can be further minimised through a good communication strategy. Prior to works being undertaken, consultation with occupiers of sensitive receptors that may be adversely affected by construction noise and vibration will be undertaken. Providing information of construction works and notice of when high noise and/or vibration generating activities are taking place can increase tolerance of receptors and thus minimise adverse effects. This is particularly pertinent when informing residents on a decision to adopt a higher noise generating piling method that will result in a significantly shorter period of disruption. Additionally, should the option of deploying two piling rigs be adopted, the reasons behind the decision should be clearly explained during consultation. All communications will contain contact details to direct any questions or complaints to.

Modern installation techniques will be adopted that utilise high frequency pile drivers which significantly limit noise and vibration. Pile dampers should be utilised during percussive piling to reduce noise and vibration emissions.

To protect the underground utilities tunnel from being damaged by piling activities, the outer surface of the tunnel that may be affected will be defined at ground level before works commence. If piling is proposed within 15m of underground utilities, the acceptability of activities will be dependent on the nature and condition of the utilities. A vibration risk assessment would be undertaken by the contractor to ensure that underground utilities are protected from damage. The risk assessment will include a structural survey with Tell Tail meters placed at cracking points and vibration monitoring locations agreed with SCC.

Airborne noise

Significant unmitigated noise effects have been predicted throughout the construction period. Measures to control significant noise effects will be adopted, the most effective of which will be a good communication strategy with nearby residents. Significant effects are likely to be limited to periods when activities are taking place in proximity to individual properties so exposure to high levels of noise is likely to last for short periods of time. People tend to be more tolerant of higher levels of noise given prior warning.

Through the commitment to implement mitigation measures, it is considered that significant noise effects can be controlled at the majority of sensitive receptors; however, the likelihood of high levels of noise for short periods of time (up to seven 5-day periods) may still cause disturbance at nearby sensitive receptors. Provided that affected receptors are given prior warning of the potentially noisy works and informed on the reasons for adopting a higher noise generating method, it is considered that significant noise effects can be suitably offset. Additionally, it may also be considered that residents are likely to be more tolerant of periods of high noise given overall long-term benefits of the project to the local community. Consequently, temporary residual construction noise impacts are considered to be **Minor Adverse** at worst and not significant.

Ground-borne vibration

Unmitigated construction vibration effects have been identified as up to Moderate Adverse significance and are only likely to occur during piling activities. Significant vibration effects are only likely to occur for limited periods when piling activities are taking place in proximity of individual receptors. Given the short exposure period to levels of vibration that may cause annoyance, it is likely that vibration effects will not be significant given the prior warning that will be provided to residents and the overall long-term benefits of the project to the local community. Consequently, temporary residual vibration impacts are considered to be **Minor Adverse** at worst and not significant.

Traffic noise during construction

Although construction traffic noise has been predicted Minor Adverse, the following measures will be employed as best practice to ensure that noise effects due to construction traffic are minimised where possible:

- Delivery vehicles will, where reasonably practicable, be fitted with effective exhaust silencers and shall be maintained in good working order and operated in a manner such that noise emissions are controlled and limited as far as reasonably practicable;
- Time slots are adopted for deliveries to ensure that convoys of vehicles do not arrive simultaneously and to avoid unnecessary idling on-site;

- Strict control to prevent temporary parking on kerbside in the vicinity of noise sensitive receptors near the site; and
- The use of sufficient clear signage to ensure that demolition and construction vehicles use only designated routes.

Residual temporary noise effects due to deliveries on the local road network have been assessed as being no worse than **Minor Adverse** and not significant.

6.6.5 Summary and Conclusions

This section reports the assessment of potential impacts on noise and vibration sensitive receptors during the construction phase of the Proposed Development. Given the adoption of appropriate mitigation, a detailed communication strategy and proposed noise and vibration monitoring during construction, it is considered that significant noise and vibration impacts can be suitably offset. A summary of the impact pathways that have been assessed and the identified residual impacts following the application of mitigation measures is presented in Table 51.

Table 51. Summary of potential impacts, mitigation measures and residual impacts for airborne noise and vibration

Receptor	Impact pathway	Impact significance	Mitigation measures/Monitoring	Residual impact	Confidence
Residential receptors at Marine Villas and Aurora	Airborne noise during construction	Negligible to Major Adverse	Adoption of BPM; Developing a noise and vibration monitoring strategy; and Implementing a communication strategy for informing residents.	Negligible to Minor Adverse	Medium
	Ground-borne vibration during construction	Moderate Adverse		Minor Adverse	Medium
	Traffic noise during construction	Minor Adverse	Adoption of BPM.	Minor Adverse	High

6.6.6 References

British Standards Institute (1991). BS 7445-1 Description and Measurement of Environmental Noise. Part 2: Guide to the Acquisition of Data Pertinent to Land Use. BSi, London.

British Standards Institute. (2014). BS 5228-1:2009+A1 – Code of practice for noise and vibration control on construction and open sites, Noise. BSi, London.

Welsh Government. (2013). A noise action plan for Wales 2013–2018. Welsh Government, Cardiff.
Department of the Environment (DoE). (1976) Leaflet AL72: Noise Control on Building Sites.

British Standards Institute (2014). BS 5228-2:2009+A1 – Code of practice for noise and vibration control on construction and open sites, Vibration. BSi, London.

Thames Water. (2016). Guidance on piling heavy loads excavations tunnelling and dewatering.

6.7 Landscape / Seascape and Visual

This section presents the assessment of potential impacts on the landscape, seascape and visual receptors during the construction and operation phases of the Proposed Development.

6.7.1 Consultation and scope

Based on the Screening and Scoping Report (ABPmer, 2018), Table 52 presents the landscape, seascape and visual receptors, the impact pathways and further work that has been carried out to inform the marine licence application. No comments were received from NRW and statutory consultees in relation to the landscape, seascape and visual appraisal (see Section 5.1).

Table 52. Impact pathways and summary of further work for landscape, seascape and visual

Receptor	Impact Pathway	Requires Further Assessment?	Justification	Summary of Further Work
Landscape and seascape character	Temporary effects on landscape and seascape during construction	Yes	The construction stage is likely to result in localised temporary adverse landscape effects due to the presence of the construction equipment. It is anticipated these impacts may be substantial, but would be short-term and localised. This impact pathway will therefore require some further assessment work.	An assessment of this impact pathway has been undertaken. This has involved undertaking a field survey to confirm the baseline landscape and seascape character of the study area.
Residents, workers and visitors	Temporary visual effects during construction	Yes	Visual effects as a result of the views of construction plant, which are likely to include cranes and piling machinery in close proximity to receptors. It is anticipated these impacts may be substantial, but would be short-term and localised. This impact pathway will therefore require some further assessment work.	An assessment of this impact pathway has been undertaken. This has involved undertaking a field survey to identify viewpoints that represent the views experienced from a range of visual receptors and at various distances and directions from the application site.
Landscape and seascape character	Permanent effects on landscape and seascape during operation	Yes	The operational stage is likely to result in localised permanent beneficial landscape effects as a result of the replacement of the dilapidated section of existing pier that is considered to detract from the townscape and visual amenity of the area. This impact pathway will therefore require some further assessment work.	An assessment of this impact pathway has been undertaken. This has involved undertaking a field survey to confirm the baseline landscape and seascape character of the study area.
Residents, workers and visitors	Permanent visual effects during operation	Yes	The operational stage is likely to result in localised permanent beneficial visual effects as a result of the replacement of the dilapidated section of existing pier that is considered to detract from the townscape and visual amenity of the area. This impact pathway will therefore require some further assessment work.	An assessment of this impact pathway has been undertaken. This has involved undertaking a field survey to identify viewpoints that represent the views experienced from a range of visual receptors and at various distances and directions from the application site.

6.7.2 Landscape and visual impact assessment methodology

The landscape and visual assessment has been undertaken in accordance with the Landscape Institute and Institute of Environmental Management and Assessment's "Guidelines for Landscape and Visual Impact Assessment, 3rd Edition" (GLVIA3) (Landscape Institute and Institute of Environmental Management and Assessment, 2013).

Landscape and seascape

The assessment identifies landscape and seascape receptors, derived from published landscape studies and field work. The assessment identifies their sensitivity, based upon consideration of their value and susceptibility (ability to accommodate change) as set out in Table 53.

Table 53. Landscape/seascape sensitivity

Landscape/Seascape Sensitivity	Criteria
High	A valued landscape/seascape, whether through landscape/seascape designations or distinctive components and characteristics, susceptible to small changes.
Medium	Landscape/seascape with some value, of relatively common components and characteristics, reasonably tolerant of changes.
Low	Landscape of limited value, relatively inconsequential components and characteristics, the nature of which is potentially tolerant of substantial change.
Very Low	Very low or no value, a degraded landscape/seascape or landscape/seascape with very few or no natural or original features remaining, such that it is tolerant of change.

Having identified the landscape/seascape receptors, the assessment then judges the magnitude of impact (change) of the Proposed Development, based upon the following criteria set out in Table 54.

Table 54. Landscape/seascape magnitude of impact criteria

Landscape/Seascape Impact	Criteria
High	The total or major loss or alteration of key characteristics or the addition of new features or components that would substantially alter the character or setting of the area.
Medium	The partial loss or alteration of characteristics or the addition of new features or components that would alter the character or setting of the area.
Low	The limited loss or alteration of components or the addition of new features or components that reflect the character or setting of the area.
Very Low	Virtually imperceptible loss or alteration or addition of new features or components that overall retain the character or setting of the area.
None	No change to the character or setting of the area.

Visual

The visual assessment is similarly undertaken by identifying people or groups of people with potential views of the Proposed Development to establish visual receptors. The assessment then considers the sensitivity of the visual receptors, based upon their value and susceptibility as set out in Table 55.

Table 55. Visual sensitivity

Visual Sensitivity	Criteria
High	Activity resulting in a particular interest or appreciation of the view (e.g. residents or people engaged in outdoor recreation whose attention is focused on the landscape) and/or a high value of existing view (e.g. a designated landscape, unspoilt countryside or conservation area designation).
Medium	Activity resulting in a general interest or appreciation of the view (e.g. residents or people engaged in outdoor recreation that does not focus on an appreciation of the landscape, residents) and/or a medium value of existing view (e.g. suburban residential areas or intensively farmed countryside).
Low	Activity where interest or appreciation of the view is secondary to the activity (e.g. people at work or motorists travelling through the area) and/or low value of existing views (e.g. featureless agricultural landscape, poor quality urban fringe).
Very Low	Activity where interest or appreciation of the view is inconsequential (e.g. people at work with limited views out, or drivers of vehicles in cutting) and/or very low value of existing view (e.g. industrial areas or derelict land).

Having identified the sensitivity of the visual receptors, the assessment then judges the magnitude of impact (change) of the Proposed Development, based upon the following criteria set out in Table 56.

Table 56. Visual impact criteria

Visual Impact	Criteria
High	Extensive change to the composition of the existing view (e.g. widespread loss of characteristic features or the widespread addition of new features within the view) and/or high degree of exposure to view (e.g. close, direct or open views).
Medium	Partial change to the composition of the existing view (e.g. loss of some characteristic features or the addition of new features within the view) and/or medium degree of exposure to view (e.g. middle-distance or partially screened views).
Low	Subtle change to existing view (e.g. limited loss of characteristic features or the addition of new features within the view) and/or low degree of exposure to view (e.g. long-distance, substantially screened or glimpsed views).
Very Low	Barely perceptible change to the existing view and/or very brief exposure to view.
None	No change to the view.

Landscape, seascape and visual effects

The following is a guide to how landscape, seascape and visual effects are classified by considering the sensitivity of the receptor with the magnitude of the impact (Table 57). Where the effects differ from those presented in the guide, a reasoned justification is presented in the text.

Table 57. Landscape, seascape and visual effects

Sensitivity of Receptor	Magnitude of Impact				
	High	Medium	Low	Very Low	None
High	Major	Major or Moderate	Moderate or Minor	Minor or Negligible	Neutral
Medium	Major or Moderate	Moderate or Minor	Minor or Negligible	Negligible	Neutral
Low	Moderate	Minor	Minor or Negligible	Negligible or Neutral	Neutral
Very Low	Minor	Negligible	Negligible or Neutral	Neutral	Neutral

A description of the above landscape, seascape and visual effects is provided in Table 58.

Table 58. Landscape, seascape and visual effect definition

Effect	Landscape/Seascape Effect	Visual Effect
Major beneficial	Where the Proposed Development substantially improves the scale, landform and pattern of the landscape/seascape and/or enriches quality or characteristic features.	Where the Proposed Development results in a pronounced improvement to the existing view.
Moderate beneficial	Where the Proposed Development largely improves the characteristic of the scale, landform and pattern of the landscape/seascape, and/or quality or characteristic features.	Where the Proposed Development results in a notable improvement to the existing view.
Minor beneficial	Where the Proposed Development partially improves the scale, landform and pattern of the landscape/seascape, and/or quality or characteristic features.	Where the Proposed Development causes a partial improvement to the existing view.
Negligible beneficial	Where the Proposed Development causes a very slight improvement to the existing landscape.	Where the Proposed Development causes a barely perceptible improvement to the existing view.
Neutral	No change to the landscape/seascape character or landscape features.	No change to the view.
Negligible adverse	Where the Proposed Development causes a very slight deterioration to the existing landscape/seascape.	Where the Proposed Development causes a barely perceptible deterioration to the existing view
Minor adverse	Where the Proposed Development partially deteriorates the scale, landform and pattern of the landscape/seascape, and/or quality or characteristic features.	Where the Proposed Development causes a partial deterioration to the existing view.
Moderate adverse	Where the Proposed Development largely deteriorates the characteristic of the scale, landform and pattern of the landscape/seascape, and/or quality or characteristic features.	Where the Proposed Development results in a notable deterioration to the existing view.
Major adverse	Where the Proposed Development substantially deteriorates the scale,	Where the Proposed Development results in a pronounced deterioration to

Effect	Landscape/Seascape Effect	Visual Effect
	landform and pattern of the landscape/seascape and/or enriches quality or characteristic features.	the aesthetic quality or composition of the existing view.

6.7.3 Baseline review

Data sources

The principal data sources that have informed this assessment are as follows:

- LANDMAP, Natural Resources Wales (NRW, 2018).

Study area

The Screening and Scoping Report proposed a study area of 0.5 km from the application site given that landscape, seascape and visual impacts would be localised as a result of the small-scale nature of the Proposed Development and the existing context. The Screening and Scoping Report noted that the study area would be reviewed at the time of assessment to ensure it was still deemed to be sufficient to assess the likely impacts and effects of the Proposed Development.

In reviewing the study area for the assessment, the Proposed Development would retain approximately the same height as the existing landside promenade west of the existing pier, and reflect the same scale as similar structures along the River Tawe. The application site is located adjacent to the Inner West Pier, within a developed part of southern Swansea's coastline, and confluence of the River Tawe into Swansea Bay.

Potential impacts are therefore considered to remain localised rather than be experienced more widely as a result of intervening land uses, including tall buildings and Swansea Docks. The 0.5 km study area is considered to remain sufficient in this context.

Application site and context

The application site is located to the south of the Swansea Barrage in Swansea Bay, at the northern end of the West Pier, on the western bank of the River Tawe. The application site comprises a heavily damaged and dilapidated section of pier extending between the Swansea Barrage and Swansea Bay Beach.

There are residential apartments to the west of the application site. These buildings range from four to twelve storeys in height, and include Swansea Marina to their north. The dilapidated section of the application site is in contrast to the contemporary and regenerated character of these apartments and the marina.

Beyond the marina is the Quadrant Shopping Centre, consisting of large scale buildings and extensive car-parks, forming the southern part of Swansea city centre.

The River Tawe continues to the north of the application site, along with the Trafalgar Bridge and the Prince of Wales Dock. The Wales Coast Path National Trail and National Cycle Network Trail 4 crosses Trafalgar Bridge, and extends along the western edge of the application site, linking to the Swansea Bay promenade.

To the east of the application site there are extensive docks, consisting of large scale engineered water bodies, bordered by hard standing, buildings and access roads.

The River Tawe continues to the south of the application site, along with the Outer West Pier and Eastern Breakwater of Swansea Docks which mark the confluence of the River Tawe with the northern part of Swansea Bay. The northern part of Swansea Bay is broadly semi-circular in form, extending between Mumbles Head and Port Talbot and includes extensive mud and sand flats along its length.

Published landscape and seascape assessments

National Landscape Character Areas

NRW has defined broad landscape character areas that cover the entirety of Wales. The application site falls within National Landscape Character Area (NLCA) 38 Swansea Bay (NRW, 2014). This NLCA is characterised by a narrow coastal plain which links the lowlands of Glamorgan and Gwendraeth. The extensive sandy coastline is backed by dunes. Large parts of the area have been built on, with major docks at the Tawe Estuary and a focus of development at the city of Swansea. The NLCA identifies that in recent years the degree of regeneration is changing the landscape, including new urban blocks of flats and marinas at the redundant former docks in Swansea.

Landmap

The baseline landscape and seascape character has been identified using LANDMAP and verified via fieldwork.

LANDMAP is the formally recognised national landscape resource in Wales to understand landscape character. It is an all-Wales landscape resource where landscape characteristics, qualities and influences on the landscape are recorded and evaluated. LANDMAP evaluates areas in terms of five key spatial datasets or 'Aspect' areas:

- **Geological Landscape:** considers the physical, primarily geological influences that have shaped the contemporary landscape and identifies those landscape qualities which are linked to the control or influence exerted by bedrock, surface processes, landforms and hydrology;
- **Landscape Habitats:** identifies the characteristics and spatial relationships of habitats and vegetation at scales broadly comparable to other Aspects;
- **Visual and Sensory:** identifies perceptual landscape qualities as well as the physical attributes of landform and land cover including visible patterns of distribution and the relationships between them;
- **Historic Landscape:** identifies those qualities that depend on key historic land uses, patterns and features; and
- **Cultural Landscape:** considers the links between landscape and people, how human activity shapes the landscape and how culture can shape the way people think about the landscape. Its aim is to identify those cultural patterns that are keeping the landscape alive today, rather than those that sustained it in the past.

Table 59 presents the LANDMAP areas that are within the study area (note there are no Geological Landscape aspect areas within the study area).

Table 59. LANDMAP aspects within the study area

LANDMAP Aspect	LANDMAP Area Name	LANDMAP Description	LANDMAP Overall Evaluation
Landscape Habitats	Swansea Beach (to the south-west of the application site)	"*Intertidal substrate... Invertebrates in sand... Fish at high tide... Bird species at low water...*"	High
	Swansea Docks (to the east of the application site, including Prince of Wales and Kings Dock)	"*Heavily urbanised area surrounding the docks with industrial units to the east and buildings surrounding the docks themselves in the west. There are a few areas of scrub and green space and a local wildlife site along the Tennant Canal.*"	Moderate
	Western Docks and Industrial Parks (to the west of the application site, including the residential apartments and Swansea)	"*The Aspect Area is mainly formed of industrial areas stretched alongside the Afon Tawe, buffered from the river edge by a linear hedgerow. The docks in the south connect directly to the river and further into Swansea Bay. There are irregular, small areas of open green space, particularly in the south.*"	Low
Visual and Sensory	River Tawe (to the north of Trafalgar Bridge)	"*The Tawe is a wide, powerful river in its lower reaches with high flow and large level range due to large catchment area in the Brecon Beacons and coalfield plateau. This characteristic means that the river is canalised with hard and soft embankments. The Tawe barrage to the south means the water levels are more constant. A series of bridges provide important crossing points, which allow attractive views such as south to the 'Sail' pedestrian footbridge by the marina. There are some detractors such as derelict sites and some commercial developments on its length. There are also points of interest reflecting industrial heritage such as the chimneys, old dock and landscaped mound at Hafod. There is riparian vegetation in parts which constrict access and provide cover for wildlife but in other areas grassed banks allow access. The river is a focus for recreation including the marina to the south, occasional kayaking, and walking and cycling alongside for part of its length as routes are forced away from the river edge in parts. The river provides the focus for the important green open space into the centre of the city and a link through to the Swansea Bay.*"	High (The river forms an interesting green corridor with some pleasing views and vistas especially to the south. It is in generally moderate condition with water providing a constant consistent theme although bounded by some intrusive development...)
	Swansea Bay Tawe Approaches (overlaps the application site)	"*The dredged tidal approaches from Swansea Bay to the Tawe lock and Swansea Docks are bounded by high protecting sea walls. These enclose the approach making the water calmer than the more open waters of Swansea Bay. The channel is fairly busy with commercial and leisure traffic depending on the state of the tide. Landward there are docks structures and new buildings marking the edge of the maritime quarter of Swansea. Seaward there are framed views of the bay and, on clear days, Somerset Coast can be seen in the distance across the Bristol Channel. Superb views are possible across this stretch of water.*"	High (robust utilitarian coastal scenic quality with views out to Swansea Bay. The channel is of consistent character, but the sea walls and other structures are in poor condition in parts...)
	Swansea Bay (to the south of the application site)	"*Large curving mud/sand beach with urban setting.*"	High (n/a)
	Swansea East (to the immediate east of the application site)	"*The city east of the River Tawe runs from the still functioning docks adjacent to Swansea Bay up the lower slopes of Kilvey Hill and north along the floor of the river valley and associated slopes to the east. The housing is densely terraced to the south around St Thomas and in parts to the north with some 20th-century estates such as at Waunwen. 20th century commercial development dominates the valley floor developed on a mix of*	-

LANDMAP Aspect	LANDMAP Area Name	LANDMAP Description	LANDMAP Overall Evaluation
		reclaimed and greenfield land. SA1 is a notable recent development on the main eastern approach to the city with new structures and uses giving new life to the dock waterfront."	
	Swansea Mumbles Coastal Park and Promenade (to the south-west of the application site, covering the thin strip of land between the bay and the built up area)	"*This corniche defines the western edge of Swansea Bay, which sweeps in a smooth wide arc from the Mumbles to the West round to the Tawe and marina to the east. The coastal edge is manmade and hard, defined by a corniche with parkland, promenade and cycle track which runs the majority of the seafront and allows leisurely enjoyment of the bay with views changing from out to sea across the Bristol Channel to views back to Swansea from the west. These views are enhanced by the dynamic nature of the wide intertidal area. Along the promenade there are intermittent cafes and beach access. At wider points the parkland is grassed with trees and there is pitch and putt. Overall the promenade and associated park are well used but there is still sufficient space to enjoy the bay and feel a sense of escape from the city streets. This part of the bay is protected from the prevailing south westerlies by Mumbles Head, especially around Mumbles itself. The bay is large scale but feels moderately enclosed by rising hills reaching over 100m AOD with an undulating skyline to the north and west. Views out to sea are enclosed on clear days by the coast of Exmoor, which lies in the distance. The primary foci across the ever changing bay are the Mumbles and lighthouse off Mumbles Head with their distinctive profile, often seen in silhouette behind the lifeboat station. The Meridian Tower forms a tall man made vertical focal point in the centre of the bay.*"	Outstanding (There are outstanding views across Swansea Bay to the Mumbles and out to sea including Exmoor. The promenade, park and structures are maintained in good condition and the promenade has a continuity and coherence with no major detractors…)
	Swansea West (to the west of the application site)	"*The city west of the River Tawe forms the majority of the city of Swansea. It runs from the Swansea Bay waterfront up the slopes of Townhill, along the River Tawe, and up the various valley slopes and hills to the north and west, towards Gower. To the south it includes the suburbs of Oystermouth and Mumbles. The city centre suffered major damage during World War II and was redeveloped post war. This development lacked a sense of place and the area continues to undergo redevelopment to improve its character and offer. Highlights include the Maritime quarter including the Marina which is popular for leisure boats and associate recreation, and the National Waterfront Museum. The tower at Meridian Quay is the tallest building in Wales and forms a strong simple landmark visible across Swansea Bay and from the north. Swansea's key characteristic is its relationship to the sweeping curve of Swansea Bay. Dense urban development on hillsides fringing the bay is a characteristic with the regimented rows of housing at Townhill particularly prominent. The University and Singleton Hospital are other large structures noticeable across the bay. These are softened to an extent by the adjoining park and vegetation. The waterfront buildings and core of Oystermouth/Mumbles have a positive former fishing village character which complements the waterfront. The 20th century residential estates running to the west towards Gower have limited coherent pattern or character although some roads are treed and well heeled. The residential and commercial development spreading to the north of Swansea centre generally lacks sense of place, coherence and understandable pattern.*"	-
Historic Landscape	H2 Foreshore	"*This comprises the area around Gower and Swansea Bay between mean high water and low water spring marks. Its historical importance lies in the preservation of ancient land-*	Unassessed

LANDMAP Aspect	LANDMAP Area Name	LANDMAP Description	LANDMAP Overall Evaluation
		surfaces which formed at periods when tidal levels were lower than they are at present. Best known for exposures under certain tidal conditions of prehistoric land surfaces; recorded data mainly palaeoenvironmental, but some anthropogenic elements known."	
	Swansea Maritime Area	"*This aspect area includes the historic Swansea Docklands and the adjacent parts of the city centre which were focused on the docks in their heyday, during the latter 19th century and the first half of the 20th century. Historically, the area included working docks, warehouses, offices, hotels and civic buildings, including the old Town Hall. During the second half of the 20th century, parts of the docks have been lost, with the North Dock being filled-in during the 1960s (that area is excluded from this aspect area). The Maritime Area has been redeveloped and regenerated in modern times. The King's Dock remains in operation as a cargo handling facility, but formerly included the ferry terminal for the Swansea to Cork route, until its cessation in 2011. The Prince of Wales Dock is being redeveloped as a marina and the Queen's Dock is now used for mussel farming. The South Dock has been redeveloped as a modern marina complex, with associated housing. The aspect area still includes hotels, commercial properties and civic buildings. Leisure and recreation extends beyond the marinas and the area includes the National Waterfront Museum, the Swansea Leisure Centre, LC2 and the Dylan Thomas Theatre and Dylan Thomas Centre (in the old Town Hall).*"	High
Cultural Landscape	SA1	"*The SA1 regeneration and development area is principally based on the former Swansea docks area. Planned or already developed are a mix of residential, hotel, office, Technium (2) and other business premises in a £200 million development that, when completed, will transform Swansea's East Docklands and eastern gateway. It is the latest phase of regenerative activity in Swansea, the most prominent examples previously being the Marina and Enterprise Park. It is supported financially - and heavily at that - by the National Assembly, the City & County and the private sector. There is concern that the inevitable increase in motorised transport will contribute further to already frustrating traffic congestion that bedevils commuters at peak travel times.*"	Outstanding
	Waterfront Museum, Leisure Centre (covering the area to the west and north of the application site, including the marina and parts of the River Tawe).	"*Although the two elements of this Aspect Area span the spectrum from intellectual to physical enjoyment, their cultural essence at Level 4 - Leisure and recreation - is the same... The Waterfront Museum contrasts sharply with the ugly bulk of the Leisure Centre, which has been mired in controversy, closed because of the presence of noxious building materials, and being redeveloped at enormous cost... Part of the National Museums & Galleries portfolio, the Waterfront Museum was part-funded by the Heritage Lottery Fund, the WDA and City Council and opened in 2005... It reports that is meeting visitor targets - a debatable claim as, being a free facility, capturing of visitor data is not precise... The Aspect Area contributes to the vigorous and aspirational redevelopment of the Marina and SA1 quarters...*"	High

Visual

The application site has a localised inter-visibility with the surrounding area as a result of the developed context of the Swansea Maritime Area and Swansea Docks and localised changes in landform.

A site visit was carried out in April 2018 by a Chartered Landscape Architect to review the application site's townscape context and identify viewpoints. Six viewpoints have been identified within the study area to represent the views experienced from a range of visual receptors and at various distances and directions from the application site. The viewpoints are summarised below.

Viewpoint 1

Viewpoint 1 (Figure 25) represents views experienced by residents of flats adjacent to the application site, people working at and visiting local businesses at the western edge of the marina, and users of the Swansea Bay Promenade which is part of the Wales Coast Path National Trail and National Cycle Network Trail 4.

Figure 25. Viewpoint 1, looking south towards the application site

The view demonstrates that the River Tawe is seen in the context of industrial land at Swansea Docks, and recent tall mixed-use developments, as well as numerous vertical features, including lighting columns. The application site is distinguishable by the Heras fencing which restricts public access due to the damaged condition of the pier, which is visible beyond the black railings. The combination of the adjacent pier wall, railings and slightly elevated dunes screen any longer distance views of Swansea Bay from ground level at this location.

Viewpoint 2

Viewpoint 2 (Figure 26) represents views experienced by visitors, residents and workers from the waterfront promenade in Swansea Marina.

Figure 26. Viewpoint 2 from the waterfront prominade in Swansea Marina

The view demonstrates that the application site is not visible from this part of Swansea Marina as a result of intervening buildings, marina seawall and fencing. Views are focused on the marina as a result of the height and scale of the surrounding buildings.

Viewpoint 3

Viewpoint 3 (Figure 27) represents recreational users on the Wales Coast Path National Trail and National Cycle Network Trail 4, crossing the Swansea Barrage via Trafalgar Bridge.

Figure 27. Viewpoint 3 from Trafalgar Bridge

The view demonstrates that the application site is visible in close range views, being on the western bank of the River Tawe. The application site is seen in the direct context of apartments, such that the application site is not part of the visual context of Swansea Bay, which is to the left of the view, along the course of the River Tawe. Additionally, the view demonstrates that because of the apartments, there are no longer distance views beyond the application site. The degraded appearance of the pier is notable and a detracting feature of the view, in contrast to the contemporary design of the apartments.

Viewpoint 4

Viewpoint 4 (Figure 28) represents the views of recreational users, residents, workers and visitors along the waterfront promenade at Swansea Marina on the eastern bank of the River Tawe.

Figure 28. Viewpoint 4 from the waterfront looking south towards the application site

The view demonstrates that Trafalgar Bridge largely filters views of the application site, and that the main features within the view are the River Tawe bordered by contemporary apartments, as well as vertical features including lighting columns and a wind turbine. The combination of the apartments and Trafalgar Bridge screen any longer distance views of Swansea Bay.

Viewpoint 5

Viewpoint 5 (Figure 29) represents users of Swansea West Pier and visitors to the dunes at the eastern end of Swansea Bay Beach.

Figure 29. Viewpoint 5: Close range view of the application site from the dunes

The view demonstrates that the application site is visible at close range from the eastern edge of the dunes. Views include part of the docks and built-up area of Swansea in the background, situated below Kilvey Hill. The landside concrete buttress wall and existing pier wall and surface are notably damaged and degraded, reducing the scenic qualities of the dunes and River Tawe.

Viewpoint 6

This view (Figure 30) represents recreational users and visitors to the dunes and the promenade between Swansea Bay and the marina.

Figure 30. Viewpoint 6: View from the dunes, looking east towards the application site

The view demonstrates that the ground level of the application site is barely visible due to the undulating dunes and barriers within the car park. The application site is seen in the context of vertical features, including cranes and lighting columns within Swansea Docks which in turn screen any longer distance views.

Visual Receptors

In summary, the application site is visible at close range from residential properties, businesses and recreational users on the promenade, dunes and Wales Coast Path National Trail. Within these views, the degraded and damaged condition of the pier, in combination with the Heras fencing, result in the application site being a notable detracting feature, which reduces the scenic quality of the view and is in contrast to the contemporary design and higher aesthetic of the residential apartments and public realm.

Beyond these locations, the views of the application site decrease, due to the intervening features including tall buildings adjacent to the River Tawe. Views in the direction of the application site include buildings and vertical features within Swansea Docks.

Table 60 identifies the visual receptors which may be impacted by the Proposed Development and their corresponding viewpoint.

Table 60. Visual receptors

Viewpoint number	Visual Receptor
1	Residents of apartments east of Trawler Road. People working and visiting local businesses. Users of the Swansea Bay Promenade, which is part of the Wales Coast Path National Trail and National Cycle Network Trail 4.
2	People visiting Swansea Marina.
3	Users of the Trafalgar Bridge across the River Tawe and public realm east of the River Tawe, which is part of the Wales Coast Path National Trail and National Cycle Network Trail 4.
4	Users of the waterfront promenade east of the River Tawe. Residents east of the River Tawe. People working east of the River Tawe.
5	Visitors to Swansea Bay Beach.

Viewpoint number	Visual Receptor
	Visitors to Swansea West Pier.
6	Visitors to the Swansea Bay Dunes. Users of the Swansea Bay Promenade, which is part of the Wales Coast Path National Trail and National Cycle Network Trail 4.

6.7.4 Impact Assessment

The following impact pathways have been assessed with respect to landscape, seascape and visual:

- Temporary effects on landscape and seascape during construction;
- Temporary visual effects during construction;
- Permanent effects on landscape and seascape during operation; and
- Permanent visual effects during operation.

The assessment has given consideration to the following with respect to the construction phase:

- Pile installation (visual and audible) and associated equipment;
- Fencing and hoardings;
- Barges and localised dredging in the River Tawe; and
- General construction activity and construction traffic.

The following has been considered with respect to the operational phase:

- New length of pier, set approximately 5 m seaward of the existing pier.

A detailed assessment of landscape, seascape and visual effects during the construction and operation of the Proposed Development is provided in Appendix I. The outcomes of this assessment are outlined in the following sections. The assessment has been undertaken for winter in line with the anticipated programme of the works and timing restrictions in relation to migratory fish (Section 6.2.3). A peak level of construction activity has been assumed, along with the incorporation of industry standard practice as detailed in the CMP (see Section 4.4.8).

Temporary effects on landscape and seascape during construction

The construction activity would be located directly within the Swansea Bay Tawe Approaches, Swansea Mumbles Coastal Park and Promenade and Swansea West LANDMAP Areas. The piling, operation of barges and lifting equipment, along with the transportation of materials and general activity, would partially alter the character of the area, including a reduction in tranquillity. For the Swansea Mumbles Coastal Park and Promenade, there would also be a localised alteration in the area of the dunes to allow access to the pier. In this part of the Aspect Area, the dunes are already degraded by the collapsing wall and presence of Heras fencing and comprise bare ground (see Section 6.3.1). The magnitude of impact to these LANDMAP Areas is therefore assessed as medium.

In relation to the sensitivity of the LANDMAP Areas, the Medium magnitude of impact would result in a range of temporary **Moderate and Minor Adverse** effects to the Swansea Bay Tawe Approaches, Swansea Mumbles Coastal Park and Promenade and Swansea West LANDMAP Areas.

For the remaining LANDMAP Areas, in which the construction activity is not directly located, the magnitude of impact is assessed as very low. This is because whilst there would not be any physical change to the LANDMAP Areas, the construction activity would still be perceived. In relation to the

sensitivity of the LANDMAP Areas, the Very Low magnitude of impact would result in temporary **Negligible Adverse** effects.

Temporary visual effects during construction

As there are a number of close range visual receptors, which include residents, local businesses, recreational users and workers, there would inevitably be open views of the construction activity. The close proximity of residential and local business receptors would result in a high degree of exposure to the construction activity, whilst for recreational users along the pier and Trafalgar Bridge the construction activity would represent a partial change to the view. This is because the dredging activity would be seen in the context of existing boats on the River Tawe and the tall lifting equipment and machinery would be seen in the context of Swansea Docks.

The magnitude of impact for these close range receptors during the construction phase would range between medium to high. In relation to the high and medium sensitivity of these receptors, the temporary visual effects would range between **Major and Moderate Adverse**.

For visual receptors not in close proximity to the application site, including on Swansea Beach and to the north of Trafalgar Bridge, the intervening features would screen the majority of the construction activity. The exception would be the upper parts of tall lifting equipment, but in the context of existing vertical features within the view, the magnitude of impact is assessed as low and the temporary effects as **Minor Adverse**.

Permanent effects on landscape and seascape during operation

During operation, the Proposed Development would represent a limited change to the character of the local area and for the LANDMAP Areas by introducing a new piled and concrete capped pier wall, in addition to and in the context of the existing degraded pier wall.

For the Swansea Bay Tawe Approaches, Swansea Mumbles Coastal Park and Promenade and Swansea West LANDMAP Areas, in which the Proposed Development is directly located, these changes would result in a low magnitude of change.

In relation to the sensitivity of these receptors, the low magnitude of change would result in permanent **Negligible Adverse** effects. These effects are considered adverse as the Proposed Development does not include the landside works, and so the anticipated overall beneficial changes arising from the improved recreational access to the waterfront, scenic quality, and public realm have not been assessed.

For the remaining LANDMAP Areas, in which the Proposed Development is not directly located, the permanent magnitude of impact would be none and the effect **Neutral**.

Permanent visual effects during operation

During operation, the Proposed Development would result in a limited change as a result of views of the new piled and concrete capped pier wall, which would be in keeping with the existing visual context.

For the close range receptors, this change to the view would result in a low magnitude of impact and permanent **Negligible Adverse** effects.

For visual receptors not in close proximity to the application site, including on Swansea Beach and to the north of Trafalgar Bridge, the intervening features would screen the Proposed Development, such that the magnitude of impact would be none and the effect **Neutral**.

6.7.5 Mitigation measures and residual effects

Apart from the incorporation of industry standard practice which will be detailed in a CMP (see Section 4.4.8), no additional mitigation measures are considered to be required. Moderate adverse landscape and visual impacts identified at construction result from operation of barges and cranes and cannot be readily mitigated; however, these effects would be temporary lasting only for the duration of construction.

The residual effects are therefore as stated for the assessment of permanent landscape, seascape and visual effects during operation in Section 6.7.4.

6.7.6 Summary and Conclusions

This section reports the assessment of potential impacts on landscape, seascape and visual receptors during the construction and operational phase of the Proposed Development. Adverse impacts are anticipated during construction, however, these will only be temporary. Following construction, the Proposed Development would result in significant beneficial effects to landscape, seascape and visual receptors. A summary of the impact pathways that have been assessed and the residual impacts is presented in Table 61.

Table 61. Summary of potential impacts, mitigation measures and residual impacts for landscape, seascape and visual

Receptor	Impact pathway	Impact significance	Mitigation measures/Monitoring	Residual impact	Confidence
Landscape and seascape character	Temporary effects on landscape and seascape during construction	Negligible to Moderate Adverse (depending on receptor area)	Incorporation of industry standard practice.	See residual impacts during operation in Appendix I.	High
Residents, workers and visitors	Temporary visual effects during construction	Minor to Major Adverse (depending on receptor location)		See residual impacts during operation in Appendix I.	High
Landscape and seascape character	Permanent effects on landscape and seascape during operation	Neutral to Negligible Adverse (depending on receptor area)	N/A	Neutral to Moderate Beneficial (depending on receptor area)	High
Residents, workers and visitors	Permanent visual effects during operation	Neutral to Negligible Adverse (depending on receptor location)	N/A	Neutral to Moderate Beneficial (depending on receptor location)	High

6.7.7 References

Landscape Institute and Institute of Environmental Management and Assessment. (2013). Guidelines for Landscape Institute and Environmental Management Assessment 3rd Edition. Routledge: Abingdon.

NRW (2018). LANDMAP. [online]. Available at: <https://landmap-maps.naturalresources.wales/> [Accessed 23/10/18].

NRW (2014). National Landscape Character Area 38 Swansea Bay. [online]. Available at: <https://naturalresources.wales/media/682627/nlca38-swansea-bay-description.pdf> [Accessed 23/10/18].

6.8 Transport and Access

This section presents the assessment of potential impacts during the construction and operation of the Proposed Development on transport and access receptors.

6.8.1 Consultation and scope

Based on the Screening and Scoping Report (ABPmer, 2018), Table 62 presents the receptors relevant to transport and access, the impact pathways and further work that has been carried out to inform the marine licence application. No comments were received from NRW and statutory consultees in relation to the landside transport and access (see Section 5.1).

Table 62. Impact pathways and summary of further work for transport and access

Receptor	Impact Pathway	Requires Further Assessment?	Justification	Summary of Further Work
Pedestrians and drivers	Pedestrian and driver delay during construction	Yes	The transport and access details during construction were not confirmed at the screening phase and therefore this impact pathway will require further assessment.	An assessment of this impact pathway has been undertaken based on the proposed transport and access routes outlined in Section 3.2. This has involved the preparation of a Transport Statement (Appendix J).
Pedestrians and drivers	Road safety during construction	Yes	The transport and access details during construction were not confirmed at the screening phase and therefore this impact pathway will require further assessment.	An assessment of this impact pathway has been undertaken based on the proposed transport and access routes outlined in Section 3.2. This has involved the preparation of a Transport Statement (Appendix J).
Pedestrians	Decrease in pedestrian amenity during construction	No	It is anticipated that there will be no impact on pedestrian amenity due to the location of the Proposed Development site which is separated from pedestrian routes and is currently not accessible to the public due to the poor state of repair of the pier. The Proposed Development itself aims to improve the pedestrian environment around Swansea Pier and during construction only limited number of deliveries will be made by road to the construction site. This impact pathway is therefore not considered to require further assessment.	No further assessment work has been undertaken for this impact pathway.
Community	Community severance during construction	Yes	The transport and access details during construction were not confirmed at the screening phase and therefore this impact pathway will require further assessment.	An assessment of this impact pathway has been undertaken based on the proposed transport and access arrangements outlined in Section 3.2. This has involved the preparation of a Transport Statement (Appendix J).
Pedestrians	Fear and intimidation during construction	Yes	The transport and access details during construction were not confirmed at the screening phase, and therefore this impact pathway will require further assessment.	An assessment of this impact pathway has been undertaken based on the proposed transport and access routes outlined in Section 3.2. This has involved the preparation of a Transport Statement (Appendix J).
Pedestrians, drivers and the community	Transport and access effects during operation	No	During operation, conditions are not expected to change as a result of the Proposed Development, with any trips associated with leisure and maintenance visits to the Proposed Development as per existing baseline conditions. Vehicle traffic is expected to be minimal. Therefore, no impacts on transport and access are anticipated during operation. This impact pathway is therefore not considered to require further assessment.	No further assessment work has been undertaken for this impact pathway.

6.8.2 Baseline review

Data sources

This section has been informed by construction information provided by ABP and their early engagement with potential contractors, as well as drawing upon experience of similar developments.

Baseline Traffic Conditions

A combination of the A4067 Oystermouth Road, Dunvant Place and Trawler Road provide road access towards the Inner West Pier. Dunvant Place is accessed from the A4067 Oystermouth Road at a signalised T-junction and becomes Trawler Road after the junction with Paxton Drive.

Trawler Road is a two-way, single carriageway 6.5 m wide residential road with a 20 mph speed limit. Trawler Road runs east-west to the south of Swansea Marina, ending at a car park for the surrounding flats and the Marina Park, which is located to the west of the application site. Dunvant Place and Trawler Road are bus routes, served by an hourly bus between the Marina and the City Centre.

An unnamed road off Trawler Road links to a small roundabout which provides access to an area of car parking adjacent to Swansea Marina and a single lane road which runs alongside the Marina towards the Tawe Lock and the northern end of the application site, which is currently controlled by a barrier. From Trawler Road, The Slipway is a single carriageway, two-way residential road of approximately 6 m width, leading to an area of car parking and an existing pedestrian access onto the beach.

In terms of the strategic road network, the A4067 runs in an east-west direction from Oystermouth in the southwest, along the coast towards Swansea city centre where it crosses the River Tawe, joining the A483 which provides access to the M4 at Junction 42 to the east. The A483 provides direct access to Swansea Docks, which is also served by the national rail network with railway lines accessing directly to the Docks.

6.8.3 Impact Assessment

The following impact pathways have been assessed with respect to transport and access:

- Pedestrian and driver delay during construction;
- Road safety during construction;
- Community severance during construction; and
- Fear and intimidation during construction.

The assessment has been based on the project methodology information regarding construction workforce, vehicles and deliveries in Section 3.2.

There are anticipated to be a maximum of 10-15 HGV deliveries per week to the eastern site compound at the docks, which is an average of approximately three HGV deliveries per day and six additional movements on the highway network (Table 63). A maximum of 10 HGV deliveries per day are anticipated to the application site / western site compound. This is equivalent to 20 additional vehicle movements a day (Table 64).

Overall, the construction of the Proposed Development will generate 63 daily arrivals and 63 daily departures, a total of 126 daily movements, of which 26 will be HGV movements. The majority of daily

movements, 100 construction worker movements and six HGV movements will take place to and from the eastern site compound, with the remaining 20 daily HGV movements taking place to and from the western site compound / application site, which is equivalent to a maximum of two HGV movements per hour. Construction trip profiles are presented below.

Table 63. Construction Trip Profile – Eastern Site Compound

East Compound						
Time	**Arrivals**		**Departures**		**Total**	
	HGV	**Light (workers)**	**HGV**	**Light (workers)**	**HGV**	**Light (workers)**
06:00-07:00	0	50	0	0	0	50
07:00-08:00	0	0	0	0	0	0
08:00-09:00	0	0	0	0	0	0
09:00-10:00	1	0	1	0	2	0
10:00-11:00	0	0	0	0	0	0
11:00-12:00	0	0	0	0	0	0
12:00-13:00	1	0	1	0	2	0
13:00-14:00	0	0	0	0	0	0
14:00-15:00	0	0	0	0	0	0
15:00-16:00	1	0	1	0	2	0
16:00-17:00	0	0	0	0	0	0
17:00-18:00	0	0	0	0	0	0
18:00-19:00	0	0	0	0	0	0
19:00-20:00	0	0	0	50	0	50
Daily	**3**	**50**	**3**	**50**	**6**	**100**

Table 64. Construction Trip Profile – Western Site Compound

West Compound						
Time	**Arrivals**		**Departures**		**Total**	
	HGV	**Light (workers)**	**HGV**	**Light (workers)**	**HGV**	**Light (workers)**
06:00-07:00	0	0	0	0	0	0
07:00-08:00	1	0	1	0	2	0
08:00-09:00	0	0	0	0	0	0
09:00-10:00	1	0	1	0	2	0
10:00-11:00	1	0	1	0	2	0
11:00-12:00	1	0	1	0	2	0
12:00-13:00	1	0	1	0	2	0
13:00-14:00	1	0	1	0	2	0
14:00-15:00	1	0	1	0	2	0
15:00-16:00	1	0	1	0	2	0
16:00-17:00	1	0	1	0	2	0
17:00-18:00	0	0	0	0	0	0
18:00-19:00	1	0	1	0	2	0
19:00-20:00	0	0	0	0	0	0
Daily	**10**	**0**	**10**	**0**	**20**	**0**

This assumption is considered to represent a 'worst case' scenario, assuming that all construction workers will drive to the application site. Although parking will be provided on the eastern site compound for approximately 40-50 vehicles it is not expected that all construction workers will travel by private motor vehicle, especially given the available sustainable travel options including a frequent bus service, and workers will be actively encouraged to travel to and from the application site by sustainable means or by car sharing as part of a construction traffic management strategy (see Section 6.8.4).

Overall, it is considered that the construction of the Proposed Development will not lead to a material impact on the highway network in transport terms.

Pedestrian and driver delay during construction

The majority of deliveries will be undertaken by barge from the Ferry Port Marshalling Yard at Swansea Docks, with materials at Swansea Docks expected to arrive or depart via the A483 or rail. Both are established and existing routes for deliveries to Swansea Docks. This approach will reduce the number of HGVs travelling on the local road network or unsuitable roads.

Movements locally are likely to be limited to those associated with construction workers, initial set-up and concrete deliveries. Both construction worker and vehicle movements will typically take place outside peak road network hours and any deliveries will be spread across the day. Workers will use existing routes between the western site compound and application site, avoiding trekking over the dune habitat (see Section 6.3.4).

According to the impact assessment methodology, the probability of occurrence is Low, and the magnitude of change is Small resulting in a Negligible exposure to change. The impact of the construction of the Proposed Development on pedestrian and driver delay is therefore anticipated to be **Insignificant**.

Road safety during construction

Personal Injury Accident (PIA) data has been obtained from CrashMap for the most recent five year period available, from January 2013 to December 2017. During this period no accidents have occurred on Trawler Road, Dunvant Place or any of the residential roads within the Maritime Quarter. One accident reported as slight in severity occurred in January 2013 at the junction between the A4067 Oystermouth Road and Dunvant Place.

The proposed access route to the eastern site compound in Swansea Docks would either use the A4067/Kings Road/A483 junction or travel onto the A483 via Baldwin Crescent. Two accidents classified as slight in severity occurred in 2015 and 2016 at the A4067/Kings Road/A483 junction, with no accidents reported in the A483/Baldwin Crescent junction.

To summarise, there have been very few accidents in the vicinity of the application site and at the junctions associated with the proposed construction routes and it is therefore considered that there are no existing collision patterns on the local road network.

Overall, the probability of an accident occurring is Low and the magnitude of change is Small resulting in a Negligible exposure to change. The impact of the construction of the Proposed Development on road safety is therefore considered to be **Insignificant**.

Community severance during construction

It is not anticipated that there will be any severance within the local community as a result of the construction of the Proposed Development as local roads are likely to remain open and the majority of deliveries would be brought in by barge. Traffic travelling to the application site will be low, consisting mainly of small vehicles such as cars and vans associated with construction workers or the initial set up of the site compound (Section 3.2).

Overall, the impact of the changes in access and transport as a result of the Proposed Development on the community is considered to be **Insignificant**.

Fear and intimidation during construction

The majority of deliveries will be brought in by barge. This would avoid HGVs travelling through the residential area of Trawler Road. The western site compound would also be separated from the surrounding residential dwellings and beach. It is therefore anticipated that construction of the Proposed Development would result in **Insignificant** fear and intimidation to the public.

6.8.4 Mitigation measures and residual effects

Despite the impacts on transport receptors being assessed as insignificant, a construction traffic management strategy will be put in place, which will include measures to manage and minimise impacts from construction traffic. These measures are outlined below and are included in the accompanying Transport Statement (Appendix J).

Safety and signage

Appropriate warning and directional signage will be provided along the construction route and at the entrance/exit to the application site to warn pedestrians and other road users of construction traffic. Other suitable precautions, such as the provision of banksmen and speed restrictions, will be put in place to ensure the safety of pedestrians and other road users along the construction route. Banksmen will be coordinated by the site traffic manager, who will organise the access points as necessary.

Construction workers and delivery drivers will be briefed on the appropriate routes to and from the application site and site compounds and the appropriate safety measures that are in place.

Delivery booking system

A delivery booking system will be operated by the contractor's site traffic manager, in order to manage the following:

1. Queuing outside of the site;
2. Arrival of unscheduled deliveries;
3. Deliveries failing to arrive or arriving early / late; and
4. No staff or equipment being available to unload the vehicle.

Mitigation of the above concerns will avoid unnecessary vehicle movements to and from the site compounds / application site and will also, importantly; reduce the possibility of construction vehicles queuing outside the site compounds waiting to be processed. The system will also ensure that deliveries take place outside of the network peak hours.

Control of dust and debris

All work will be monitored on a daily basis to ensure that no excessive dust or debris is created by the construction process and abatement techniques will be used to limit the potential generation of dust and debris.

Vehicle wheel washing facilities will be provided and there will be a road sweeper on hand at the site to clear up any material deposited on the public highway by vehicles accessing/egressing the application site and site compounds.

Encouraging sustainable travel

Workers will be able to park and then walk to the Proposed Development across the footbridge at the marina entrance or will be shuttled to the Proposed Development via minibus. Although parking will be available, there are many opportunities for construction workers to travel to the Proposed Development by sustainable means and construction contractors will be responsible for encouraging workers to do so, for example by using public transport, or encouraging car sharing.

6.8.5 Summary and Conclusions

This section reports the assessment of potential impacts of the Proposed Development on transport and access receptors. No material impact will result on the highway network and therefore the impacts on transport and access receptors are considered to be insignificant. In accordance with good practice, a construction traffic management strategy will be put in place which will include a number of measures to minimise and/or avoid any impacts. A summary of the impact pathways that have been assessed and the residual impacts is presented in Table 65.

Table 65. Summary of potential impacts, mitigation measures and residual impacts for transport and access

Receptor	Impact pathway	Impact significance	Mitigation measures/Monitoring	Residual impact	Confidence
Pedestrians and drivers	Pedestrian and driver delay during construction	Insignificant	Developing a construction traffic management strategy.	Insignificant	Medium/High
Pedestrians and drivers	Road safety during construction	Insignificant		Insignificant	Medium/High
Community	Community severance during construction	Insignificant		Insignificant	Medium/High
Pedestrians	Fear and intimidation during construction	Insignificant		Insignificant	Medium/High

7 Cumulative and In-combination Effects

The Proposed Development has the potential to cause cumulative / in-combination effects and these have been assessed in this section.

Industry standards for conducting cumulative and in-combination impact assessments include a guidance note published by the MMO (2014) and Natural England (2014). This section considers that a cumulative / in-combination assessment needs to take account of the total effects of all impacts from the Proposed Development alone acting upon all relevant receptors in seeking to assess the overall cumulative / in-combination significance. Additionally, consideration is given to any other activities and plans or projects, including any impacts that do not directly overlap spatially, but may indirectly result in a cumulative / in-combination impact. By looking at all potential impacts, the information provided in this section addresses the requirements under The Marine Works (EIA) Regulations 2007 (as amended) and also informs the assessment of in-combination impacts in line with the requirements of the Habitats Directive.

7.1 Baseline review

7.1.1 Plans or projects

The following plans or projects are licensed and/or in the process of being consented in Swansea Bay:

- Tidal Lagoon Swansea Bay;
- Swansea maintenance dredge (ABP); and
- Grab samples to undertake hydrographic survey and environmental sampling to update navigational charts and publications.

7.1.2 Activities

The following activities are taking place in Swansea Bay and have the potential to result in cumulative/ in-combination effects with the Proposed Development:

- Commercial and recreational fishing; and
- Commercial and recreational navigation.

7.1.3 Proposed Development alone

Based on the outcomes of the individual assessment topics presented in Section 6, the impact pathways relevant to the Proposed Development with residual adverse impacts are as follows:

- Underwater noise and vibration during construction on migratory fish (Minor Adverse);
- Underwater noise and vibration during construction on marine mammals (Minor Adverse);
- Airborne noise and visual disturbance during construction on coastal birds (Minor Adverse);
- Displacement of vessels during construction (Minor adverse);
- Accident or incident involving construction craft during construction (Minor adverse);
- Airborne noise during construction on residential receptors at Marine Villas and Aurora (Minor Adverse);
- Ground-borne vibration during construction on residential receptors at Marine Villas and Aurora (Minor adverse); and

- Traffic noise during construction on residential receptors at Marine Villas and Aurora (Minor Adverse);

7.2 Cumulative/In-combination Assessment

7.2.1 Plans or projects

The potential for cumulative / in-combination effects with other plans or projects are summarised as follows:

- The Proposed Development is likely to be constructed before construction begins on Tidal Lagoon Swansea Bay[24] and therefore no temporal overlap between the two projects will occur. Consequently, no cumulative / in-combination effects with the Proposed Development are envisaged;
- Any maintenance dredging carried out by ABP will be timed to avoid the period of bed preparation works for the Proposed Development. Given that benthic species at the dredge areas and disposal site will recover quickly from this disturbance (see Section 6.2), the effects are expected to be negligible. Therefore, no cumulative / in-combination effects with the Proposed Development are envisaged; and
- GI works and grab sampling surveys are of small scale and unlikely to have significant impacts on marine receptors. Furthermore, the survey licenced areas do not overlap with the Proposed Development. Therefore, no cumulative / in-combination effects with the Proposed Development are envisaged.

7.2.2 Activities

Commercial and recreational fishing

Both fishing activities and the Proposed Development have the potential to cumulatively impact upon:

- Fish; and
- Marine mammals.

Fishing may cause impacts to these receptors through removal of fish species, and/or by-catch of marine mammals (impacts of vessel disturbance are considered below). Given that the Proposed Development will only cause temporary impacts during construction to these receptors (through underwater noise and vibration), it is deemed unlikely that impacts will cause a significant cumulative / in-combination effect with fishing activities.

Commercial and recreational navigation

Both vessel navigation and the Proposed Development have the potential to impact upon the following receptors:

- Fish;
- Marine mammals; and
- Coastal birds.

Noise and visual disturbance are the main impact pathways from navigation that can interact with the Proposed Development. However, given that the Proposed Development will only cause temporary

[24] UK Government has not approved the project and there is uncertainty surrounding the possibility of gaining consent

impacts during construction to these receptors (through underwater and airborne noise and vibration, and visual disturbance), it is deemed unlikely that impacts will cause a significant cumulative / in-combination effect with commercial and recreational navigation.

7.2.3 Proposed Development alone

Of the impact pathways that have been identified as having residual adverse impacts (see Section 7.1.3), the following have the potential to act on the same receptor, namely residential receptors at Marine Villas and Aurora:

- Airborne noise during construction;
- Ground-borne vibration during construction; and
- Traffic noise during construction.

Although there is the potential for these residual impacts to result in a significant cumulatively / in-combination effect on residential receptors, these impacts are temporary, and the baseline situation will fully recover upon cessation of the works.

7.3 References

Marine Management Organisation (MMO) (2014). A Strategic Framework for Scoping Cumulative Effects. December 2014.

Natural England (2014). Development of a generic framework for informing Cumulative Impact Assessments (CIA) related to Marine Protected Areas through evaluation of best practice. Natural England Commissioned Report NECR147. Report produced by ABP Marine Environmental Research Ltd (ABPmer) supported by Wildfowl & Wetlands Trust Consulting.

8 Conclusions

This Environmental Appraisal has considered and assessed potential environmental impacts associated with the Proposed Development on all relevant environmental receptors. Consultation with key stakeholders has been undertaken prior to and throughout the assessment in order to discuss environmental issues. This was valuable for confirming that the Proposed Development will have the lowest environmental impact of any available alternative.

The majority of impacts identified in this Environmental Appraisal have been assessed to be of no or minor adverse significance. The key issues were found to be those associated with elevated levels of noise and vibration during construction on marine fauna and residents, and the displacement of vessels and risk of an accident or incident involving marine craft during construction. Following the adoption of appropriate mitigation measures, residual impacts will be reduced to minor adverse at worst. Once the Proposed Development has been constructed, no significant impacts are anticipated during operation.

9 Abbreviations/Acronyms

AA	Annual Average
ABP	Associated British Ports
AEP	Annual Exceedance Probability
AIS	Automatic Identification System
ANG	Isle of Anglesey
AOD	Above Ordnance Datum
BAP	Biodiversity Action Plan
BG	Bare Ground
BIS	Biodiversity Information Service
BPM	Best Practice Management
BRG	Bridgend
BS	British Standard
BSI	British Standards Institute
BWD	Bathing Waters Directive
CCW	Countryside Council for Wales
CDM	Construction, Design and Management
CEFAS	Centre for Environment, Fisheries and Aquaculture Science
CEMP	Construction Environmental Management Plan
CIA	Cumulative Impact Assessments
CIEEM	Chartered Institute of Ecology and Environmental Management
CIRIA	Construction Industry Research and Information Association
CIS	Celtic and Irish Seas
CMP	Construction Management Plan
CON	Conwy
DEN	Denbighshire
DMRB	Design Manual for Roads and Bridges
EA	Environment Agency
EC	European Commission
EcIA	Ecological Impact Assessment
EEC	European Economic Community
EIA	Environmental Impact Assessment
EQS	Environmental Quality Standard
ES	Environmental Statement
EU	European Union
FLI	Flintshire
FRAP	Flood Risk Activity Permit
GB	Great Britain
GHG	Greenhouse Gas
GI	Ground Investigation
GIS	Geographic Information System
GWY	Gwenydd
HAZID	Hazard Identification
HF	High-frequency cetaceans
HGV	Heavy Goods Vehicle
HM	Her Majesty's
HMWB	Heavily Modified Water Body
HRA	Habitat Regulations Assessment
IAMMWG	Inter-Agency Marine Mammal Working Group

ICE	Institute for Civil Engineers
ICES	International Council for the Exploration of the Sea
IECS	Institute of Estuarine and Coastal Studies
IEEM	Institute for Ecology and Environmental Management
IEMA	Institute for Environmental Management and Assessment
IGGI	Integrated Green Grey Infrastructure
IMO	International Maritime Organisation
IQI	Infaunal Quality Index
IUCN	International Union for Conservation of Nature
JNCC	Joint Nature Conservation Committee
KE	Kelt
LBAP	Local Biodiversity Action Plan
LFRMS	Local Flood Risk Management Strategy
LOAEL	Lowest Observable Adverse Effect Level
LPS	Local Port Service
LSE	Likely Significant Effect
LW	Low Water
MAC	Maximum Allowable Concentration
MarNIS	Maritime Navigation and Information Services
MCA	Maritime and Coastguard Agency
MCZ	Marine Conservation Zone
MHWS	Mean High Water Springs
ML	Marine Licence
MMO	Marine Management Organisation
MPA	Marine Protected Area
MSFD	Marine Strategy Framework Directive
NEW	Newport
NLCA	National Landscape Character Area
NNSS	Non-native Species Secretariat
NOAA	National Oceanic and Atmospheric Administration
NPT	Neath Port Talbot
NRA	Navigational Risk Assessment
NRW	Natural Resources Wales
OCSW	Offshore Channel, Celtic Sea & South West England
OGC	Office of Government Commerce
OSPAR	OSPAR Commission (named after the original Oslo and Paris Conventions)
PCB	Polychlorinated Biphenyl
PEA	Preliminary Ecological Appraisal
PIA	Personal Injury Accident
PMSC	Port Marine Safety Code
PPV	Peak Particle Velocity
PTS	Permanent Threshold Shift
PW	Phocid pinniped
RA	Returning Adult
RBMP	River Basin Management Plan
RNLI	Royal National Lifeboat Institute
SAC	Special Area of Conservation
SCC	Swansea City Council
SEL	Sound Exposure Level
SEPA	Scottish Environment Protection Agency
SEWBReC	South East Wales Biodiversity Records Centre
SHA	Statutory Harbour Authority

SI	Semi-improved [grassland]
SINC	Site of Importance for Nature Conservation
SM	Smolt
SOAEL	Significant Observed Adverse Effect Level
SSSI	Site of Special Scientific Interest
SWALL	Sea Wall
SYCSAC	Swansea Yacht Club and Sub-Aqua Club
TAG	Technical Advisory Group
TRA	Trunk Roads Estate
TTS	Temporary Threshold Shift
VHF	Very High Frequency
WCA	Wildlife and Countryside Act
WFD	Water Framework Directive
WVP	Welsh Vascular Plants

Cardinal points/directions are used unless otherwise stated.

SI units are used unless otherwise stated.