IMPACTS UPON FISH MIGRATION AND FISHING AREAS

7.1 to the Applicants

Paragraph 9.7.4.19 concludes that during the operational phase:

...the overall predicted long-term impact on the salmon and sea trout fishery is expected to be of Low magnitude with a significance value of Minor, and a confidence of Probable.

The basis for the assessment is summarised in paragraph 9.7.4.18, in the following terms:

The impact of the operational phase on salmon and sea trout smolt and adult migration, including entrainment and injury in the turbines, has been assessed as being of Minor significance post mitigation. This is due to the low proportion of fish that are predicted to pass through the turbines, the relatively fish-friendly design (small number of blades, slow rotation rate and minimum gap runner) of the turbines and the proposed deployment of fish deterrent systems as a mitigation measure.

(a) Does the NRW's "concern over levels of evidence and explanations to support confidence on impacts predicted" expressed in the letter of 11 April 2014 apply to the above assessment? And if so what further analysis is needed to bolster confidence in the assessment made?

(b) What aspects of this assessment and these conclusions are not accepted by those making representations on behalf of fishing interests?

TLSB's Response

1. It is understood that the concern expressed does relate to the above assessment. At a meeting on the 9 April 2014 between TLSB (and their expert fisheries advisers, THA) and NRW, NRW sought clarification on the evidence that supported the prediction presented by TLSB that long-term impact on the salmon and sea trout fishery is expected to be of Low magnitude with a significance value of Minor, and a confidence of Probable. THA and TLSB provided further explanation as to why the modelling approach should enjoy confidence and that confidence should extend to the assessed outcomes.

2. Issues considered at the meeting (TLSB and NRW 9 April) included:

    2.1 validation of inputs to both the IBM and STRIKER model;

    2.2 model sensitivity;

    2.3 accommodating randomness within the model;

    2.4 model calibration;

    2.5 linkage between models;

2.6 fish behaviour; and

2.7 mitigation.

3. These issues have been addressed within a series of briefing notes submitted to NRW since the meeting with the aim of bolstering confidence in the prediction of the ES, which are annexed at Appendix 7.1.1 to 7.1.5.

4. During this meeting it was explained by THA that the Individual Based Model (IBM) that informed the assessment process was an appropriate tool to assist in the prediction of a likely response by smolt (juvenile) and returning adult migratory fish to the proposed scheme. NRW has not stated in any of its representations that the use of an IBM model is an inappropriate or insufficient assessment tool, or that it has been wrongly applied in this case.

5. The IBM is not in itself a prediction of an outcome. However, the outputs of the model are used by fish biologists to estimate a likely response by the species under consideration to the proposed development based upon their expert knowledge. The IBM model is an appropriate tool to resolve the likely behavioural response of migratory fish in this context.

6. With specific reference to the Project and the assessments reported within the current application, the appropriateness of the approach to the model and the interpretation of its results is supported by:

6.1 An independent peer review (Mr Steve Colclough ex. EA estuarine fish biologist),who commented 'I find the modelling outputs to be extremely high quality, built on robust and thoroughly explored rationales which provide a high level of confidence that these are good approximations of real life fish behaviours" (Appendix 7.1.6).

6.2 The comments of an independent fisheries consultant (APEM), who reviewed THA's assessment on behalf of Fish Legal, and noted Modelling through the combination of a hydrodynamic model of the site and species specific Individual Based Model (IBM) is the only means of predicting fish encounter prior to construction', and the Crown Estate who recently published a report[1] which supported the use of the hydraulic models for the assessment of impacts on salmon stocks in marine renewables projects in Scotland.

7. THA consider, as NRW and APEM have noted, that the model may not appropriately model the behaviour of sea trout foraging near shore (in their non-migratory phase) within the Bay. Expert opinion has been used to consider effects to foraging stocks within the Bay. Where the unmitigated significance of impacts caused by the Project was considered moderate or greater, mitigation has been described (see table 9.27, Entrainment and injury from turbines).

[1] Guerin A.J., Jackson A.C., Bower P.A., Youngson A.F. (2014). Marine Research Report Hydrodynamic models to understand salmon migration in Scotland.

Publisher: The Crown Estate, ISBN: 978-1-906410-52-0

7.2 to the Applicant

An attachment setting out a fisheries analysis report is referred to within the Relevant Representations from the Usk Fishing Association and from Fish Legal and several other fishing clubs/angling societies. The Panel has not received this attachment and requests that a copy be submitted into the examination.

TLSB's Response

1. A review of the assessments contained in the ES in relation to the fisheries resource undertaken by the independent consultants retained by Fish Legal, APEM, is at Appendix 7.2.1.

2. This review was undertaken of the relevant parts of the draft ES, which had been made available to various parties including Portadawe and Swansea Angling Society (PASAS), without prejudice, in November 2013. This draft of the ES was a relatively early draft released for consultation purposes and which had not been subject to full technical or legal review by TLSB. As such, although reviewed and commented on by APEM, a parallel review and updating process was being undertaken in relation to the ES by TLSB and THA.

3. To facilitate an understanding of the how comments identified by the APEM report have been addressed, either in the final ES or through additional work, the APEM comments have been tabulated and a response has been provided in the adjacent column. Please see Appendix 7.2.2.

7.3 to the Interested parties

Does the ES address the requirements for on-going monitoring, review and mitigation of the effects of the Project upon fish populations?

TLSB's Response

1. An outline monitoring strategy is provided in the ES and is presented in Appendix 23.1 to the ES, the AEMP. TLSB would welcome detailed comments from interested parties on the proposals and suggestions as to how its performance can be improved.

2. As identified in the AEMP, the monitoring strategy is adaptive in nature. As such, TLSB will review and update it as the project progresses in consultation with NRW and other stakeholders. The draft AEMP will be updated and re-submitted during the course of the Examination. As part of this update it is proposed to link the predicted impact pathways, proposed monitoring and suggested mitigation such that a clearer understanding of potential effects and monitoring can be seen. Notwithstanding this further surveys are progressing where relevant in 2014 and data from these studies will also be used to inform the on-going update of the AEMP. These surveys have commenced and are outlined below:

3. Four surveys involving intertidal and subtidal techniques are being conducted at 6 intertidal sites and 6 subtidal sites, following the same methods as employed for the characterisation surveys (See ES Appendix 9.2). Surveys will take place: Quarter one (spring – complete); Quarter two (summer); Quarter three (autumn) and Quarter four (winter).

4. Intertidal surveys involve two surveying methods: a beach seine net (43 m long by 4 m deep, with 6.5mm knotless mesh) set from a small rigid vessel; and a Riley push-net (1.5 m wide by 30 cm deep with 1 mm fry mesh) used from the shore.

5. The subtidal surveys will be carried out from a 12.1 m mono-hull trawler using both otter and beam trawls. For each survey the catch will be identified to species level and measured to the nearest millimetre; fish were sub-sampled when > 50 specimens of the same species were captured. The surveys will then be repeated in 2017, 2020, 2024 and 2028.

7.4 to the Applicant and Interested Parties including, but not restricted to NRW and the Wildlife Trust of South and West Wales

The ES proposes to use acoustic fish deterrents as mitigation to lower the numbers of fish entrained through the turbines, if this becomes a significant issue.

Is there evidence that identifies that acoustic fish deterrents have a significant effect upon other species such as seals and porpoises?

TLSB's Response

1. The effects of Acoustic Fish Deterrents (AFD) on marine mammals is discussed in Chapter 10, Marine Mammals. Paragraph 10.5.10.10 states "*Acoustic fish deterrents (AFDs) identifies the potential to mitigate the potential collision risk of fish as a result of the operation of the turbines (see Chapter 9, Fish including recreational and commercial fisheries). This will also provide early acoustic warning for marine mammals. Sound projector source levels are typically 160 dB re 1µPa@1m, with frequencies covering a maximum range of 20-3000 Hertz. Neither PTS nor TTS will occur in harbour porpoise or grey seal even at the source of the AFDs. Strong behavioural reactions are also not predicted to occur in either species. However, a minor behavioural reaction of 50dBht is anticipated to occur in the majority of individuals within a maximum range of approximately 180m in harbour porpoise and 20m in grey seal."*

2. Paragraph 10.5.10.11 goes on to say "*Fish that are resident within the vicinity of the turbines for long periods may become habituated to acoustic signals if subjected to them repeatedly. For this reason, AFD operation should ensure that signals can altered at intervals to prevent habituation (Turnpenny & O'Keeffe, 2005). This can be achieved through the use of signal generators with multi-signal capability. Marine mammals (seals in particular), can also become habituated to continuous acoustic signals and therefore, this approach of randomising the operation of the AFD will be of benefit to marine mammals.*"

3. Paragraph 10.5.10.12 concludes "*Only minor behavioural responses are predicted to occur in harbour porpoise or grey seal within a short distance of AFDs and therefore the magnitude of the change in operational noise is considered to be negligible to small. Applying the standard impact assessment criteria as above, the overall exposure and vulnerability of marine mammals will be none to low. Overall, therefore, the impacts of the operational noise generated by the AFDs is considered to be* ***insignificant to minor adverse significant*** *but in terms of collision risk it could be considered to be a benefit as it will act as an early acoustic warning (see Section 10.5.8.6).*"

4. Therefore, it is concluded that any adverse effect on seals and harbour porpoises is not significant in relation to environmental impact assessment or to any habitats regulations assessment.

7.5 to the Applicant and any interested parties who have an interest in this issue

(a) Does the ES sufficiently recognise the importance of the local fishing industry in the Swansea Bay area as a local employer and a supplier of local produce caught sustainably which is supplied into the local markets?

TLSB's Response

1. The commercial fishing fleet found within Swansea Bay has been described in Section 9.6.4 and table 9.4.5 of the ES and Appendix 9.1, where both the relative small scale and the nature of the industry are identified.

2. The relative sustainability of the fishing industry can be identified in a number of senses: first, in terms of the manner in which a fishery is fished and managed, how self-supporting it is; second in terms of the conduct of those fishing in the fishery, their practices; and third, the economic viability of the fishery and the fleet that it supports.

3. The ES does not strictly identify the sustainability of each stock which is fished. However, it is recognised that small inshore vessels using static gear are regarded as sustainable. A strict socio-economic appraisal of the fishing industry was not within the remit of Chapter 9. Nevertheless, chapter 22 dealing with the socio-economic effects of the Project, records that overall the impacts will range from minor adverse to minor beneficial (see paragraphs 22.5.3.20 to 22.5.3.26). Mariculture opportunities which will be integral to the Project (see paragraphs 22.5.3.27 to 22.5.3.29), including encouraging the re-introduction of the native oyster, are reported to have a potential moderate beneficial effect on the local economy.

(b) Is there sufficient mitigation proposed to address the loss of this economic activity?

TLSB's Response

4. The effect of the Project on fisheries resources is addressed in a number of ways, including:

    4.1 Direct discussions with fishermen who operate in the marine fishing industry in Swansea Bay. In this regard, TLSB has appointed MacAlister Elliott and Partners Ltd (MEP) as fishery consultants. Without prejudice to any requirement to do so, MEP has entered into negotiations with potentially affected fishermen;

    4.2 Provision of off-setting measures, such as marine aquaculture opportunities within the Lagoon;

    4.3 Wider-offsetting in respect of any adverse effect on economic activity by promotion of the Project as a leisure and visitor attraction, as well as promoting the creation of new industrial opportunities related to tidal lagoons; and

4.4 Extension of the DCWW long sea outfall, which will enable fishing opportunities previously to have been enclosed within the Lagoon to be relocated to a location outside its seawall.

5. In light of these measures, TLSB considers that the effects on marine fisheries interests will be fully and appropriately compensated or off-set.

7.6 to the Applicant

How do you intend to address the concerns of NRW, Fish Legal and Angling Clubs that the modelling undertaken for the assessment in Chapter 9 does not contain sufficient information on the parameters and sensitivity testing to have confidence that the models are robust and that worst case scenarios have been assessed (NRW RR, Fish Legal RR, Afan Valley Angling Club RR, 10026555 [Mond Angling Society] RR, Phil Jones RR)?

TLSB's Response

1. This question is assumed to refer specifically to the IBM fish behaviour model, as the STRIKER v.4 turbine fish injury model is a generally and accepted tool for entrainment assessment. APEM, which advised Fish Legal commented "The STRIKER fish turbine passage modelling approach adopted within this assessment is generally an appropriate technique for predicting quantitative estimates of fish mortality for a tidal power scheme. It is a similar modelling approach based on the original Von Raben method to that used for other tidal power scheme assessments including the operating Annapolis Royal development and the DECC Severn Tidal Power Scheme study options (APEM report and response, provided at Appendices 7.2.1 and 7.2.2). Calibration of these models is much more than theoretical – it is supported by over 70 scientific papers, which have informed the assessments undertaken.

Technical responses - enhanced certainty

2. With regard to the IBM fish behaviour model, the parameters and sensitivity testing have been set out in Appendix 9.5 to the ES, which deals with accuracies and uncertainties (an updated version is attached Appendix 7.6.1 - updated text is highlighted). The general 'Rochdale Envelope' approach was used throughout, and only the worst cases were presented in the ES meaning that where any model runs are not reported, these tend to demonstrate more benign effects than those reported in the ES.

3. The Appendix sections dealing with accuracy and uncertainties within the assessment (Appendix 9.5 to the ES as submitted) were included following meetings with NRW, who requested that more information should be given on other cases considered so that it would be more apparent that the figures presented could be reasonably assumed to represent a worst case. An updated ES Appendix 9.5 is provided at Appendix 7.6.1.

4. As well as this, video files generated by the IBM model (filenames for which are referenced in paragraph 3.1.0.6 of Appendix 9.5) for representative cases and species with and without the tidal lagoon in place have been made available on the TLSB website for viewing at http://www.tidallagoonswanseabay.com/environmental-statement-other.aspx. These animations show the movements of all fish species examined across a full model range of model runs and it demonstrates the comprehensive nature of the assessment undertaken and provides additional confidence in modelling.

5. Subsequently, APEM has drawn TLSB's attention to a study in which CEFAS[2] recorded the track of an acoustically tagged salmon smolt swimming from the mouth of the Tawe out to sea via Swansea Bay. These data had not previously been identified, but provide an opportunity to test whether the IBM models fish behaviour accurately. By plotting the route of the tagged individual and comparing with the modelled behaviour of individuals provides a comparison of modelled and real world data.

6. To test how running the IBM model with the information contained within this track on smolt swimming speed and response to background currents would compare with the version used in developing the ES, the track was analysed and the model re-run with this data. The details of how this was done is explained in a note prepared by THA "New tagged smolt analysis for Swansea Bay Tidal Lagoon" (provided at Appendix 7.1.5). Running the salmon smolt model with inputs from the Swansea Bay smolt showed that smolt passage from the river mouth out into the Bristol Channel would be faster than assumed in the ES model runs, resulting in lower turbine entrainment risk. This valuable set of data therefore adds to confidence that the ES model runs have been pessimistic in their assumptions.

7. A further note, (at Appendix 7.6.2), deals with "Entrainment of olfactory trails into proposed Swansea Bay tidal lagoon" has been prepared in response to stakeholder concerns that river water, with its characteristic natal river 'smell' (olfactory cues), might attract return adult salmon and sea trout into the tidal lagoon. The note provides a detailed description of how the model demonstrates that the risk of entrainment as a result of diversion of the natal river "smell" is minimal with consequently little impact on fish.

8. The modelled behaviours reported here serve to add to confidence in the performance of the model, which is then interpreted by THA's experts. There is no reason to suppose that the conservative assumptions demonstrated in relation to one fish species (the smolt referred to above) would not be equally conservative in relation to other species. Objectively, this enhances expert confidence in the model on which assessments are based.

Confidence building by engagement

9. TLSB has also sought (and seeks) to address the concerns of NRW, Fish Legal and the Angling Clubs through meetings, answering of written questions and model explanations. Over the last nine months since modelling data became available, TLSB has published that information and sought face-to-face engagement.

10. TLSB and its experts have met with APEM, who have advised fisheries interests and therefore provide a useful peer review of TLSB's approach (on two occasions), and with NRW (on six occasions). TLSB considers that there is a strong consensus amongst experts as to the appropriateness of the modelling

[2] Moore, A. (1997). The Movements of Atlantic salmon (*Salmo salar* L.) and sea trout (*Salmo trutta* L.) smolts in the impounded estuary of the R.Tawe, South Wales. Environment Agency. R & D Technical Report W81.

approaches deployed, the level and detail of the modelling carried out and the nature of the species characterisations and behaviours.

11. Some of the angling clubs and angling interests have not taken part in such meetings to date, but TLSB has now agreed a technical meeting with a number of angling organisations.

Monitoring and Mitigation

12. In light of the approach adopted, TLSB considers that its approach and assessment is robust. The assessment undertaken by TLSB's independent adviser THA has evidenced that the Project will have a very limited (if any) impact on all but two species (sea trout and herring being the exceptions). Even then, TLSB considers that by selection of variable speed turbine technologies, the use of acoustic fish deterrents and the creation of spawning media for herring, the impact on these two remaining species will be reduced to minor.

13. Furthermore, in the next edition of the AEMP, which is secured by a requirement attached to the DCO, TLSB will commit to installation of cameras in the draft tubes to record fish movements and mortality, which will demonstrate the effect of the Project in practice. In addition to the above, following dialogue with NRW, TLSB is considering off-site enhancement measures to remove obstructions at the Capitol Falls weir to improve stocks in the overall Tawe. This would improve the overall ecosystem benefits in the Tawe River basin, meaning that waterbody improvements would be secured, or at least accelerated as a result of the Project.

7.7 to the Applicant

Would you please clarify how the assessment of significance has been determined in respect of fish and shellfish (6.4.9.1 Tables 9.28-9.30)?

TLSB's Response

1. The assessment of significance for fish and shellfish was carried out in accordance with methodologies described IEEM (now CIEEM) 2010 (Chartered Institute of Ecology and Environmental Management (2010). Guidelines for Ecological Impact Assessment in Britain and Ireland. Marine and Coastal, Final Document).

2. The following standard EIA criteria were taken into account to determine the significance of possible impacts:

   2.1 Magnitude of the impact;

   2.2 Spatial extent of the impact;

   2.3 Duration of the impact;

   2.4 Likelihood of occurrence; and

   2.5 Confidence in accuracy of predicted impact.

3. The methodology has been described in Chapter 9 Section 9.3.5 of the ES. The table below, copied from Chapter 9 summarises the assessment of significance. (Please see also Appendix 7.7.1 for further details.)

Table 9.4 Significance of an impact resulting from the combination of receptor sensitivity/value and the magnitude of the effect upon it

Value/importance	Magnitude (Positive/Adverse)				
	Neutral	Negligible	Low	Medium	High
Very High/International	No impact	Minor to insignificant	Moderate to Minor	Major	Major
High/National	No impact	Insignificant	Minor	Moderate	Major
Medium/regional	No impact	Insignificant	Minor	Moderate	Moderate
Low/local	No impact	Insignificant	Insignificant	Minor	Minor

N.B. Within the significance matrix an impact of positive magnitude can have the same significance value as an adverse effect (i.e. negligible to high).

7.8 to the Applicant

How do you intend to address the concerns of NRW and Fish Legal regarding fish mortality given in Table 9.5 (NRW RR, Fish Legal RR)?

TLSB's Response

Assessment approach

1. Fish mortality assessments associated with turbine passage in the context of the Project, have been assessed using the conservative criteria provided in Table 9.5, repeated here for ease of reference:

Table 9.5 Assessment criteria for turbine passage

Impact Magnitude	Annual Mortality Rate Due to Project
High	> 10 %
Medium	2.1 - 10 %
Low	1 - 2.0 %
Negligible	< 1 %

2. There are no formal regulatory guidelines on how to assess the magnitude of mortality impact on fish populations. For the purpose of this assessment, THA constructed a scale of values ranging from <1% to >10% based on the Thames Tideway Fish Risk Model (TFRM) and a number of other project studies. The TFRM has been provided to NRW for independent analysis. It should be noted that it is not suggested a 10% mortality would necessarily be sustainable in the Swansea Bay context, although for some species, this level of mortality may fall within harvestable surplus where the loss of this component of stock would not affect the long term stability of the population. It is the objective of TLSB that mortality should be as low as possible.

3. Table 9.22 (also repeated below), provides the combined results of the IBM Encounter Model and STRIKER^{TM}v.4 fish injury model, for fixed speed turbines operating at 67rpm (i.e. a more conservative assessment than would apply given the adoption of variable speed turbines for the Project). Without mitigation, the annual mortality as a result of passage through the turbines is predicted to be "significant" for two species: namely, adult sea trout (3.4% mortality, medium impact) and herring adult (26.69% mortality, high impact).

4. A low impact (on River lamprey and Sea lamprey) and a negligible impact is predicted for all other species with regard to mortality through turbine passage

Table 9.22 Combined results of IBM Encounter Model and STRIKER™ v.4 Fish Injury Model

Species	No. of fish Encountering turbines	Mean Repeat No. of Turbine passes	Overall Turbine Entrainment Injury Rate	
			mean %	standard error %
Atlantic salmon adult	603	1.65	0.87	0.09
Atlantic salmon smolt	125	2.98	0.12	0.03
Sea trout adult	2044	1.91	3.40	0.19
Sea trout smolt	149	3.38	0.16	0.04
Shad	56	4.30	0.77	0.08
Herring adult	6368	1.42	26.69	0.34
Eel adult	223	1.64	0.19	0.04
Eel elver	393	3.27	0.07	0.03
River Lamprey adult	999	2.68	1.35	0.11
River Lamprey transformer	120	3.33	0.02	0.02
Sea Lamprey Adult	1399	3.14	1.86	0.13
Sea Lamprey transformer	101	3.40	0.15	0.04
Bass adult	1186	3.69	0.27	0.01
Bass juvenile	1702	1.16	0.27	0.01
Plaice juvenile	38	4.76	0.69	0.01
Sandeel	41	3.93	0.01	0.01

Mitigation

5. To reduce this impact, Acoustic Fish Deterrents (AFDs) will be used. The use of AFDs are discussed further in Chapter 9, paragraphs 9.5.6.14 – 9.5.6.20 of the ES.

6. In summary paragraph 9.5.6.20 states "*deflection efficiencies for hearing specialists* [such as Herring] *are expected to be high, typically between 80 to 90 %. Whilst for hearing generalists, such as many demersal species including cod and bass, deflection efficiencies are lower, in the 50 to 70 % range. Epibenthic fish are the least affected by AFDs, and deflection efficiencies are 15 % or less. Table 9.26 gives a summary of mortality expected from the turbines after AFD systems have been installed. This technology is now widely employed for excluding fish from coastal and estuarine power station cooling water systems and other types of water intakes*."

7. As mentioned is paragraph 9.5.6.19 "*Installation of AFD systems should be preceded by acoustic modelling of installation to ensure that the spread of noise is not excessive, which might interfere with the natural movements of fish or marine mammals. Sound projector source levels are typically 160 dB re 1µPa@1m, with frequencies covering a maximum range of 20-3000 Hertz. Normally effective ranges are limited to a few tens of metres. The actual acoustic field should be measured during the commissioning phase to allow adjustment of sound levels to the desired values.*"

8. With mitigation installed in the form of AFDs, the mortality is predicted to be reduced to that shown in table 9.26, which significantly reduces impacts on herring (a hearing specialist) and adult sea trout, to levels considered not to be significant for assessment and decision-making purposes.

Table 9.26 Fish mortality accounting for the use of AFD

Species	Mean mortality (%)	Expected AFD efficiency (%)	Residual mortality with AFD (%)
Atlantic salmon adult	0.87	70	0.26
Atlantic salmon smolt	0.12	70	0.04
Sea trout adult	3.40	70	1.02
Sea trout smolt	0.16	70	0.05
Shad	0.77	80	0.15
Herring adult	26.69	80	5.34
Eel adult	0.19	0	0.19
Eel elver	0.07	0	0.07
River lamprey adult	1.35	0	1.35
River lamprey transformer	0.02	0	0.02
Sea lamprey adult	1.86	0	1.86
Sea lamprey transformer	0.15	0	0.15
Bass adult	0.27	75	0.07
Bass juvenile	0.27	75	0.07
Plaice juvenile	0.69	0	0.69
Sandeel	0.01	50	0.01

9. Notwithstanding the above, additional mitigation measures are proposed for herring in terms of provision of alternative spawning habitat, which should negate the need for herring to access the lagoon (if they were to do so in order to access historic spawning areas). This, combined with the natural spawning behaviour of Herring (males marking suitable habitat, as discussed elsewhere) should further reduce impacts on herring.

Confidence based on conservatism of assessment

10. Furthermore, the entirety of the assessment within the fish chapter has been based on a conservative worst case assessment. For the purpose of the EIA the STRIKER™ v.4 model has been used to determine the impact on fish as they pass through the turbines. In terms of effects on fish fixed speed turbines are considered worst case over variable speed. This is described further in 9.5.3.97 where it states "This use of fixed speed turbines has two potential effects with regard to the safety of fish passage. First, as the water flow through the turbine reduces at the same time as operating head decreases, the axial velocity of water through the turbine becomes slower but the blade speed remains the same. This means that the water-length (described above) reduces and therefore that the probability that a fish will be struck by the blade increases towards lower flows. Second, as the blade angles change, the turbine moves away from its most efficient operating point, hence efficiency reduces and more turbulence, hydrodynamic pressure change and shear stress is generated, potentially creating more harmful conditions for fish."

11. In terms of rotational speeds, fixed speed fixed speed or 'synchronous' turbines would operate at approx 60rpm (+/- 2.5rpm); whereas variable speed turbines would operate between 30 – 67rpm, average 50rpm (4.3.2.2). For the purpose of the EIA a precautionary approach has been undertaken (section 4.3.2.7) and an assessment of fixed speed turbines with a rotational speed of 67rpm has been used within the EIA (tables 9.20 and 9.21). The predicted impacts on fish presented in the ES for fixed speed turbine are therefore worst case, as in reality if fixed speed turbines were used they would be at a slower rpm and they would therefore have lesser impact.

12. In comparison (9.5.3.98) "Variable speed turbines are matched to distribution grid frequency either by using variable speed gearboxes or using electronic inverters. In a variable-speed turbine the converse of the above with regard to fish is true. First, as the water flow reduces, the blades slow proportionately so that the water-length remains constant. Secondly, the water-to-blade angle remains constant so that efficiency is maintained".

13. The Striker V4 modelling which has been undertaken within the ES represented the reduced blade speed (ranging from 30 to 67rpm), but as information on the final turbine internal characteristics was not available, data from a fixed speed turbine has been used.

14. The results are presented in Table 9.23 show that there would be an improvement (reduced injury rate) across all fish species with the use of variable speed turbines (up to 67rpm) over fixed speed turbines at 67rpm. Note that the ES also states that (9.5.3.99) that no Computational Fluid Dynamics (CFD) modelling data are as yet available from which to assess the effects of improved internal hydrodynamics, but this could yield further benefits for some species, notably the clupeid species for which this represents the largest source of trauma. As such, even though the Striker V4 results for variable speed turbines presented in table 9.23 show significant improvement over fixed speed, they are still worst case.

7.9 to the Applicant

Do you have any evidence to support your conclusion that altering the location of the turbines would have no material effect on fish species (6.4.9.1 Table 4.1)?

TLSB's Response

1. In TLSB's submission dated 4 June 2014, the ExA was informed that it was no-longer proposed to promote an alternative location (Option B) for the siting of the turbine and sluice gate housing structure. The assessment of alternative locations for Work No. 2a in Chapter 9 of the ES, relating to the fisheries resource, is performed as a qualitative assessment, without re-performing modelling using either the IBM or STRIKER^{TM} model. This is recorded in paragraph 9.5.3.100.

2. The principal assessed scenario was siting Option A. Nevertheless, it was concluded that for most fish species there would be no material difference in effect between the two siting options. For salmon and sea trout entering the River Tawe as returning adults, and for smolts exiting the Tawe, Option B was predicted, on the basis of the qualitative expert assessment, to result in a reduced risk of entrainment. Nevertheless, since the location in Option A had been assessed, and concluded to be acceptable, albeit performing less well than Option B, the outcome of assessment was unaffected by a decision to pursue Option A.

3. In light of this position, there is no requirement for further evidence to support the location of the turbine and sluice gate housing structure other than in location option A.

7.10 to the Applicant

Do you expect to carry out further fish surveys, if so, do you anticipate the results will affect the baseline, impact modelling or predicted impacts for the project (6.2.23.3.2)?

TLSB's Response

1. Prior to implementation of a project such as this, it is important to continue assembling baseline data so that even after the EIA and consenting processes are complete, better data can be used and confidence reposed in the baseline.

2. Accordingly, quarterly fish characterisation surveys have continued, in the same manner as for the baseline surveys, and this exercise will continue until the start of construction. These pre-construction surveys have been discussed in section 7.3.1 of the AEMP. Appropriate surveys are also being identified to confirm locations of herring spawning in Swansea Bay. These surveys will be undertaken in September when herring spawn in the Bay.

3. The surveys and monitoring will be continued through the construction period and during the operation stage. The draft AEMP is in the process of being updated, taking on board feedback from stakeholders. A revised version will be submitted during the course of the examination.

4. TLSB believe this additional work to be beneficial in enhancing baseline data to assist with monitoring during construction and operation, but it is not anticipated that this will affect the assessment submitted in the ES.

7.11 to the Applicant

What are the species referred to, with their value, in the phrase 'other demersal and pelagic species' (6.4.9.1Table 9.4)?

TLSB's Response

1. The term "other demersal and pelagic species" is used to encapsulate all fish species which have not been assessed at an individual level. The full list of species that contribute to this grouping have been provided within Table 9.3 of Appendix 9.1, Volume 3. This summary table has been attached to this document as Appendix 7.11.1.

7.12 to the Applicant

How will you remove the uncertainty on potential sediment levels and construction methods as they feed into the uncertainty over the potential for impacts on fish spawning, foraging and nursery areas (NRW RR)?

TLSB's Response

1. NRW's relevant representation dated 11 April 2014 identifies outstanding concerns with construction impacts and uncertainties on potential suspended sediment levels and construction methods in coastal processes. NRW asserted that these uncertainties fed into uncertainty on the potential for impacts on fish spawning, foraging and nursery areas.

2. TLSB is in discussion with NRW on this matter, particularly with regard to the coastal processes assessment, which TLSB believes is robust and sufficient for the assessment based on extensive existing data, modelling and conceptual understanding. Clarification has been provided to give further confidence in the modelling.

3. As TLSB understands NRW's representation, one of the main concerns is regarding the effects on herring, and the removal of the herring spawning ground as a result of construction of the western landfall of Work No. 1a. Clarification has been provided to NRW on this subject in a note sent to NRW in June 2014, which is provided at Appendix 7.1.1. The note explains that Herring Spawning is not specific to the types of environment present at the prospective western landfall, since it is available elsewhere in Swansea Bay on entirely different substrate – e.g. Mumbles and Port Talbot outer Harbour wall. TLSB's expert advisers have predicted that the seawalls of the Project will function as new herring spawning areas in substitution for any habitat lost.

4. CEFAS has provided comments on Section 9.5.6.4 of the ES in relation to the Project, stating that *"Current ICES advice for the Celtic Sea herring stock is that "activities that have a negative impact on the spawning habitat of herring, such as extraction of marine aggregates and construction on the spawning grounds, should not occur" and that "spawning and nursery areas are sensitive and vulnerable to anthropogenic influences. Gravel extraction or disturbance in the close vicinity of any herring spawning will disturb that spawning activity and will reduce the available area for successful spawning" (ICES, 2013). Given this advice, I would recommend that all construction activities should really occur outside of the spawning season* ***and the proposed mitigation seems to conform to this.*** *The ES states that mitigation to minimise the potential effect on herring during the construction of western landfall and offshore cofferdam dredging in year 1, will not commence until end of March/beginning of April. In this way the herring will be able to spawn in February/March and the juveniles will move offshore before the commencement of works. Appropriate spawning media will then be placed at the foot of the western Lagoon wall by the end of August in year 1 so that it will be available for herring to use in the September spawning run."*

5. As identified in the Chapter 9, Table 9.27 appropriate mitigation will be put in place to minimise effects, including the following with respect to suspended sediments and habitat modification:

   a) Use of appropriate geotextile lining to minimise the release of fine sediment into the water column;

   b) Selection of dredging equipment by the contractor will be appropriate to the depths and material types to be dredged and to minimise the creation of plumes;

   c) Marine habitat or seafloor disturbance clearing for the construction of the Project will be limited to the red line footprint of the development. Operations outside the scheme footprint will be prohibited. Boundaries will be enforced and distribution of worker awareness information;

   d) The Project will adhere to Best Practice Guidance identified in Marine Minerals Guidance 1: Extraction by dredging from the English seabed (Office of the Deputy Prime Minister, 2002), or other industry standards with respect to dredging and disposal of dredged material;

   e) Disposal of the dredge spoil not pumped into the Geotubes will be undertaken at Swansea Bay licensed outer disposal grounds thereby presenting minimal risk of impact to sites outside the development area;

   f) Dredging will be generally be undertaken between April and October; and

   g) Preventing on-board screening or minimising material passing through spillways when outside the dredging area to reduce the spread of the sediment plume.

   Further, with respect to habitat modification:

   a) the design of seawall will be adapted to increase heterogeneity and potential for fish spawning through the following measures:
      I. Avoid smooth rock material/increase roughness; and
      II. Introduce gravel/appropriate media at the base of the seawall for fish which use substrate to spawn (e.g. herring).
   b) Removal and Relocation of Shellfish from the Dredged Areas/Seawall footprint by trawling translocation of sessile species.
   c) Inclusion of a lobster hatchery within the design of the Lagoon.
   d) Mariculture facilities would indirectly provide suitable forage and refuge habitat to juvenile fish and shellfish.
   e) The use of BioBlocks will also be investigated to enhance the ecology of the area.

6. Appropriate monitoring will take place to monitor any effects. The AEMP will be developed with NRW to ensure this monitoring is suitable. It is proposed that the updated AEMP will be provided to the ExA at deadline III on 5 August 2014.

7.13 to the Applicant

NRW have concerns over the proposed mitigation measures, in particular, they 'do not consider that sufficient evidence has been provided to demonstrate that measures are fit for purpose, provide suitable alternative habitat or have been adequately assessed for viability'. How will you address these concerns (NRW RR)?

TLSB's Response

1. TLSB is discussing these concerns with NRW and believes progress is being made.

2. Specific concerns were raised by NRW regarding the mitigation for loss of herring spawning grounds. TLSB provided a note to NRW on this matter, in June 2014, provided at Appendix 7.1.1, which demonstrates why these measures are considered to perform suitably, and why the seawall will provide a suitable alternative spawning habitat. Discussion is continuing with NRW to provide assurance in relation to matters raised.

3. A review of the viability of the Lagoon as a reef is provided in Appendix 8.3 of the ES and is discussed further below.

4. Artificial structures in marine environments have the potential to increase diversity and abundance of fish and crustaceans. This has been shown for offshore structures ranging from wind turbines to wave power devices and oil jetties (Langham & Wilhelmsson 2009[3], Langhamer 2012[4]). Positive effects can be found for fish such as cod, but particularly also for edible crab (*Cancer pagurus*) (Langham & Wilhelmsson 2009). The increase in fish and crabs may have negative knock-on effects for other fauna such as starfish, which are exposed to higher predation pressure (Langham & Wilhelmsson 2009). Positive effects on fish can also be found comparing artificial reefs with soft bottom habitats, and artificial reefs may also attract a more diverse fish fauna than natural ones (Rilvo & Benayahu 2000[5]). Benefits for fish may result from reefs being enhanced feeding grounds as well as shelter from predators, water movement and trawling. Rilvo & Benayahu (2000) suggested that artificial reefs also provide more successful recruitment grounds. In the longer term, a spill-over of fish and invertebrates to other areas further afield would be of benefit to commercial fisheries (Langhamer 2012).

5. It is acknowledged in Appendix 8.3 that there are some cases where artificial reefs had no effect on fish and ongoing discussions question whether artificial reefs attract and concentrate existing individuals, with no overall net increase in abundance, or whether they actually promote recruitment and the production of

[3] Langhamer, O., et al. (2009). "Artificial reef effect and fouling impacts on offshore wave power foundations and buoys – a pilot study." Estuarine, Coastal and Shelf Science **82**(3): 426-432.

[4] Langhamer, O. (2012) "Artificial Reef Effect in relation to Offshore Renewable Energy Conversion: State of the Art". Scientific World Journal 37.

[5] Rilov, G. & Benayahu, Y. (2000) "Fish assemblage on natural versus vertical artificial reefs: the rehabilitation perspective". Marine Biology, **136**(5), 931-42.

individuals, resulting in a net increase of fish or invertebrates (Brickhill 2005[6], Pickering & Whitmarsh 1997[7]).

6. The variety of artificial reefs that have been studied is vast, making it difficult to assess and compare design aspects and performance as suitable habitats for fish and crustaceans. The difference in geographic location and localised environmental conditions will also have an effect on the species attracted (Baine, 2001[8]). Low-crested coastal defence structures (LCS) may be the most appropriate comparison structure to the Tidal Lagoon Swansea Bay in terms of its construction and design.

7. LCS built in coastal areas dominated by soft substrata can have a strong effect in the structure of the fish community by attracting species typical of rocky shores, and thereby locally increasing diversity (Martin et al., 2005[9]). The fish observed on the structures mainly consisted of juveniles and individuals no older than 2 years. The accumulation of drifting algae around LCS was shown indirectly to enhance the settlement of fish and crustaceans. This algal detritus can be attractive to new settlers and juveniles of fish and crabs (Martin et al., 2005).

8. Large artificial reef units with varying complexity have been found to attract different compositions of fish species. In a study off the coast of France, reef units that had been filled with materials to increase complexity were found to attract different species of fish (Charbonnel, 2002[10]). Fewer planktivorous fish but significantly higher numbers of commercial species were found in the more complex reef unit structures. The principals described for invertebrates are transferable to fish: an artificial structure that aims to increase fish biodiversity needs to be as heterogeneous as possible. Using a complex mixture of materials such as hollow bricks, concrete pipes etc., creates irregular and interconnected spaces that can be utilised by predatory and prey fish (Charbonnel, 2002). As the tidal lagoon aims to design part of its structure to become conducive to fish and crustaceans, the ecological requirements of the local species will be taken into account. More complex and heterogeneous structures through the use of natural rock armour will provide more shelter for fish and crustaceans, with high-profile structures attracting pelagic fish and low profile, bottom reefs with extensive void space will attract mobile shellfish (Baine, 2001).

9. Overall, it can be predicted that herring mitigation, and the lagoon seawall itself, will provide valuable habitat to the Bay, similar to that found at Mumbles Head.

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[6] Brickhill, M. J., et al. (2005). "Fishes associated with artificial reefs: attributing changes to attraction or production using novel approaches." Journal of Fish Biology **67**: 53-71.

[7] Pickering, H. and D. Whitmarsh (1997). "Artificial reefs and fisheries exploitation: a review of the 'attraction versus production 'debate, the influence of design and its significance for policy." Fisheries Research **31(1)**: 39-59.

[8] Baine, M. (2001). "Artificial reefs: a review of their design, application, management and performance." Ocean & Coastal Management **44**(3–4): 241-259.

[9] Martin, D., Bertasi, F., Colangelo, M. A., de Vries, M., Frost, M., Hawkins, S. J. *et al.* (2005). Ecological impact of coastal defence structures on sediment and mobile fauna: Evaluating and forecasting consequences of unavoidable modifications of native habitats. Coastal Engineering, 52(10–11), 1027–1051

[10] Charbonnel, E. (2002). Effects of increased habitat complexity on fish assemblages associated with large artificial reef units (French Mediterranean coast). ICES Journal of Marine Science, *59*.

7.14 to the Applicant

NRW consider that 'further work is needed to create a robust and fit for purpose monitoring programme'. How will you address these concerns (NRW RR)?

TLSB's Response

1. TLSB is working with NRW to develop the AEMP and ensure a robust monitoring programme is in place. Discussions will continue and an updated AEMP will be provided during the examination process at Deadline 3 on 5 August 2015.

2. Current proposals for monitoring and management include the following:

    a. Monitoring substrate for herring with drop down cameras or similar to see if it is used within the first two years after commencement of operation of the Project;

    b. General survey of the seawall with drop down cameras or similar to observe seawall colonisation;

    c. One turbine draft tube to be fitted with camera and sonar on both ends to validate fish passes;

    d. One camera and sonar on sluice gates to validate fish passage through them;

    e. Second year of quarterly fish surveys, continued during 2014, with further surveys: 2017, 2020, 2024 and 2028.

    f. Desk top review of Afan camera, Tawe and Neath recorded catches;

    g. Surveys of anglers using the wall and numbers of catches;

    h. Make the seawall open access to anglers, but require catch data in the simplest form to be logged on leaving; and

    i. Run annual event which will establish a growing database of records of catches

7.15 to the Applicant

Do you intend to compensate the fisherman who will be displaced by the lagoon (Swansea Fisherman's Group RR)?

TLSB's Response

1. There is no evidence of displacement of fishermen or statutory obligation to pay compensation if such displacement occurs. Nonetheless, TLSB has engaged with fishermen active in Swansea Bay throughout the application process, meeting groups of individuals on at least six occasions.

2. More recently, TLSB has appointed an appropriate expert to liaise with fishermen who have commercial fisheries interests in the Bay. Discussions have begun and are expected to conclude before the end of examination. It is intended that where an adverse effect from the Project can be shown and financial effects properly quantified, then TLSB will be able to extend compensation to suitably eligible fishermen.

7.16 to the Applicant

Several local fishing clubs have stated that no consultations have taken place to date. When will you consult with them (Neath and Dulais Angling Club RR, Pontardawe and Swansea Angling Society RR, Afan Valley Angling Club RR, Mond Angling Club RR)?

TLSB's Response

1. It is incorrect that "no consultations have taken place to date" with these bodies individually and as part of a wider consultation campaign. TLSB conducted extensive pre-application consultation with local fishing (and angling) groups, as evidenced in the Consultation Report. Post-application, TLSB has pursued a principal of 'ongoing engagement' with all stakeholders, though angling clubs only responded on 24 June 2014, with a meeting being arranged as soon as possible in July. These engagement activities are described in greater detail below.

Pre-application consultation

2. Chapter 8 of the Consultation Report sets out statutory consultation (on the Preliminary Environmental Information Report, PEIR) undertaken with non-statutory bodies under s47 of the PA2008, summarising issues raised by various groups and TLSB's responses. The chapter shows consultation by meetings with the following bodies (among others) or their representatives: Pontardawe & Swansea Angling Society, Mond Angling Club, Ogmore Angling Association, Tawe & Tributaries Angling Association, Angling Cymru, the Welsh Salmon & Trout Association, and Fish Legal (on behalf of Afan Valley Angling Club, Neath & Dulais Angling Association, Pontardawe & Swansea Angling Society, Tawe & Tributaries Angling Association and Ogmore Angling Association). Other bodies also commented on matters relating to fishing/angling and are included in the Report. The corresponding Appendix 7.9 of the Consultation Report provides additional detail on representations received and how TLSB had regard to them.

3. Chapter 10 of the Consultation Report addresses TLSB's statutory consultation with "persons with an interest in the land" under s42(1)(d) of PA2008. Section 10.6 addresses TLSB's position in relation to riparian rights, setting out why TLSB believes that angling groups are not statutory consulteess under s42(1)(d) and do not qualify as Category 3 persons under s44 of the PA2008, also listing consultation undertaken with angling groups as non-statutory consultees under s47. A summary of all such consultation is included in Table 10.4, with detail provided in supporting Appendix 10.7. It is important to realise that the conclusion on this point does not exclude the various bodies from participating in the consultation or reduce the weight ascribed to consultation responses received.

4. Appendix 10.7 details all consultation relating to angling in one place, including meetings, phone calls, letters, emails with: Pontardawe & Swansea Angling Society, Neath & Dulais Angling Association, Afan Valley Angling Club, Brynmill & District Angling Club, the Angling Trust, Pleasure Anglers & Kayakers Association, Angling Cymru, Tawe & Tributaries Angling Association, Salmon & Trout Angling Association, Mond Angling Society, Ogmore Angling Association, the Welsh Salmon & Trout Association, Carmarthenshire Rivers

Trust, Monkstone Cruising & Sailing Club (which includes fishing members, contrary to any misleading impression derived from its name) and Fish Legal (on behalf of Afan Valley Angling Club, Neath & Dulais Angling Association, Pontardawe & Swansea Angling Society, Tawe & Tributaries Angling Association and Ogmore Angling Association). Appendix 10.7 also lists a letter regarding fish/angling sent to: the Sea Fish Industry Authority, National Federation of Fisherman Organisation, New Under Ten Fishermen's Organisation (NUFTA), South and West Wales Fishermen's Organisation, South West Wales Association of Sea Angling, Welsh Federation of Sea Anglers, the Angling Trust, the Wildlife Trust of South West Wales, Welsh Salmon and Sea Trout Association (WSTTA), Wales Coastal and Maritime Partnership (WCMP), Wales Biodiversity Partnership, South Wales Sea Fisheries Committee and Wales Biodiversity Partnership.

5. Finally, Chapter 11 of the Consultation Report describes further, non-statutory consultation undertaken pre-application. This includes an EIA Presentation Event (17 October 2013) to which all consultees were invited (including listed fishing/angling groups), and which was attended by Pontardawe & Swansea Angling Society and Monkstone Cruising & Sailing Club. It also reports on consultation on a draft Environmental Statement with a focused group including Fish Legal and Pontardawe & Swansea Angling Society. Fish Legal responded to the draft ES consultation on behalf of Pontardawe & Swansea Angling Society (and the same list of clubs as previously), as set out in Chapter 11 and listed in the accompanying Appendix 11.4.

Post-application, ongoing engagement

6. As noted above, TLSB has pursued a principal of ‘ongoing engagement’ with all stakeholders including angling groups. Since October 2013, TLSB has repeatedly sought to engage with Fish Legal in its position representing multiple angling groups, and with Pontardawe & Swansea Angling Society. A meeting has now been arranged and will take place in mid-July 2014.

7.17 to NRW

Do you agree with the valuations assigned to fish and shellfish Valued Ecological Receptors (VERs') (6.4.9.1Table 9.2)?

TLSB's Response

1. As identified in Chapter 9 of the ES, the valuation of importance of individual VER is based on their conservation value, distribution and status within the potential zone of impact, the spatial extent of spawning and nursery areas, and migratory activity, as well as importance as commercial or recreational species.

2. Some features may not be of specific conservation interest in themselves, but can provide a key ecological function in support of a more valuable feature. As such, it is considered that appropriate weight has been assigned to the various VER's. In discussion with NRW (9 April 2014) VERs were discussed and a request was made for an overall summary of effect on each VER as a result of the Project. This is provided in Appendix 7.7.1.

7.18 to NRW

Do you consider the fish and shellfish surveys and proposed further surveys sufficient, if not, what further surveys would you require (6.2.23.3.2)?

TLSB's Response

1. TLSB considers that the fish and shellfish surveys undertaken to inform the ES sufficient. As stated in paragraph 9.3.3.1 the fish surveys are based on "*standardised EU Water Framework Directive survey protocols*".

2. In addition to this TLSB has commenced a second year of quarterly surveys, the first being undertaken in Spring 2014. These quarterly surveys are ongoing and will continue through the examination process, with the last baseline survey being completed in winter 2014. TLSB considers that the evidence assembled is sufficient to date and the quarterly survey for spring 2014 does not show any anomalous results inconsistent with the data already assembled. The summer fish surveys will be undertaken in July, weather permitting, and data processing should be complete by the beginning of September.

3. In any event, pre-construction surveys are still being discussed with NRW to establish the most effective and appropriate use for future monitoring, in the meantime the characterisation surveys which commenced during the baseline are being continued.

7.19 to NRW

Do you consider the baseline for fish and shellfish satisfactory (6.4.9.1.4)?

TLSB's Response

1. To characterise the existing fish populations and associated fisheries, data has been gathered from published and unpublished literature and from consultation with regulators, including the Countryside Council for Wales (CCW), the Centre for Environment, Fisheries and Aquaculture Science (CEFAS) and the Marine Management Organisation (MMO), as well as with local commercial and recreational fishing bodies (see paragraph 9.3.1.1 of the ES)

2. Consultation with local fishermen and fishing union representatives has also yielded useful information on the distribution and presence of commercially exploited species in the relevant area.

3. As stated in paragraph 9.3.3.1 of the ES "*Further to the desktop study, data has being gathered through a series of ongoing seasonal fisheries surveys, based on standardised EU Water Framework Directive (WFD) (Directive 2000/60/EC of the European Parliament and of the Council establishing a framework for the Community action in the field of water policy) survey protocols. Four quarterly surveys were completed in 2013.*" These surveys are detailed in Appendix 9.2 to the ES.

4. A summary of the baseline is provided at Chapter 9 of the ES with the full results of these studies presented in the fish and shellfish baseline report (Appendix 9.1 of the ES).

5. TLSB considers that an adequate baseline has been provided for use in the assessment. As proposed in section 7.3.1 of the draft AEMP submitted with the Application, TLSB will continue to carry out quarterly fish surveys to enhance this baseline data for monitoring purposes. However it is not anticipated that the results of these surveys would change the outcome of the assessment(s) reported in the ES.

7.20 to NRW and the EA

Do you consider 'far-field zone' is wide enough when considering the populations of migratory fish passing through the area (6.2.9.7, Appendix 9.1, Usk Fishing Association RR and Fish Legal RR)?

TLSB's Response

1. TLSB considers that the 'far-field zone' assessed in Chapter 9 includes an area wide enough to encompass all those receptors that could potentially be affected by the Project.

2. As stated in paragraph 9.3.3.7 of the ES: "*EIA is an iterative process and therefore, the near-field and far-field zones have been the subject of review as assessment has progressed. As detailed in the assessments given in Section 9.6, the residual impact of the Project on migratory fish in the principal rivers (Rivers Afan, Neath, Tawe and Kenfig) is* ***minor*** *to* ***insignificant****. Consequently, whilst consideration was given to including other rivers in the study area, it has been possible to exclude such rivers outside Swansea Bay, including the River Ogmore, from the assessment. This has been possible on the grounds that any effects on other rivers will also be negligible owing to their hydrographic isolation from Swansea Bay tidal circulation, particularly given that even those rivers within Swansea Bay experience limited effects*".

3. It should also be recognised that, whilst not included in the Chapter 9 assessment due to the reasons stated above, Section 10 of the HRA provides an "*Appropriate Assessment of potential effects on SACs designated for migratory fish*". This assesses the potential for adverse effects on the diadromous fish features of the River Wye, River Usk and Severn Estuary SACs.

4. TLSB does not believe that the Usk Fishing Association and Fish Legal had seen this report. The independent analysis undertaken on the draft ES looked only at the Chapter 9 assessment and did not proceed to consider the Wye and Usk.

7.21 to NRW

What further assessment would you require to be confident that the long term effects have been sufficiently considered over the lifetime of the project (NRW RR)?

TLSB's Response

1. Where possible, the Environmental Statement has considered the effects of climate change and other anthropogenic pressures on and an in-combination with the Project. However the effects on fish populations in relation to climate change are not possible to quantify, and even, to a considerable extent, predict. The operational life of the Project will last for 120 years, and although it is understood that climate change and other anthropogenic pressures will likely have an effect on fish populations, no meaningful assessment can be made at that range.

2. Notwithstanding this, the issue of sea level rise has been reviewed. In general, impacts on fish tend to be greater in fixed speed turbines as generation head decreases, water speed reduces but turbine rpm remains the same. In this way the reduction in generation head through climate change could affect the STRIKER™ output such that there would be an increased impact. However, as any potential change in sea level will affect both the low and high water levels, overall it is not anticipated that there will be any net change in the results.

7.22 to NRW

Table 9.41 provides figures for reported salmon catches on the Rivers Afan, Neath and Tawe between 2002 and 2011. This question is primarily for NRW but other parties may wish to comment.

(a) Are figures for 2012 and 2013 available from NRW and can figures for reported catches on the Neath and Tawe stretching back to 1964 be provided please?

TLSB's Response

1. Figures for 2012 have been provided below in Table 1. It is likely that NRW will be able to provide rod catch data stretching back to the 1950s. Figures for 2013 do not appear to be publicly available at present. The 2012 data presented below does not affect the fisheries assessment included in Chapter 9 of the ES.

Table 1. Reported salmon rod catch 2012

River					
Afan		Neath		Tawe	
Reported	Returned	Reported	Returned	Reported	Returned
15	8	56	23	65	24

(b) Can comparable figures be provided for reported catches of sea trout on the Rivers Neath and Tawe?

TLSB's Response

2. Comparable data is available for sea trout catches. Raw data can be seen in the series of reports produced by the Environment Agency 'Salmonid & Freshwater Fisheries Statistics for England and Wales (2000 to 2012) and have been included in Table 2 below. The data presented does not affect the fisheries assessment.

Table 2. Reported sea trout rod catch 2002-2012

Year	River					
	Afan		Neath		Tawe	
	Reported	Returned	Reported	Returned	Reported	Returned
2002	103	52	782	541	424	291
2003	162	111	400	271	272	141
2004	168	105	532	328	173	95
2005	153	99	393	248	372	208
2006	63	48	298	240	153	92
2007	158	99	487	384	243	164
2008	161	114	317	199	144	70
2009	120	74	492	376	242	132
2010	112	96	493	407	426	337
2011	142	119	444	367	196	151
2012	130	101	403	294	139	102

(c) If the results are presented graphically as 5 year moving averages, are there any identifiable trends that emerge?

TLSB's Response

3. TLSB does not have access to historic data stretching back to 1964. For catches back to 1980, see Figure 3.2 in the 2014 APEM report[11]. This dataset gives a representation of raw rod catch data between 1980 and 2010. Although fluctuating, annual sea trout rod catch has been fairly stable within all rivers since the early 2000s. However, it is noted that the 2012 catch for the Tawe is the lowest in the last decade. Salmon rod catches have been increasing since the 1980s in both the Tawe and Neath, whilst they have been consistently low in the Afan. A decrease in salmon catch is evident for 2012 with exception of the River Afan.

(d) Are there detectable changes for reported catches on the Tawe as a result of the construction of the barrage in 1992 and modification of the fish pass in 2001?

TLSB's Response

4. Chapter 9, 9.5.3.2 of the ES discusses obstacles within the Tawe Catchment – "The spawning migration of fish into Swansea Bay is either diadromous (fish moving between sea and rivers) or oceanodromous (migrating wholly in the sea). The Tawe Barrage, located on the lower section of the Tawe Estuary is known to add delays to the migration of diadromous fish within the R. Tawe estuary, as are other obstacles within the Tawe catchment. Both Mee et al. (1996) and Russell et al. (1998) indicate that salmon typically move past the structure when the barrage is overtopped. This occurs during tides > 8.05 m which account for approximately 71 % of tides in Swansea Bay, additionally inundation only lasts for 16 % of the tidal cycle".

5. Section 9.5.3.40 of the ES provides further information where it states "For instance, the current barrage at Tidal Lagoon Swansea Bay plc the mouth of the River Tawe has been shown to have a significant effect on salmon and sea trout movements (Mee et al., 1996; Moore et al., 1998). A later study by Washburn (2007), suggests that modification to the fish pass to improve energy dissipation levels within the pools in 2001, now allows fish to migrate under a wider range of environmental conditions.

6. In addition to this based on the APEM Fig. 3.2 dataset a positive trend in salmon rod catches between 1992 and 2001 can be observed, whilst sea trout rod catches seem fairly stable throughout the period. It should be noted that fishing effort is not identified in these figures and that the data cannot be taken as an indication of the effect of the Tawe Barrage in isolation.

[11] APEM. 2014. Proposed Swansea Bay Tidal Lagoon Hydropower Development – Independent Expert Fisheries Analysis. Report No. 413196.

7.23 to the Applicant

Application of "IBM fish encounter modelling" is described in paragraphs 9.5.3.30-8 of Chapter 9 of the ES: Fish including Recreational and Commercial Fisheries and output from the model (a still-frame example from the adult salmon model video) is illustrated in Figure 15. Para 9.5.3.38 (Doc 6.2.9) states that:

The model shows that olfactory trails from the two rivers remain quite distinct with the Lagoon in place and turbines and sluices operating, allowing adult salmon to home to their natal rivers with minimal distraction. Results demonstrated that there is no significant effect on olfactory trails as a result of water being drawn in to the Lagoon and released again.

(a) What level of confidence should the panel have in the output from this model?

TLSB's Response

1. In respect of the specific question of whether it is likely that some of the olfactory material that forms the olfactory trail is likely to be entrained in the Lagoon and subsequently discharged at a concentration that might form a false trail, or overwhelm the primary olfactory trail; the panel should have high confidence in the model result that it will not have this effect (no significant impact).

2. This has been tested in a high resolution hydrodynamic model of Swansea Bay during spring tides with a high level of discharge from the rivers carrying the olfactory material. Subsequent to TLSB's meeting with NRW on the 9th April, further information on olfactory trails in the proposed Lagoon has been assembled and is provided at Appendix 7.6.1.

(b) What would be needed to produce an assessment that would be more firmly based?

TLSB's Response

3. Given that the composition of the olfactory substance that forms the olfactory trail of salmon and trout is presently unknown to science it is difficult to see how this specific question can be addressed in more detail. Furthermore it is unknown how exactly the fish follow the trail, although it is hypothesised that they do this through frequent vertical movements through the water column. If the composition of the substance was known it could be incorporated into the hydrodynamic modelling in the same way as substances are within a water quality model.

4. It would remain necessary to know the sensitivity of fish to this substance to predict the impact of changes to its patterns or concentrations. With the information that is available, the most principled and logical scientific approach is to make the best possible model to test the implications of our assumptions and to confront this with present knowledge. Nevertheless, until there is perfect knowledge of the animals in question any prediction of impact will always require expert opinion to interpret the results.