HORIZON NUCLEAR POWER

WYLFA NEWYDD

ENERGY WORKING FOR BRITAIN

Wylfa Newydd Project

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8 Surface water and groundwater

8.1 Introduction

8.1.1 This chapter describes the assessment of potential surface water and groundwater effects resulting from the construction, operation and decommissioning of the Power Station, other on-site development (as described in chapter A2 introduction to the project and approach to the EIA, Application Reference Number: 6.1.2), and the Site Campus within the Wylfa Newydd Development Area.

8.1.2 Please refer to chapter B8 (surface water and groundwater) (Application Reference Number: 6.2.8) for the technical basis for the assessment including a summary of legislation, policy and guidance; key points arising in consultation that have guided the surface water and groundwater assessment; and assessment methodologies and criteria.

8.2 Study areas

8.2.1 This section describes the study areas relevant to the surface water, fluvial geomorphology and groundwater assessment for all construction, operation and decommissioning activities associated with the Power Station and other land-based on-site development, including the Site Campus, within the Wylfa Newydd Development Area.

Surface water

8.2.2 The surface water study area (figure D8-1, Application Reference Number: 6.4.101) has been determined by an examination of the (freshwater) surface water features that could potentially be affected by works within the Wylfa Newydd Development Area and operation of the Power Station. This area includes all water features that may be hydrologically linked to the Wylfa Newydd Development Area and includes the land areas that drain to these features. The surface water study area is therefore based on the watercourse catchments at and around the Wylfa Newydd Development Area, as well as important surface water features within that area. These include the Sites of Special Scientific Interest (SSSIs) at Tre'r Gof, Cae Gwyn and Cemlyn Bay. Cemlyn Bay is a coastal lagoon and its assessment is included both within this chapter and chapter D13 (the marine environment) (Application Reference Number: 6.4.13). This chapter focusses on the potential freshwater effects on the lagoon, specifically at its eastern end close to the Nant Cemlyn inflow point.

8.2.3 The northern boundary of the surface water study area is defined by the Irish Sea coastline. The eastern, southern and western boundaries are defined by the surface water catchment boundaries of relevant watercourses.

8.2.4 The study area comprises five small surface water catchments which are discussed later in this chapter. The catchments and the watercourses within them are:

- Tre'r Gof Catchment – Tre'r Gof drains;

- Afon Cafnan Catchment – the Afon Cafnan, Nant Caerdegog Isaf, and wetted ditches and field drains;
- Cemaes Catchment – Nant Cemaes;
- Cemlyn Catchment – Nant Cemlyn and Nant Plas Cemlyn;
- Power Station Catchment – Nant Porth-y-pistyll; and
- other catchments – coastal areas that drain directly to the sea and small isolated drainage systems.

8.2.5 The Afon Wygyr Catchment has not been included within the surface water study area because no part of the Wylfa Newydd Development Area is sited within that catchment and there are no works proposed within the catchment, or which could affect the catchment.

8.2.6 As the Wylfa Newydd Development Area is wholly encompassed by these catchments, and does not extend up to the edge of these catchments (except at the coast) there are no activities that are likely to affect adjacent catchments. The extent of the study area is therefore appropriate for this assessment.

Fluvial geomorphology

8.2.7 A study area (figure D8-2, Application Reference Number: 6.4.101) has been defined for the fluvial geomorphology component of the assessment by taking into account all receptors that could potentially be affected by works within the Wylfa Newydd Development Area and operation of the Power Station. A 1km buffer has been selected around the Wylfa Newydd Development Area boundary allowing for assessment of potential direct effects, as well as providing a broader catchment context. This buffer includes lengths of watercourse both upstream and downstream of the Wylfa Newydd Development Area and extends as far as the coast, since the watercourses could act as pathways for sediments to the sea. The coastal environment and remainder of the sea within the fluvial geomorphological study area is considered in chapter D12 (coastal processes and coastal geomorphology) (Application Reference Number: 6.4.12).

Groundwater

8.2.8 The groundwater level data collected as part of the baseline study (figure 6-2 in appendix D8-3, groundwater baseline report, Application Reference Number: 6.4.28) show that bedrock groundwater generally flows from the south to the north-west, north and north-east, discharging into the sea. The northerly boundary of the study area is therefore defined by the coastline and there are no sensitive groundwater receptors downgradient of this area with the exception of the marine environment (which is assessed in chapter D13, Application Reference Number: 6.4.13).

8.2.9 The upgradient extent of the study area is not as simple to establish as there is no well-defined groundwater catchment or geological boundary. Therefore, due to uncertainties regarding the radius of potential effects on hydrogeological receptors, a conservative approach to the assessment has been taken by identifying two zones of the groundwater study area.

- An inner study area with a 1.8km radius from the centre of the Wylfa Newydd Development Area (see figure D8-3, Application Reference Number: 6.4.101). The boundary has been selected as a circular area (albeit truncated by the coast) to reflect the nature of groundwater movement and the potential zones of influence of dewatering activities, which in homogeneous aquifers will be circular in nature. The 1.8km radius incorporates all of the land-based Wylfa Newydd Development Area out to its furthest points from the centre (figure D8-3, Application Reference Number: 6.4.101). In addition, the inner study area captures all of the groundwater features considered to have the highest potential of being affected by works within the Wylfa Newydd Development Area. Important ecological sites, which need to be assessed due to their sensitivity (including the Tre'r Gof and the Cae Gwyn SSSIs and the Cemlyn Bay SSSI), are also captured by the inner study area.
- An outer study area, which measures 3km in radius, has also been defined (see figure D8-3, Application Reference Number: 6.4.101) in order to capture residual uncertainty associated with the radius of influence calculations, especially the degree of heterogeneity of the aquifer, and the possibility that potential effects may extend further than 1.8km. The degree of uncertainty (in heterogeneity) was determined using data collected in pumping tests undertaken in late summer 2015 (see section 6 of appendix D8-3, Application Reference Number: 6.4.28). The 3km boundary ensures that all relevant features that could be of concern to the public and regulators are assessed, even where the potential effect is assessed as being extremely low.

8.2.10 Defining two areas allows this assessment to be concentrated in the area of most concern, but does not lose sight of the fact that features further from the Wylfa Newydd Development Area may be of relevance, thereby enabling a conservative approach to the impact assessment. The approach also allows the study area to be easily and simply revised in the future if required as further data are collected. It should also be noted that the area considered for a numerical groundwater model comprises a larger study area than shown above to ensure that boundary effects in the model do not affect the results of the model within the study area.

8.2.11 The groundwater flow direction, with groundwater broadly flowing from the south and east to discharge at the coast, is such that the groundwater study area also incorporates all surface water features that could potentially be affected by changes to the groundwater regime. The inner groundwater study area is wholly within the surface water study area with the exception of a small area in the east where the groundwater study area extends into the Wygyr Catchment. As the groundwater and surface water catchments will not necessarily be the same, this does not affect the assessment in terms of the groundwater and surface water interactions.

8.3 Baseline environment

8.3.1 This section provides a summary of the baseline conditions for surface water and groundwater within the study areas described in section 8.2.

8.3.2 The baseline environment has been assessed in a number of appendices to this chapter as follows with the key points provided in this section of the report:

- appendix D8-1 (surface water baseline report) (Application Reference Number: 6.4.26);
- appendix D8-2 (fluvial geomorphology baseline report) (Application Reference Number: 6.4.27);
- appendix D8-3 (groundwater baseline report) (Application Reference Number: 6.4.28);
- appendix D8-4 (flood consequences assessment) (Application Reference Number: 6.4.29) – baseline for flooding (included within the Flood Consequence Assessment (FCA) Report);
- appendix D8-5 (Tre'r Gof hydroecological assessment) (Application Reference Number: 6.4.30) – baseline conditions at the Tre'r Gof SSSI; and
- appendix D8-6 (Cae Gwyn hydroecological assessment) (Application Reference Number: 6.4.31) – baseline conditions at the Cae Gwyn SSSI.

Surface water

8.3.3 The surface water receptors were selected based on professional judgement of an understanding of the potential for effects from construction, operation and decommissioning where activities could have the potential to cause an impact on surface water features in terms of water availably and water quality. More information on the use of professional judgement is provided in section 8.4 of chapter B8 (Application Reference Number: 6.2.8). The groups of receptors which were selected are as follows.

- Surface water catchments including rivers, drains, lakes and other flow pathways. These receptors are sensitive to changes in water quality, changes in water availability and changes in flow and flood risk.
- Designated sites – these are water-dependent statutory designated sites. These receptors are sensitive to changes in water quality and water availability.

8.3.4 The existing baseline context of the surface water within the study area is discussed in detail within the surface water baseline report (appendix D8-1, Application Reference Number: 6.4.26). This is based on a combination of a desk study, site walkovers, site surveys, field monitoring and hydrological and hydraulic modelling. Details of the surface water baseline with respect to flood risk are contained in appendix D8-4 (Application Reference Number: 6.4.29).

Data sources

8.3.5 All data sources used to identify surface water features that could be impacted, the nature of these features, and assessment of how they may vary over time are outlined below. In some instances monitoring data are limited due to access constraints and/or the duration of monitoring. Monitoring is ongoing such that the baseline dataset would be more comprehensive than that discussed here. A limitation on all monitoring is the number of extreme events that are captured, the relevance of which is related to the duration of construction and operation of the Power Station. Uncertainties due to monitoring limitations are taken into account in this assessment by using a conservative approach to assess a likely worst case scenario or by providing a range of potential effects (for example in modelling studies).

Mapping

- Ordnance Survey maps [RD1];
- British Geological Survey geological maps [RD2]; and
- Natural Resources Wales (NRW) Water Watch Wales Map Gallery [RD3].

Meteorological data and monitoring

- Twenty years of rainfall data to 2016 available from the NRW-operated Llyn Alaw rain gauge which is 7km to the south-east.
- The Royal Air Force Valley rain gauge (approximately 17km to the south of the Wylfa Newydd Development Area) comprises more than 50 years of digitised hourly data (1960 – 2016).
- A meteorological station was installed by Magnox at the Existing Power Station site in May 2010. Rainfall depths, humidity, temperature and wind speed are all collected at this station, although technical problems do mean that significant gaps exist in this data record and so this data has not been used as part of this assessment.
- In March 2015, Horizon Nuclear Power (Horizon) installed an additional meteorological station within the Wylfa Newydd Development Area. Rainfall depths, humidity, temperature and wind speed (all required for assessing potential evaporation) are all collected at this station. These data are used to supplement data from other sources as the data provide site-specific information, although they are only available to late 2016.

Water flow data and surveys

- NRW provided spot gauge flow rate readings for the Afon Cafnan. The surface water baseline report (appendix D8-1, Application Reference Number: 6.4.26) provides the results.
- NRW has a permanent gauging station on Anglesey in the Cefni Catchment at Bodffordd, 14km south of the study area. Flow from this catchment has been monitored continuously and recorded every 15 minutes since 1988. This catchment is 21.4km^2 with a southerly aspect

and elevations of between 35m Above Ordnance Datum (AOD) and 100mAOD. The geology and land use in this catchment are broadly similar to those in the study area and therefore this catchment is a suitable data source for this assessment.

- Spot flow gauging has been undertaken on a fortnightly basis from December 2014 to May 2015, and then on a monthly basis from May 2015 until August 2017. This was carried out at three locations within the study area: on Nant Caerdegog Isaf downstream of the Cae Gwyn SSSI; on Nant Cemlyn immediately upstream of the Cemlyn Bay SSSI; and on Afon Cafnan immediately before the discharge into Porth-y-pistyll. The results of these are contained in the surface water baseline report (appendix D8-1, Application Reference Number: 6.4.26). Monitoring is ongoing but for this assessment only data to August 2017 have been analysed.
- Flumes were installed in May 2015 with water level monitoring at each flume used to derive a continuous flow series on Nant Caerdegog Isaf and Nant Cemlyn. These installations aim to provide a better indication of flow conditions in these two catchments, particularly through storm events. Data up to August 2017 have been analysed in this Environmental Statement, although monitoring is ongoing.

Water quality data and surveys

- NRW provided the results of water quality monitoring undertaken at the outfall of Llyn Llygeirian (SH 34330 89950) within the study area. This occurred monthly between October 2003 and June 2007.
- Surface water quality data have been collected by Horizon from around the Wylfa Newydd Development Area on a quarterly basis from February 2011 to August 2017. Monitoring commenced at five locations but was subsequently expanded to more locations and more regular sampling as detailed in appendix D8-1 (Application Reference Number: 6.4.26). This monitoring is ongoing.
- Water quality monitoring around the Tre'r Gof SSSI and the Cae Gwyn SSSI is outlined below.
- Continuous water quality monitoring commenced in May 2015 at two monitoring stations on Nant Caerdegog Isaf downstream of the Cae Gwyn SSSI and on Nant Cemlyn immediately upstream of the Cemlyn Bay SSSI. These take readings every 15 minutes and monitor temporal variations in a small number of water quality parameters. Data up to August 2017 have been analysed in this Environmental Statement, although monitoring is ongoing.

Tre'r Gof SSSI monitoring and studies

- In April 2015, a hydrologist and hydrogeologist from Jacobs UK Limited (Jacobs) (on behalf of Horizon) carried out a walkover of the Tre'r Gof SSSI.
- In order to measure stream flow rates, five flumes and data loggers were installed around the Tre'r Gof SSSI in 2010: four on the inflows and one on the outflow. Data are available from January 2012 to August 2017, but with significant data gaps prior to April 2015 due to equipment failure. There are smaller data gaps post-April 2015 due to equipment failure and vandalism of monitoring equipment.
- At Tre'r Gof water quality sampling of surface water and shallow groundwater have been carried out on an ad hoc basis since 2011, with nominally monthly sampling since November 2015.
- In November 2015, nine piezometers were installed into the Tre'r Gof SSSI with water level loggers continuously monitoring water levels in each of these.
- A detailed study into the current hydrological function of the Tre'r Gof SSSI has been undertaken by Jacobs (appendix D8-5 Tre'r Gof hydroecological assessment, Application Reference Number: 6.4.30). This details all monitoring data collected/locations of monitoring points and includes analysis of the flume data to establish a water balance to determine the surface water and groundwater inflows and outflows of the SSSI.
- Data have been analysed to August 2017, although data collection is ongoing.

Cae Gwyn SSSI monitoring and studies

- In November 2015, a Jacobs' hydrologist and hydrogeologist carried out a walkover of the Cae Gwyn SSSI.
- Water quality sampling of surface water and shallow groundwater have been carried out on a nominal monthly basis between November 2015 and May 2017. Surveys of the Cae Gwyn SSSI started at a later date than at the Tre'r Gof SSSI due to land access restrictions. The locations of all monitoring points are shown on figures included in appendix D8-6 (Application Reference Number: 6.4.31).
- In January 2016, four piezometers were installed, one into each of the four basins at the Cae Gwyn SSSI with water level loggers continuously monitoring water levels until May 2017.
- A detailed study into the current hydrological function of the Cae Gwyn SSSI has been undertaken by Jacobs (appendix D8-6, Application Reference Number: 6.4.31). This details all monitoring data collected/locations of monitoring points and includes analysis of the meteorological data along with known flow routes to establish a water

balance for the surface water and groundwater inflows and outflows to and from and within the SSSI.

- Data have been analysed to May 2017, with access restrictions preventing data collection after this date.

Flooding

- NRW flood mapping is publicly available and was delivered as part of a national programme to delineate indicative areas of elevated flood risk [RD4].
- Technical Advice Note (TAN) 15 Development Advice Map [RD5] is publicly available mapping created by the Welsh Government and is based on the NRW flood map [RD4] and British Geological Survey mapping [RD2].
- Hydrological modelling to understand the water availability within each catchment was undertaken in 2017 (see appendix D8-7, surface water and groundwater modelling results, Application Reference Number: 6.4.32).
- Flood risk modelling was undertaken for each catchment in 2015 and 2017 (see appendix D8-4, Application Reference Number: 6.4.29).

Tre'r Gof Catchment

8.3.6 The Tre'r Gof Catchment has an estimated area of 1km^2 and is almost entirely located within the north-east corner of the Wylfa Newydd Development Area. The catchment drains into the Tre'r Gof SSSI to the east of the Power Station Site. The Tre'r Gof SSSI is fed by a number of springs and small watercourses and ditches. The small watercourses and ditches are referred to here as the Tre'r Gof drains. The Tre'r Gof Catchment discharges to the sea from the Tre'r Gof SSSI basin via a culvert and outfall at Porth y Wylfa.

8.3.7 Surface water flow data indicate that for much of the year the SSSI is drying out, with a recharge/wetting-up season occurring at the onset of winter (November/December). During the summer (June to August) many springs and many of the smaller Tre'r Gof drains are dry. Water quality monitoring does not indicate significant pollution in the streams that flow into the SSSI, although coliforms and ammoniacal nitrogen are both elevated due to the surrounding agricultural land use.

8.3.8 Tre'r Gof SSSI is a naturally complex hydrological system which has interactions between direct rainfall, surface water, soil and sub-soil water and shallow (and to a lesser degree deep) groundwater. The geology beneath and adjacent to the SSSI is complex with a variety of drift deposits present underlain by bedrock which is heterogeneous. There are substantial variations in recharge and stream flow through the SSSI and therefore significant changes in water quality across the area caused by the different water sources and flow routes. Significant hydrological changes occur over a range of timescales, including short term changes during rainfall events (especially summer storms), medium term changes due to seasons and long

term changes caused by climate change and other factors such as management practices. The drainage system in Tre'r Gof is itself artificial having been installed to drain the wetland area several hundred years ago, and controlled by a culvert outfall. The hydrological system is still changing and it has been noted during site walkover surveys for example that the location of some seeps and flushes move even over the medium term. A detailed assessment of the hydrology of the Tre'r Gof SSSI is contained in appendix D8-5 (Application Reference Number: 6.4.30) and is not repeated here.

8.3.9 The TAN 15 Development Advice Map [RD5] indicates that the Tre'r Gof Catchment is predominantly at low risk (Zone A) from fluvial and coastal flooding, aside from the low-lying Tre'r Gof SSSI basin, which is classified as an area known to have been flooded in the past (Zone B).

8.3.10 The Tre'r Gof drains feed directly into the Tre'r Gof SSSI. On the basis that the SSSI is a designated site of national importance and hence has a high ecological value, the Tre'r Gof Catchment has also been assessed as having a high value in terms of its hydrology (water flow and water quality) as changes to these factors have the potential to affect the SSSI's ecology.

Afon Cafnan Catchment

8.3.11 The Afon Cafnan Catchment has an estimated area of 9.9km^2 and comprises the Afon Cafnan as well as its tributaries, including Nant Caerdegog Isaf. The Cae Gwyn SSSI is situated within this catchment at the head of the Nant Caerdegog Isaf. The majority of the catchment is located to the south of the Wylfa Newydd Development Area but the lower reaches of the catchment are situated within the centre and west of the Wylfa Newydd Development Area. The Afon Cafnan and the Nant Caerdegog Isaf are classified by NRW as main rivers. These are rivers that NRW is responsible for carrying out maintenance, improvement or construction work on in order to manage flood risk.

8.3.12 Detailed assessment of gauging data demonstrated a 'flashy' (i.e. stream flow responds rapidly to rainfall) flow regime and that during the summer months the Nant Caerdegog Isaf was almost dry (typically less than 0.02l/s) for long periods. This indicates that in the summer months, surface water runoff is the key driver of flow with no base flow.

8.3.13 NRW has provided water quality data for the outfall from Llyn Llygeirian in the upstream part of the Afon Cafnan; these data do not suggest the presence of any significant pollution in this part of the catchment. Monitoring by Horizon lower in the catchment indicates water quality that is consistent with pollution caused by livestock grazing (coliforms and ammoniacal nitrogen).

8.3.14 *In situ* monitoring of a small number of parameters on Nant Caerdegog Isaf indicates that 'normal' concentrations of suspended solids are below 25mg/l, but there are regular fluctuations of between 40mg/l and 200mg/l, with a maximum measured suspended solid concentration (estimated from turbidity measurements) of 1,067mg/l. Peaks in suspended solids concentrations are likely to be associated with rainstorms due to greater overland flow rates washing off soil as well as with bank erosion and cattle poaching (i.e. erosion resulting from hooves of livestock).

8.3.15 The TAN 15 Development Advice Map [RD5] indicates that the Afon Cafnan Catchment is predominantly at low risk from fluvial and coastal flooding (Zone A). Only two areas are shown to be at risk of flooding, that is:

- low-lying areas inland of Porth-y-pistyll where extreme sea levels result in inland flooding; and
- along the majority of the Afon Cafnan, and the lower reaches of Nant Caerdegog Isaf, where areas within fluvial Flood Zone C are shown, that is areas with a 0.1% annual chance of fluvial flooding or greater.

8.3.16 The Afon Cafnan Catchment has been assessed as having a medium value based on the main river status of the Afon Cafnan and the Nant Caerdegog Isaf.

Cemaes Catchment

8.3.17 The Cemaes Catchment drains an area of 3.0km² that is mostly situated to the east and south-east of the Wylfa Newydd Development Area. Nant Cemaes, which is classified as a main river by NRW, flows in a generally northern direction through Tregele and to the west of Cemaes before discharging to Cemaes Bay via a culvert.

8.3.18 Water quality data collected by Horizon do not indicate any major evidence of pollution although coliforms and ammoniacal nitrogen were elevated and suspended solids within the Nant Cemaes were variable, regularly exceeding 25mg/l with a mean value of 16mg/l, median value of 7mg/l and maximum of 106mg/l. Monitoring by NRW at Cemaes Bay in 2015 and 2016 suggests that bathing water quality standards are regularly exceeded for total coliforms and other microbiological contaminants which are likely due to livestock grazing within the catchment.

8.3.19 The TAN 15 Development Advice Map [RD5] indicates that the Cemaes Catchment is predominantly at low risk from fluvial and coastal flooding (Zone A), with only one small area in the upper reaches of a tributary of Nant Cemaes within Flood Zone B (an area known to have flooded in the past).

8.3.20 The Cemaes Catchment has been assessed as having a medium value based on the main river status of Nant Cemaes and, as it discharges to Cemaes Bay which is used for bathing, it is locally important.

Cemlyn Catchment

8.3.21 The Cemlyn Catchment drains an area of 2.3km^2 and is mostly situated beyond and to the south-west of the Wylfa Newydd Development Area. The Nant Cemlyn flows in a northerly direction along the western boundary of the Wylfa Newydd Development Area prior to draining into Cemlyn Lagoon which forms part of the Cemlyn Bay SSSI, Special Protection Area (SPA) and Special Area of Conservation (SAC). Flow monitoring results show that Nant Cemlyn has a ‘flashy’ flow regime and indicates that both surface water runoff and groundwater contribute to this watercourse.

8.3.22 Ongoing surface water quality monitoring does not indicate any major evidence of pollution, although elevated coliforms and ammoniacal nitrogen

were detected, likely due to agricultural activities. Suspended solids within the Nant Cemlyn were variable, regularly exceeding 25mg/l. From 35 samples collected between 2013 and 2017, suspended solids concentrations ranged from 2.3mg/l to 161mg/l (appendix D8-1, Application Reference Number: 6.4.26), with the higher concentrations generally in summer months.

8.3.23 The TAN 15 Development Advice Map [RD5] indicates that the Cemlyn Catchment is predominantly at low risk from fluvial and coastal flooding (Zone A), with only the lower reaches of Nant Cemlyn within fluvial Flood Zone C.

8.3.24 Nant Cemlyn outfalls directly into Cemlyn Lagoon. On the basis that the Cemlyn Bay SSSI is a designated site of national importance and a SPA and SAC, which are both designations of international importance, and all of which have a high value, the Cemlyn Catchment has been assessed as having a high value.

Power Station Catchment

8.3.25 The Power Station Catchment drains a small area of approximately 0.3km^2 immediately to the south of the Existing Power Station. The small channel within this catchment is unnamed but termed here Nant Porth-y-pistyll. The upper reaches of this channel are culverted, and the channel is a large flush (wetland) across a field that drains in a westward direction and discharges to the sea at Porth-y-pistyll. Due to the low flows which have been observed in this watercourse, no flow monitoring has been or is proposed to be undertaken within this catchment.

8.3.26 Ongoing surface water quality data collected by Horizon do not indicate any evidence of pollution. However, there was an oil leak from an oil-cooled cable, detected in 2016, adjacent to a historical lime kiln. Contamination was found that matched the oil recovered from the spill location with very low concentrations of pollutants found within Nant Porth-y-pistyll.

8.3.27 The TAN 15 Development Advice Map [RD5] indicates that the Power Station Catchment is predominantly at low risk from fluvial and coastal flooding (Zone A), with only the low-lying areas inland of Porth-y-pistyll in Zone C2, where extreme sea levels result in inland flooding. It should be noted that the lower limit of modelling undertaken to generate TAN 15 mapping is a catchment area of 3km^2. Therefore, flood mapping may not represent the true flood risk in small catchments, such as the Power Station Catchment. However, in this case, there is considered to be a low fluvial flood risk due to absence of main rivers, and a low coastal flood risk due to the catchment topography relative to the sea; the catchment being over 5m above sea level and rising inland.

8.3.28 The Power Station Catchment has been assessed as having a low value given that it comprises ordinary watercourses (watercourses which are not designated as main rivers and which are the responsibility of the riparian landowners).

Other areas

8.3.29 Areas within the study area adjacent to the coast, and not within the catchments defined above, are believed to drain informally (i.e. not in defined

drainage channels or watercourses) directly to the coast. The only exceptions to this are discussed below.

- The area between the Cemlyn Catchment and Cemlyn Bay. In this area, a very small ephemeral drain along the western side of the road down to Cemlyn Bay car park collects surface runoff and directs this into the eastern end of Cemlyn Bay.
- The Existing Power Station, which is drained by three surface water drainage systems. Two of these discharge onto the foreshore, and one discharges into the main Existing Power Station outfall which discharges into the sea.

8.3.30 The area between the Cemlyn Catchment and Cemlyn Bay has been monitored for suspended solids and microbiological analysis between 2015 and 2016. The full results are contained in appendix D8-1 (Application Reference Number: 6.4.26). The results show variable suspended solids and high concentrations of total coliforms and other microbiological organisms, due to the agricultural use of adjacent land.

8.3.31 The TAN 15 Development Advice Map [RD5] indicates that the area between the Cemlyn Catchment and Cemlyn Bay is predominantly at high risk from coastal flooding (Zone C2). The flood risk area is largely confined to Cemlyn Lagoon; however, sections of the road leading down to Bryn Aber property and Bryn Aber itself are located within the floodplain. These flood risk receptors have been assigned a high value, in line with the TAN 15 advice, which states that all developments are highly sensitive [RD6].

8.3.32 The TAN 15 Development Advice Map [RD5] indicates that the Existing Power Station is entirely located within Flood Zone A, and at low risk of fluvial and coastal flooding.

8.3.33 The above areas have been assessed as having a low value given that they comprise ordinary watercourses.

Designated sites

Tre'r Gof SSSI

8.3.34 The NRW citation [RD7] states that the Tre'r Gof SSSI is a lime-rich wetland, dependent on a gradual movement of water through the site derived from springs, groundwater seepages, ditches and surface water runoff. It is sensitive to changes in water flow, water level and water quality.

8.3.35 A hydroecological assessment of the Tre'r Gof SSSI (appendix D8-5, Application Reference Number: 6.4.30) has shown that the Tre'r Gof SSSI is situated in a topographic basin which intersects the water table held within superficial deposits and that this shallow water table is important in maintaining saturation during drier periods. Groundwater within the shallow superficial deposits was also identified as critical for maintaining base flow to seepages, drains and springs which discharge directly into the Tre'r Gof SSSI. The assessment has identified that groundwater input from the bedrock aquifer is only a small component of the overall water balance for the Tre'r Gof

SSSI. However, it is recognised that the hydroecology is complex and there is some uncertainty regarding water movement to the SSSI.

8.3.36 The Tre'r Gof SSSI has been assessed as having a high value based on its designation as an SSSI.

Cae Gwyn SSSI

8.3.37 The Cae Gwyn SSSI is located immediately south of the Wylfa Newydd Development Area. The NRW citation [RD8] classified Cae Gwyn SSSI as two small acidic basin mires separated by rocky heathland, dependent on a steady water supply through springs, groundwater seepages and surface water runoff. The citation for this site indicates it to be groundwater-fed in part and that a high groundwater table is essential for the survival of wetland plants and animals. The citation also states that it is important not to lower water levels at the Cae Gwyn SSSI and to maintain the water supply through springs and groundwater seepage.

8.3.38 The hydroecological assessment of the Cae Gwyn SSSI, provided in appendix D8-6 (Application Reference Number: 6.4.31), has identified four small basins and indicates that the input to the wetland from groundwater in the bedrock aquifer is likely to be limited. The basins are largely maintained by direct rainfall over the basins and inflows from the adjacent catchment area. There are only limited hydrological data available (in terms of space and time) regarding the Cae Gwyn SSSI so there is considerable uncertainty regarding the hydrology of the SSSI and its surrounds. There is ongoing data collection to reduce these uncertainties.

8.3.39 The Cae Gwyn SSSI has been assessed as having a high value based on its nationally important designation as an SSSI.

Cemlyn Bay SSSI, SPA and SAC

8.3.40 This saline coastal lagoon is designated as an SSSI, SPA and SAC (for brevity, in this chapter it is referred to as the Cemlyn Bay SSSI). The lagoon that forms part of the Cemlyn Bay SSSI is separated from the sea by a shingle bank with a narrow channel at the western end.

8.3.41 Cemlyn Bay is located outside of the Wylfa Newydd Development Area. However, it is close to the Wylfa Newydd Development Area and drainage from one of the landscape mounds would discharge into Nant Cemlyn leading to the Cemlyn Bay SSSI. The SSSI has been assessed in order to establish its characteristics and to determine if there is potential for it to be affected by works within the Wylfa Newydd Development Area.

8.3.42 The Cemlyn Bay SSSI has been assessed as having a high value based on its nationally and internationally important designations as an SSSI, SPA and SAC.

Fluvial geomorphology

8.3.43 A summary of the fluvial geomorphology environmental baseline is presented in the following section; detailed results are provided in appendix D8-2 (Application Reference Number: 6.4.27). This includes information on channel

dimensions, bed substrate, flow types, bank material and profile and structure of the riparian zone. The receptors for fluvial geomorphology have been selected based on professional judgement of an understanding of the potential for effects from construction, operation and decommissioning. This judgement includes identifying where activities could have the potential to cause an impact on the fluvial geomorphology due to changes in sediment loads, watercourse flow rates or from works that are proposed to be undertaken within the watercourses. The receptors, including tributaries and drains to the named watercourses, are as follows:

- Afon Cafnan;
- Nant Caerdegog Isaf;
- Nant Cemaes;
- Tre'r Gof SSSI drains;
- Nant Cemlyn; and
- Power Station drain.

8.3.44 Three watercourses within the study area, the Afon Wygyr, Afon Traeth Mawr and Nant Caerdegog Uchaf, have been scoped out of further assessment. This is due to the absence of effects on these watercourses in terms of fluvial geomorphology. These watercourses are either upstream of the Wylfa Newydd Development Area, or are in a different catchment that has no connection to the Wylfa Newydd Development Area. There would be no direct modifications to these watercourses and sufficient distances separate them from construction activities to prevent potential effects.

8.3.45 The watercourses listed above ultimately discharge to the sea within the study area at Porth-y-pistyll, Cemaes Bay, Porth y Wylfa and Cemlyn Lagoon. The baseline information for these coastal features is provided within chapter D12 (Application Reference Number: 6.4.12) and chapter D13 (Application Reference Numbers: 6.4.13). The effects due to the transfer of sediments through the fluvial system on the coastal features are also covered within those chapters and so are not discussed in this chapter.

Data sources

8.3.46 The following provides an overview of the data sources used to inform the fluvial geomorphology baseline:

Desk study sources

- Ordnance Survey maps [RD1];
- geological maps [RD2];
- NRW Water Watch Wales Map Gallery [RD3];
- Western Wales River Basin Management Plan (RBMP) [RD9];
- Multi-Agency Geographic Information for the Countryside [RD10];
- aerial photographs [RD11]; and
- historical maps [RD12].

Site walkovers

- geomorphological reconnaissance survey undertaken from 17 November 2014 to 20 November 2014; and
- geomorphological reconnaissance survey undertaken from 20 July 2015 to 24 July 2015.

Afon Cafnan

8.3.47 The Afon Cafnan flows from two sources, one from Llyn Llygeirian and the other from land to the north of Llanrhyddlad. The watercourse draining from Llyn Llygeirian is referred to here as Nant Llygeirian.

8.3.48 Much of the Afon Cafnan channel has an artificially straightened planform. It is likely that this is a reflection of the historical need to establish relatively straight field boundaries. Realignment probably also provided an opportunity to deepen some channels, particularly within fields with poor arterial drainage.

8.3.49 Some lengths of channel show evidence of natural processes and forms, particularly between Mynydd-Ithel and Cafnan. Here the channel is naturally sinuous within the confines of a relatively narrow floodplain. A natural bedrock cascade is present within the upstream reach immediately downstream of the small road crossing near Cefn Coch.

8.3.50 The Nant Llygeirian is similar in nature to the main channel of the Afon Cafnan, with evidence of historical artificial straightening. The channel is approximately 2m to 3m wide (measured during the walkover surveys in 2015), with the bed and banks consisting primarily of finer sediment fractions (i.e. silt, sand and fine gravels).

8.3.51 The vegetation within the riparian zone is fragmented along most of the Afon Cafnan and Nant Llygeirian. The predominant land use is livestock grazing; with significant poaching along some lengths leading to fine sediment input to the channel. Analysis of historical maps depicts that there has been no significant change in the planform of the Afon Cafnan since 1889 (the first published map of the area).

8.3.52 The Afon Cafnan exhibits a range of morphological features and has a gravel-bed and riffle-pool sequence. It is assessed as having a medium value with regards to fluvial geomorphology.

8.3.53 Due to the sufficient distance (approximately 2km upstream) from the Wylfa Newydd Development Area, the Nant Llygeirian has been scoped out of this assessment.

Afon Cafnan – tributaries

8.3.54 There are two smaller tributaries forming part of the Afon Cafnan fluvial geomorphology receptor, the Afon Cefn Coch and the Bod-hedd Drain.

8.3.55 The Afon Cefn Coch has an artificially straight planform through agricultural land and semi-improved grassland. The watercourse has a vegetated riparian zone comprising trees and shrubs along the right bank but with no significant vegetation along the left bank. The channel has a uniform cross-section and

several reaches are choked with terrestrial vegetation. The substrate consists mainly of silt and lengths of the watercourse have been poached by livestock. There has been no significant change to the planform of the Afon Cefn Coch since 1889 (the first published map of the area).

8.3.56 The Bod-hedd Drain has an artificially straightened planform through agricultural, semi-improved grassland and has no vegetated riparian buffer zone. Some local deposition of silt was noted at the channel margins, particularly upstream of the confluence with the Afon Cafnan. The bed substrate is typically fine and coarse gravel, and some mud. The left bank appeared poached, potentially acting as a sediment source. There has been no significant change to the planform of the Bod-hedd Drain since 1889 (the first published map of the area).

8.3.57 The Afon Cefn Coch and Bod-hedd Drain both have a low value with regards to fluvial geomorphology. As the Afon Cefn Coch is just at the upstream limit of the study area and the Bod-hedd Drain is outside of the study area, they are both scoped out of this assessment.

Nant Caerdegog Isaf

8.3.58 The Nant Caerdegog Isaf is located to the west of Tregele and the A5025. The watercourse has an artificially straight planform with a uniform and modified channel cross-section. The substrate is mainly silt with some fine gravel. The watercourse overall is a sediment sink, i.e. it is locally narrowing as a result of areas of sediment deposition in an over-wide channel. There has been no significant change to the planform of the Nant Caerdegog Isaf since 1889 (the first published map of the area).

8.3.59 The Nant Caerdegog Isaf has a low value with regards to fluvial geomorphology.

Nant Cemaes

8.3.60 The Nant Cemaes is a small watercourse with an artificially straightened planform and no significant vegetated riparian zone, with some trees noted intermittently.

8.3.61 The watercourse has a uniform channel cross-section which is over-deep and over-wide and smooth (glide) flow predominates. The upstream reach along the A5025 is artificially reinforced and a silty substrate was observed. The downstream reach, immediately upstream of Cemaes Bay, has fully vegetated banks. There has been no significant change to the planform of the Nant Cemaes since 1889 (the first published map of the area).

8.3.62 The Nant Cemaes has a low value with regards to fluvial geomorphology.

Tre'r Gof SSSI drains

8.3.63 A network of small watercourses is located within the Tre'r Gof SSSI to the east of the Existing Power Station. The watercourses appear to have artificially straight planforms and they join before discharging into the Irish Sea at Porth y Wylfa. The watercourses are over-deep and over-wide and choked with terrestrial vegetation; and are considered a sink for sediment, locally

narrowing. The channel substrate is predominantly silt. There has been no significant change to the planform of the Tre'r Gof SSSI drains since 1889.

8.3.64 The Tre'r Gof SSSI drains have a low value with regards to fluvial geomorphology.

Nant Cemlyn

8.3.65 The Nant Cemlyn has a shallow valley gradient. Most of the Nant Cemlyn channel has an artificially straight planform, likely to accommodate field boundaries and aid field drainage. The main land use is agricultural, with the fields being used predominantly for pasture and some as tilled arable land. Some lengths of natural channel recovery are present, with erosion and deposition creating a more sinuous planform within the artificially constrained channel. Several lengths of poaching and consequent bank slumping were recorded as present along the left bank. Culverts and bridges are present along the entire reach. Terrestrial vegetation is present alongside the channel on the floodplain which suggests a well-established riparian corridor. However, there is also some terrestrial vegetation within the channel which suggests that the riparian floodplain is encroaching on the channel. Substrate consists of gravel, cobbles and pebbles. There has been no significant change to the planform of the Nant Cemlyn since 1889 (the first published map of the area).

8.3.66 The Nant Cemlyn has a low value with regards to fluvial geomorphology due to the limited range of morphological features present and as it has been modified in several reaches.

Nant Porth-y-pistyll

8.3.67 The Nant Porth-y-pistyll was found to typically have no vegetated riparian corridor, with grassed banks and some scattered trees in the furthest upstream reach. The channel is uniform with limited morphological features and is affected by adjacent land uses (including poaching by livestock). There has been no significant change to the planform of the Nant Porth-y-pistyll since 1889.

8.3.68 The Nant Porth-y-pistyll has a low value with regards to fluvial geomorphology.

Groundwater

Data sources

8.3.69 This topic is defined by a number of receptor groups. Table D8-1 summarises those groupings and their data sources used to identify the receptors, with full details provided in appendix D8-3 (Application Reference Number: 6.4.28).

Table D8-1 Groundwater receptor baseline characterisation

Receptor	Data collection to identify receptors (including duration where relevant)
Groundwater in Secondary Aquifers	• Groundwater quality sampling as part of Ground Investigation (GI) works and longer-term monitoring from November 2014 to August 2017. Although data collection is ongoing, this chapter only assesses data to August 2017 as this is the cut-off date for reporting. • Measurement of groundwater levels using manual measurements and from groundwater level data loggers from March 2010 to August 2017, although data collection is ongoing. • Groundwater modelling.
Groundwater abstractions (Private Water Supplies (PWSs))	• Provision of data from the Isle of Anglesey County Council (IACC) and water quality monitoring from one PWS.
Groundwater abstractions (Historical Public Wells)	• Provision of data from the IACC.
Groundwater Dependent Terrestrial Ecosystems (GWDTEs) (the Tre'r Gof and Cae Gwyn SSSIs)	• Bespoke studies of the two SSSIs from November 2015 to August 2017 including collection of groundwater and surface water quality and groundwater level data.
Watercourses considered as secondary receptors for groundwater	• Measurement of watercourse flows and quality from December 2014 to August 2017 and groundwater modelling studies.

8.3.70 The baseline condition of groundwater and identification of associated receptors has been characterised through the analysis of a variety of data sources. In summary, this includes a desk study of available information, including data published by regulators such as NRW, historical groundwater data and data collected on soils and geology. Site investigations have been undertaken to expand the historical dataset and collect further information on groundwater levels and groundwater quality. The key sources of data are outlined in table D8-2 and a full description of the data and methods used to characterise the existing groundwater baseline are outlined in appendix D8-3 (Application Reference Number: 6.4.28).

Table D8-2 Sources of data used in the characterisation of the groundwater baseline

Data source	Description of data
Desk study (including assessment of available GI data)	• The Environment Agency's 'What's in Your Backyard?' online tool accessed March 2015 to establish aquifer designations [RD13]. It should be noted that the Environment Agency has subsequently removed data from its 'What's In Your Backyard?' website in relation to Wales (which is now regulated by NRW). However, data were obtained prior to this for production of the baseline report. More recent data produced by the Environment Agency does show that the glacial tills have been re-designated [RD14]. • Ordnance Survey maps [RD1]. • Geological maps [RD2]. • Geological, water level and water quality data collected as part of GI. • Consultancy reports: - Surface Water Baseline Report (appendix D8-1, Application Reference Number: 6.4.26); - Groundwater Baseline Report (appendix D8-3, Application Reference Number: 6.4.28); - Tre'r Gof SSSI Hydroecological Assessment (appendix D8-5, Application Reference Number: 6.4.30); - Cae Gwyn SSSI Hydroecological Assessment (appendix D8-6, Application Reference Number: 6.4.31); and - interpretation of geological data is presented in chapter D7 (soils and geology) (Application Reference Number: 6.4.7).
Groundwater baseline surveys	• Groundwater sampling and associated chemical analysis from boreholes installed during GI across the Wylfa Newydd Development Area and immediately outside of the Wylfa Newydd Development Area. • Collection and chemical analysis of groundwater samples from a PWS. • Measurement of groundwater levels using manual measurements and groundwater level data loggers from boreholes across the Wylfa Newydd Development Area and immediately outside of the Wylfa Newydd Development Area. • Installation of shallow groundwater monitoring points (piezometers) within the Tre'r Gof and Cae Gwyn SSSIs with associated groundwater level and groundwater quality monitoring.

Data source	Description of data
	• Pumping tests which involved the drilling of two groundwater abstraction boreholes, associated observation boreholes and pumping tests at two locations (PW1 and PW2).

8.3.71 Following collection and assessment of the baseline data, a groundwater conceptual site model has been produced for the Wylfa Newydd Development Area (appendix D8-3, Application Reference Number: 6.4.28) with further conceptual site models produced for the Tre'r Gof SSSI (appendix D8-5, Application Reference Number: 6.4.30) and the Cae Gwyn SSSI (appendix D8-6, Application Reference Number: 6.4.31).

8.3.72 Groundwater modelling studies have also been undertaken, principally to assess the effects of dewatering for deep basement construction and the effects of the Power Station on the groundwater levels in the bedrock for the long-term operation of the Power Station. Details of this groundwater modelling and the model results are provided in appendix D8-7 (Application Reference Number: 6.4.32) with the results used, where relevant, for assessing the effects considered later in this chapter.

8.3.73 The groundwater modelling was undertaken assuming that dewatering in the excavation for the reactors during construction would be required down to an elevation of -18mAOD for the reactor building (as detailed in chapter D1 (proposed development) (Application Reference Number: 6.4.1)). As a conservative approach, the model for the construction phase does not allow for shotcreting of the excavation walls as for a time during construction, prior to shotcreting or construction of the basement floors, groundwater inflow to the exaction would continue either through the walls or base of the excavation until the fissures were sealed. For the operational phase, the model assumes that major fractures encountered in the excavations would be sealed with shotcrete and a drain would be installed around this shotcreted excavation for passive drainage, with the drains at an elevation of 6mAOD.

8.3.74 The model considered in this assessment is termed the 'Central' model as it uses the most likely parameter values with respect to the amount of rainfall (the recharge) reaching the bedrock and the permeability of the bedrock aquifer. Comparison of modelled to measured groundwater levels shows this model to represent actual conditions reasonably closely, although as with most groundwater models in a relatively complex hydrogeological setting, comparison of actual and modelled groundwater levels for individual boreholes may not always perfectly match. The model has been used to assess the effects of the construction and operation of the Power Station and associated landscape mounds on the groundwater environment and associated secondary receptors such as GWDTEs and PWSs.

8.3.75 Two additional models were also constructed in order to test the sensitivity of the Central model to changes in recharge and permeability. The 'High' groundwater model included a four times increase in recharge to the bedrock and corresponding increase in permeability compared to the Central model. The 'Low' groundwater model has a four times reduction in recharge and permeability compared to the Central model. In both instances the modelled

water levels do not compare well to the measured groundwater levels indicating that these models are not a good indication of reality and that the Central model uses broadly appropriate values for recharge and permeability.

8.3.76 The groundwater modelling work does not consider the consequences of climate change or drought events more severe than those experienced in the historical climate record from 1960 to 2016. This historical record does include some significant drought and wet periods and these have been selected as a focus for output analysis. However, the focus of this modelling work is to assess the effects of the construction and operational phases on the water and hydroecological regimes experienced by the environmental receptors in comparison with the current baseline over timescales of weeks, months and years. As such, including the unpredictable effects of climate change in this comparison would introduce a greater level of uncertainty in the assessment.

Soils and geology

8.3.77 The soils across the study area are generally 'freely draining, slightly acid loamy soils' in the areas towards the coast, and 'slowly permeable, seasonally wet, acid loamy and clayey soil' further inland. The former would allow more recharge to groundwater than the latter.

8.3.78 Made ground is not widespread across the Wylfa Newydd Development Area. Where it has been identified, it is generally related to the construction of the Existing Power Station, and is normally less than 2m thick, although made ground over 4m thick has been encountered (see chapter D7, Application Reference Number: 6.4.7).

8.3.79 The superficial deposits of glacial origin overlie much of the Wylfa Newydd Development Area in varying thicknesses. Typically, the superficial deposits are less than 5m thick; however, superficial deposits are up to 30m thick beneath half-egg-shaped hills known as 'drumlins'. A deep sequence, over 25m thick, of alluvial deposits and lacustrine sediments infill has been measured in BH311 on the northern side of the Tre'r Gof SSSI. This feature is thought to have either been formed in a glacial feature known as a kettle hole or is part of a buried valley (appendix D8-5, Application Reference Number: 6.4.30).

8.3.80 The majority of the Wylfa Newydd Development Area is underlain by rocks belonging to the New Harbour Group, which also incorporates the Skerries Group, with the Gwna Group being at the northern extent near Wylfa Head and the proposed cooling water outfall at Porth Wnal. The elevation of the rock head in the Wylfa Newydd Development Area is typically 10mAOD to 20mAOD, although it is lower than this in the west and north adjacent to the coast.

Aquifer designations and vulnerability

8.3.81 The glacial till superficial deposits across the majority of the Wylfa Newydd Development Area are defined by the Environment Agency (NRW has not separately defined aquifer types) as a Secondary (Undifferentiated) aquifer [RD14] due to their importance in maintaining local water supplies and base flow to wetlands, lakes and rivers. Secondary (Undifferentiated) aquifers were

previously designated as both minor and non-aquifers in different locations due to the variable characteristics of the rock type. Within the Wylfa Newydd Development Area, the superficial deposits are generally of low permeability and across the majority of the Wylfa Newydd Development Area it is unlikely that there will be any significant groundwater flow within these deposits. Granular superficial deposits, expected to be more permeable and consisting of variably clayey, silty sand and gravel, are present across the south-western portion of the Wylfa Newydd Development Area. These include examples where significant layers of both low permeability and granular materials are present. The GI information suggests that granular materials become the predominant superficial deposits broadly to the south-west of a line between Tregele village and Porth-y-pistyll, although low permeability, clay dominated deposits are still present in this area and are observed further to the south-west in the vicinity of Cae Gwyn.

8.3.82 The superficial deposits at the Tre'r Gof SSSI are defined as a Secondary A aquifer, although the available borehole logs (appendix D-5, Application Reference Number: 6.4.30) do not indicate any extensive granular layers beneath the SSSI. The bedrock beneath the Wylfa Newydd Development Area is defined as a Secondary B aquifer.

8.3.83 NRW's "Water Watch Wales Map Gallery" [RD3] shows that the Wylfa Newydd Development Area boundary lies within the Ynys Môn Secondary water body unit (GB41002G204400) which covers a large part of Anglesey (see appendix D8-3, Application Reference Number: 6.4.28) and applies to both the bedrock and superficial deposits. This area was designated in 2015 as being of good quantitative status and poor quality status. The poor quality status relates to hazardous substances in groundwater which are associated with historical mining activities (metals) which are impacting on surface water quality in the Amlwch area over 8km to the west of the Wylfa Newydd Development Area. As the groundwater body covers much of Anglesey, the chemical water quality will vary throughout and groundwater quality is better in the vast majority of areas than the classification for the whole water body would indicate.

Aquifer recharge

8.3.84 Groundwater recharge refers to the flux of water, which moves from the ground surface or a surface water body into an underlying aquifer. Rainfall is normally the most significant source of recharge, although only a proportion of total annual rainfall actually enters the groundwater system. Runoff and shallow base flow to surface water, evaporation and transpiration from plants and reduction of soil moisture deficits all reduce the total annual downward flux. The actual volume of rainfall that is available for groundwater recharge and surface water runoff following evapotranspiration losses and reduction of soil moisture deficits is known as 'effective rainfall'.

8.3.85 Effective rainfall has been estimated to be approximately 500mm per year, based on data reported for the Cefni flow gauging station (station number 102001) on Anglesey, at National Grid Reference SH 429 769 [RD15]. The effective rainfall rate of approximately 500mm per year in part reflects the flux, which recharges shallow groundwater located in the superficial deposits to

provide shallow base flow or that, where overburden is very thin or absent, which recharges the shallow bedrock to provide base flow.

8.3.86 Recharge to bedrock in areas where the low permeability superficial overburden is very thick, such as beneath drumlins, is likely to be significantly lower. Studies indicate recharge rates through glacial till in other parts of the UK are typically around 20% of the total annual effective rainfall [RD16]. In this case, this would be approximately 100mm per year although the actual rate will vary markedly depending on the nature and thickness of the till which can differ substantially both locally and over larger areas.

8.3.87 Groundwater modelling has also assessed the recharge to the bedrock aquifer, as this is a key parameter for calibration of the model. Appendix D8-7 (Application Reference Number: 6.4.32) shows that for the Central model recharge amounts to the bedrock ranges from around 30mm per year to 100mm per year. Based on the above assessment of recharge through till, this is not unreasonable.

Groundwater flow and levels

8.3.88 The key findings from analysis of the water level data are summarised below.

- Groundwater levels typically rise by around 2.5m in the winter.
- Groundwater levels in the bedrock and superficial deposits are similar in most cases, although there are significant differences in specific areas such as beneath drumlins.
- Where there are boreholes near to watercourses, the groundwater level and elevation of water levels in the watercourse are both at similar elevations, although winter groundwater levels can be higher than watercourse levels and in summer they can be lower. This means during the winter, groundwater will be discharging to the streams, but during summer there is the potential for streams to leak to groundwater. The degree of interaction between groundwater and surface water will depend on the stream bed's permeability and local geology. However, the data suggest that groundwater and surface water are in continuity over much of the Wylfa Newydd Development Area.
- Groundwater levels can respond quickly to rainfall.
- Tidal influences on the groundwater appear generally to be very slight and restricted to a maximum of approximately 50m from the coast.
- Groundwater flow direction generally follows the broad ground elevation with the highest bedrock groundwater levels being to the south of the Wylfa Newydd Development Area and the lowest at the coast.
- There is an inferred groundwater divide trending from the south-west towards the north-east under a slight topographic ridge that passes beneath Tregele. Groundwater west of the divide flows north-west across the Wylfa Newydd Development Area towards Porth-y-pistyll whilst

groundwater east of the divide flows towards Porth y Wylfa and the Tre'r Gof SSSI.

- A further groundwater divide is present to the east, close to the line of the surface water catchment for the Nant Cemaes.
- Towards the west of the Wylfa Newydd Development Area, another divide indicates that groundwater to the west of the divide flows in the direction of Nant Cemlyn and Cemlyn Lagoon whilst that to the east flows towards the coast to the west of Porth-y-pistyll.

Aquifer permeability

8.3.89 Permeability indicates the ease with which a fluid can move through rock. Technically, permeability is a function of the liquid moving through the rock as well as the properties of the rock. However, in this chapter, the general term of "permeability" is used rather than the term "hydraulic conductivity" which is the term used in a technical sense when the liquid moving through the rock is water. Testing to determine this parameter has been undertaken in a number of boreholes in the various phases of site investigations. The pumping tests also recorded permeability.

8.3.90 The permeability testing undertaken is presented in appendix D8-3 (Application Reference Number: 6.4.28). In summary, the permeability testing indicates a range in the superficial deposits from 0.0005m/d to 60m/d, whilst that in the bedrock ranges from 0.001m/d to 3m/d. Results of the pumping tests, which measure permeability over a larger area than the tests in individual boreholes, showed permeability to be approximately 0.1m/d to 1m/d.

8.3.91 The data, combined with information on the borehole logs, show that for the superficial deposits, intergranular flow through the pore spaces is the dominant flow mechanism. The data also show that fracture flow is the dominant groundwater flow mechanism for the bedrock with the majority of this fracture flow being in the upper portion of the bedrock aquifer.

Aquifer storage

8.3.92 Porosity, water content and bulk density tests were carried out on soil and rock samples as part of the GI. The results of these tests are summarised in table 6-6 of appendix D8-3 (Application Reference Number: 6.4.28). The clay deposits have a relatively high porosity and moisture content whereas the bedrock is lower with a mean porosity of around 2% and moisture content of 4%.

Groundwater quality

8.3.93 Groundwater quality data showed that for the majority of locations and determinands, the groundwater was of good quality compared to water quality standards associated with river quality and drinking water. In relation to the substances that are likely to be of most relevance to the works taking place within the Wylfa Newydd Development Area, the following are noted.

- Concentrations of dissolved manganese are particularly high, probably reflecting mineralisation from both rock and superficial deposits.
- No saline waters due to sea water ingress were identified in the aquifer.
- In a small number of groundwater samples, concentrations of aluminium, arsenic, nickel, lead, copper and zinc exceeded one or more water quality standards. With respect to the majority of these metals, the source is considered most likely to be natural. For lead it is likely that the elevated concentration in some areas (particularly to the south-west of the Existing Power Station) is the result of contaminated made ground (see chapter D7, Application Reference Number: 6.4.7).
- Iron showed a more widespread elevated concentration in comparison to the water quality standards.
- Organic compounds were generally below the level of detection. However, chlorinated solvents have been detected to the immediate south of the Existing Power Station, and are thought to be associated with historical contamination (see chapter D7, Application Reference Number: 6.4.7 for further consideration of this contamination).
- Total petroleum hydrocarbons have been detected in a small number of boreholes within the Wylfa Newydd Development Area.
- In the autumn of 2015, a leak of oil from a below ground electricity cable was identified to the east of Porth-y-pistyll. The subsequent groundwater investigation and monitoring near the leak did not identify any groundwater contamination associated with the leak. However, as oil was observed at the shoreline, and it probably reached the Nant Porth-y-pistyll (very low concentrations of Total Petroleum Hydrocarbons were measured in this watercourse), it is likely that localised groundwater contamination did occur near the leak.

Groundwater Dependent Terrestrial Ecosystems

8.3.94 A GWDTE is a wetland that critically depends on groundwater flow and/or water quality. As GWDTEs are intrinsically linked to the aquifer body that supports them, they are considered a part of the groundwater system. Two sites have been identified as GWDTE, the Tre'r Gof SSSI and the Cae Gwyn SSSI (figure D8-3, Application Reference Number: 6.4.101). Further details of these are provided in chapter D9 (terrestrial and freshwater ecology) (Application Reference Number: 6.4.9).

8.3.95 A study into the Tre'r Gof SSSI is provided in appendix D8-5 (Application Reference Number: 6.4.30). This shows that the Tre'r Gof SSSI is dependent on shallow calcareous groundwater and surface water inflows with the input of bedrock groundwater to the system being a minor component. The shallow groundwater inputs to the Tre'r Gof SSSI are considered alongside the surface water inputs within the relevant sections of this chapter.

8.3.96 A study into the Cae Gwyn SSSI has been undertaken and is provided in appendix D8-6 (Application Reference Number: 6.4.31). This shows that in

relation to groundwater levels, the feature is not downgradient of the Wylfa Newydd Development Area. This means that significant effects from a groundwater contamination perspective on this feature are unlikely. However, there could potentially be effects on its catchment area from the proposed car park to the east of the SSSI. Based on the identified groundwater flow direction, any effects would be to the primary outflow basin at the extreme east of the SSSI.

Groundwater abstractions

8.3.97 Up until January 2018, the Wylfa Newydd Development Area was located in a geographical area that was exempt from the requirements for licensing of groundwater abstractions greater than 20m^3/day. However, it will be a few years until all existing groundwater abstractions are licenced and NRW does not currently have a list of groundwater abstractions within the study area.

8.3.98 The IACC maintains a list of PWSs under the Private Water Supplies (Wales) Regulations 2010. The IACC provided information on a total of 29 wells within the outer groundwater study area. The majority of these are historical public supplies and are no longer in use for any purposes, although some of these are still physically present within the groundwater inner study area. The three historical public supply wells within the Wylfa Newydd Development Area which have the potential to be lost as part of the construction works, have been confirmed to no longer be used as water supplies.

8.3.99 Three PWSs were identified within the inner groundwater study area, Foel Fawr, Caerdegog Uchaf and Cae Gwyn. Their locations are shown on figure D8-3 (Application Reference Number: 6.4.101). Foel Fawr PWS has been sampled for chemical analysis. Caerdegog Uchaf and Cae Gwyn have not been sampled due to access restrictions. These two properties are towards the edge of the inner study area and up hydraulic gradient of the Wylfa Newydd Development Area. As such, it is unlikely that water quality at these locations would be affected by the work across the Wylfa Newydd Development Area.

8.3.100 In Wales, all Water Framework Directive (WFD) designated groundwater bodies, including the Ynys Môn Secondary groundwater body, are designated as Groundwater Drinking Water Protected Areas. These areas have to be protected with the aim of avoiding deterioration in their water quality which would compromise a relevant abstraction of groundwater intended for human consumption. The status of water bodies under the WFD, as opposed to Drinking Water Protected Areas, is considered below.

Existing buildings

8.3.101 To consider the potential effects on building foundations due to the lowering of the bedrock groundwater table, existing buildings have been considered. The nearest main development at the time that dewatering starts would comprise the Existing Power Station, although, due to the nature of the construction it is only services and/or the smaller ancillary buildings that could be affected if there was any drawdown. In addition to the ancillary buildings at the Existing Power Station there are buildings in the village of Tregele which

could potentially be affected. Further isolated buildings are also present close to the boundary of the Wylfa Newydd Development Area (see figure 8-4, Application Reference Number: 6.4.101 for properties that have been identified in groundwater modelling work as having the potential to be most affected).

Water Framework Directive

8.3.102 The WFD requires the consideration of any effects associated with the introduction of a modification or change in activity/structure on or near a WFD water body to determine if it could cause deterioration in any quality elements. A WFD compliance assessment is required to assess if the potential effects are deemed to be substantial and cause a deterioration in the status of a WFD water body or prevention of it achieving Good Ecological Status or Good Ecological Potential and consideration of deterioration in status of a groundwater body from “good” to “poor”.

8.3.103 Consideration must also be given to whether the works could prevent any planned mitigation measures or actions intended to achieve Good Ecological Status or Good Ecological Potential from being implemented, potentially resulting in the WFD water body failing to meet its objectives.

8.3.104 A Preliminary WFD Report was provided to NRW in 2016 for comment, in particular to agree upon the WFD water bodies to be screened in for assessment. The comments have subsequently been taken into account in the detailed WFD Compliance Assessment (Application Reference Number: 8.26).

8.3.105 The surface water study area is within the geographical coverage of the Western Wales River Basin District and is included in the corresponding Western Wales RBMP. One fluvial WFD water body, three coastal WFD water bodies and one groundwater WFD water body have been identified within the study areas. Due to the lack of potential direct or indirect effects on the only fluvial WFD water body (Wygyr – GB110102059170), this receptor has been scoped out of further assessment. The other surface waters within the hydrology study area form part of the coastal WFD water bodies. The coastal WFD water bodies are described in table D8-3 whilst the groundwater WFD water body (which includes the superficial and bedrock aquifers) is described in table D8-4.

8.3.106 Under the WFD, NRW requires all potentially impacted watercourses within the coastal WFD water body catchments to be considered and assessed. Impacts have been assessed using fluvial WFD parameters; however, the overall assessment is displayed as a potential impact to the relevant coastal WFD water body (table D8-3). Within this chapter, the Afon Cafnan, Nant Caerdegog Isaf and tributary of the Afon Cafnan are considered part of The Skerries coastal WFD water body; the Nant Cemaes and the Tre’r Gof SSSI drains form part of Anglesey North WFD water body whilst the Nant Cemlyn forms part of the Cemlyn Lagoon WFD water body.

Table D8-3 Coastal WFD water body quality elements [RD3]

Element	Classification		
WFD water body no.	GB11010390000	GB641010620000	GB610100083000
WFD water body name	The Skerries	Anglesey North	Cemlyn Lagoon
Typology	Exposed, microtidal	Moderately exposed, microtidal	Coastal water body
Hydromorph-ological status	Not A/HMWB*	Not A/HMWB*	HMWB*
Overall ecological status	High	Moderate	Good potential
Chemical status	Good	Fail	Good
Ecological status	High	Good	Good potential

*A/HMWB – artificial/heavily modified water body

Table D8-4 Groundwater WFD water body quality elements [RD3]

Element	Classification
WFD water body no.	GB41002G204400
WFD water body name	Ynys Môn Secondary
Overall status	Poor
Quantitative status	Good
Chemical status	Poor

8.3.107 The RBMP [RD9] was the subject of a public consultation process during the first half of 2015. Specifically, the Ynys Môn Management Catchment Summary formed part of this consultation. The summary briefly describes the current status of the water environment and its main challenges, objectives and measures. The stated aim is "*…to develop a single integrated programme of measures by 2021 that meets Water Framework Directive Objectives*". The objectives include the following:

- prevent deterioration in status of a water body (from current status);
- achieve the objectives for protected areas (i.e. water-dependent Natura 2000 sites); and
- aim to achieve good overall status for surface water and groundwater.

Summary of receptors

8.3.108 A summary of the identified receptors is provided in table D8-5, along with their value. The value for the receptors has been determined based on the methodology provided in chapter B8 (Application Reference Number: 6.2.8) and detailed in section 8.3 of this chapter. Only receptors of a low, medium or high value are taken through to the effects assessment, with receptors of negligible value being scoped out of further consideration.

8.3.109 The WFD Ynys Môn Secondary Groundwater Body relates to both groundwater in the bedrock aquifer and the glacial till aquifer, and considers these as a single unit across the majority of Anglesey. However, it is the groundwater in the study area that is being considered as a receptor in this assessment and so this is termed the "Secondary aquifers". This term incorporates the Secondary B bedrock aquifer and the Secondary (Undifferentiated) glacial till aquifers. Although observations from the GIs indicate that the Secondary (Undifferentiated) glacial till aquifer would not form a productive aquifer due to the predominantly clay matrix of the glacial till (see appendix D8-3 (Application Reference Number: 6.8.30), it is still included here as a receptor.

8.3.110 Although the strata at the Tre'r Gof SSSI are classified as a Secondary A aquifer, this designation is believed to be incorrect as it is based on limited geological data. Borehole and piezometers installed into and around the SSSI indicate that the SSSI comprises peat overlying silts and clays (appendix D8-5, Application Reference Number: 6.4.30). These strata will not form a productive Secondary A aquifer and so have been treated here as a Secondary (Undifferentiated) deposit.

8.3.111 Marine receptors are not included in this chapter as these are discussed in chapter D13 (Application Reference Number: 6.4.13). As noted previously, Cemlyn Lagoon is considered in both the marine chapter and this chapter as it is a brackish coastal lagoon which can be affected by changes to both environments.

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Table D8-5 Freshwater receptors and assigned values

Receptor	Value	Rationale for value
Surface water receptors		
Tre'r Gof Catchment and water within the Tre'r Gof SSSI	High	Water supporting a site with a high environmental importance and international or national value.
Afon Cafnan Catchment	Medium	Main river within a catchment, locally important watercourse.
Water within the Cae Gwyn SSSI	High	Water supporting a site with a high environmental importance and international or national value.
Cemaes Catchment	Medium	Main river within a catchment, locally important watercourse.
Cemlyn Catchment	High	Water supporting a site with a high environmental importance and international or national value.
Water within the Cemlyn Bay SSSI	High	Water supporting a site with a high environmental importance and international or national value.
Power Station Catchment	Low	Minor watercourse.
Flood risk receptors	Medium to High	All construction areas, temporary and permanent structures and supporting infrastructure are key receptors for flood risk, as well as all onshore land outside of the Wylfa Newydd Development Area boundary where there is a potential flood risk downstream of the development. Further details are provided in the FCA in appendix D8-4 (Application Reference Number: 6.4.29).
Fluvial geomorphology receptors		
The Tre'r Gof SSSI drains	Low	A network of small drains, likely to have been historically modified and with a limited range of morphological features.

Receptor	Value	Rationale for value
Afon Cafnan	Medium	A watercourse that appears to be adjusting following historical channel change and exhibits some morphological features. Watercourse has a gravel-bed with a riffle-pool sequence and localised areas of erosion and deposition.
Nant Caerdegog Isaf	Low	A small gravel and silt bed watercourse with limited geomorphological features including areas of erosion and deposition.
Nant Cemaes	Low	A small stream with straight planform with limited vegetated riparian buffer. Some channel adjustment.
Nant Cemlyn	Low	A small stream with a straight planform and some channel adjustment through erosion.
Nant Porth-y-pistyll	Low	Small artificially straight watercourse with limited morphological features.
Groundwater receptors		
Groundwater in Secondary Aquifers	Low	Low productivity aquifers including glacial till and bedrock.
Private water supplies	Medium	PWSs serving three or more (but fewer than 50) properties and where viable alternative supplies are available.
Historical public wells	Low	Wells not used for a potable or other use for many years.
Ancillary buildings and services at the Existing Power Station	High	Infrastructure of national importance. Potential effects due to lowing of the bedrock groundwater table leading to subsidence.
Off-site properties (houses/farms)	High	Residential properties. Potential effects due to lowering of the bedrock groundwater table leading to subsidence.
The Wylfa Newydd Development Area following decommissioning*	High	Former Power Station infrastructure would remain on-site for some time during and following the decommissioning process.

Receptor	Value	Rationale for value
		The land could ultimately be brought back to beneficial use.
Tre'r Gof Catchment and water within the Tre'r Gof SSSI	High	Secondary receptor for groundwater. Site designated as a GWDTE. Water supporting a site with a high environmental importance and international or national value.
Water within the Cae Gwyn SSSI	High	Secondary receptor for groundwater. Site designated as a GWDTE. Water supporting a site with a high environmental importance and international or national value.
Water within the Cemlyn Bay SSSI	High	Secondary receptor for groundwater although this SSSI is not designated as a GWDTE. Water supporting a site with a high environmental importance and international or national value.
Nant Cemlyn	High	Secondary receptor for groundwater. Water supporting a site with a high environmental importance and international or national value.
Afon Cafnan	Medium	Secondary receptor for groundwater. Main river within a catchment, locally important watercourse.
Nant Porth-y-pistyll	Low	Secondary receptor for groundwater. Minor watercourse.
Nant Cemaes	Medium	Secondary receptor for groundwater. Main river within a catchment, locally important watercourse.
Land at the Power Station (post decommissioning)	High	The land would be of high value post decommissioning

* This receptor is related to the land within the Wylfa Newydd Development Area which following decommissioning has the potential to be subject to groundwater flooding.

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Evolution of the baseline

Surface water

8.3.112 Further information on the evolution of the surface water baseline is provided in appendix D8-1 (Application Reference Number: 6.4.26). In summary the following is considered.

- **Evolution due to climate change.** The direct effect of climate change on surface water depends primarily upon the change in the intensity, volume and seasonal distribution of rainfall. Drier, warmer summers could lead to reduced flows in watercourses which would result in less water available for riparian use and other abstractions, and could also affect flora and fauna living in or by watercourses. Some watercourses could dry up completely in the summer months. More intense rain storms in the summer months could give rise to more rapid runoff and result in localised flooding and affect water quality. Similarly, an increase in rainfall volume, particularly in winter when it falls on saturated soils, could give rise to prolonged periods of flooding over much larger areas than is currently the case and it could also increase suspended sediment loads. Climate change is provided by UK Climate Change Projections (UKCP09) [RD17] including the principle that climate change will likely increase the risk of coastal and river flooding. Climate change allowances are included in the FCA (appendix D8-4, Application Reference Number: 6.4.29).
- **Evolution due to changes in abstractions.** It is possible in the future that if there were longer, drier summers that surface water abstraction could become more common and widespread, particularly for agricultural purposes in the summer months.

Fluvial geomorphology

8.3.113 In summary the following evolution is considered with respect to fluvial geomorphology.

- **Evolution due to natural adjustment.** The Afon Cafnan, Nant Llygeirian and Nant Cemlyn are currently exhibiting some evidence of channel adjustment. These channels have been assessed as having a low to moderate energy, with limited competence to actively move the course of the planform. It is anticipated that if left undisturbed, the watercourses would continue to adjust slowly laterally and potentially through incision within the defined wider corridor. The remaining watercourses in the study area (Tre'r Gof SSSI drains, Nant Porth-y-pistyll, Nant Caerdegog Isaf and Nant Cemaes) exhibited less evidence of adjustment, with lower energies (arising from a combination of low slope/discharge). These were observed to be typically artificial field drains and artificial extensions to the drainage network. These could potentially continue receiving fine sediment, which would become

deposited and, in the absence of maintenance to remove accumulated deposits, remain on the channel bed.

- **Evolution due to meeting policy objectives.** The Western Wales RBMP provides details of the anticipated ecological status (which is partly dependent on stream morphology) for the WFD water bodies within the study area for years 2021 and subsequently 2027. As suitable mitigation is put in place, it is anticipated that WFD water body status and the quality elements (including hydromorphology) would improve.
- **Evolution due to climate change.** Over a medium to long-term time period, climate change could potentially alter the hydrological regime of the watercourses. Increased frequency/severity of droughts and floods could potentially lead to the watercourses adjusting to different patterns of erosion and deposition. However, it is likely that the adjustment would remain localised and of relatively low magnitude given the channel types.

Groundwater

8.3.114 Further information on the evolution of the groundwater baseline is provided in appendix D8-3 (Application Reference Number: 6.4.28). In summary the following is considered.

- **Evolution due to reasonably foreseeable development**. For reasonably foreseeable external third party projects as identified in volume I (cumulative assessment) of this Environmental Statement, there would be no impact on groundwater resources and associated receptors that would significantly change the groundwater baseline.
- **Evolution due to climate change**. Over the medium-term and long-term, groundwater resources in the groundwater study area may be affected by climate change. However, any changes would be complex and may result in:
  - a long-term decline in groundwater storage due to higher soil moisture deficits due to warmer, drier summers; and
  - increased frequency and severity of groundwater droughts leading to reduction in base flow to watercourses or GWDTEs.
- **Evolution due to changes in groundwater abstraction**. There is no reason to suspect any significant changes in groundwater abstractions across northern Anglesey.
- **Evolution due to changes in groundwater quality**. Based on currently available information, there is unlikely to be a significant change in the baseline groundwater quality. Changes to the groundwater regime brought about by climate change are unlikely to affect groundwater quality (for example, saline intrusion would not be anticipated).

8.3.115 Overall, changes to the current baseline for surface water, fluvial geomorphology and groundwater are likely to be limited in the foreseeable future.

8.4 Design basis and activities

8.4.1 This section sets out the design basis for this assessment of effects. It sets out where any assumptions have been made to enable the assessment to be carried out at this stage in the evolution of the design. This section also identifies the embedded and good practice mitigation that would be adopted to reduce adverse effects as inherent design features or by implementation of standard industry good working practice.

8.4.2 Details of the design for the Power Station, Site Campus, landscape mounds and drainage are provided in chapter D1 (proposed development) (Application Reference Number: 6.4.1) along with detailed descriptions of the development phases and activities. The approach adopted for the design of the Power Station, Site Campus and landscape mounds has been to utilise a parameter approach to the development. Parameter plans have been submitted with the application for development consent and show the extent of each parameter zone as shown in figures D1-1 to D1-6 (Application Reference Number: 6.4.101).

8.4.3 For the Power Station, parameters have been set for platform elevation and for building location and size. With regard to platform elevation, ten work areas have been identified with a range of minimum and maximum elevations from 6mAOD to 34mAOD (see table D1-1 in chapter D1 (Application Reference Number: 6.4.1).

8.4.4 The groundwater model used to assess the effects of groundwater dewatering (appendix D8-7, Application Reference Number: 6.4.32) has assumed a maximum depth of dewatering down to -18mAOD. Although the design depth for the excavation is -16.9mAOD, the modelled depth is slightly deeper to allow for any sumps needed in the base of the excavation for dewatering. This also makes the model slightly more conservative than would otherwise be the case.

8.4.5 With regard to building/structure location and size, parameter zones for the Power Station, including building/structure length, width and height, have been set as detailed in table D1-2 in chapter D1 (Application Reference Number: 6.4.1). As the area outside of the buildings/structures will be predominantly hardstanding with very little landscaped area, the majority of rainfall runoff would be to drains with little recharge to groundwater. The actual above-ground size of the buildings within the parameter zones would not therefore have any effect on the surface water and groundwater environment as rainfall runoff would be either from buildings or hardstanding and flow into the surface water drainage system.

8.4.6 However, the extent of parameter zones could have an important effect as they could change the extent of hardstanding area and runoff that is apportioned between natural catchments when compared to the baseline. The worst case situation would be all parameter zones at the Power Station covered with buildings/structures or hardstanding to the maximum extent with no/minimal landscaped areas.

8.4.7 The extent of the parameter zones for the Power Station Site have been compared to the extent of hardstanding used in the surface water modelling.

Comparison of the areas of hardstanding defined by the parameter plan areas to the areas of hardstanding modelled in the surface water modelling, shows that there may be a slight reduction in the amount of hardstanding within the Power Station Site. It is not considered that the slight difference in impermeable area would materially affect the level of flood risk from the assessment presented in this chapter.

8.4.8 For the Site Campus, parameter zones have been established that identify the location of the accommodation blocks, amenity building, substation, cycle store and other facilities. The parameters listed in table D1-11 in chapter D1 (Application Reference Number: 6.4.1) only allow the size of the buildings to be changed within each zone and this has the potential to change groundwater recharge and rainfall/runoff response. Smaller buildings would mean more landscape area which would result in less rapid rainfall runoff and more infiltration to the ground. As the largest building size would result in the most change from baseline it is this that has been assessed in this chapter as it represents the worst case within these parameters.

8.4.9 For the Wylfa Newydd Development Area, parameter zones have been set for the construction works and the five landscape Mounds A to E, including height and slope. Details can be found in Table D1-4 of chapter D1 (Application Reference Number: 6.4.1).

8.4.10 The assessment of effects due to storm runoff has used a likely worst case for the mounds as they would be constrained in terms of height and footprint. The storm water settlement ponds considered in the assessment have been sized in relation to the size and slope angle for each mound. If the slope-angles were to change significantly this would require reassessment of the size of the settlement ponds.

8.4.11 In the case of the Tre'r Gof, SSSI, the construction parameter plan limits the extent of works around the Tre'r Gof SSSI and provides a buffer between the area that work would take place in the Wylfa Newydd Development Area, and the SSSI.

Construction

Basis of assessment and assumptions

8.4.12 The activities relevant to surface water, fluvial geomorphology and groundwater as set out in chapter D1 (Application Reference Number: 6.4.1) and appendix D1-1 (construction method statement) (Application Reference Number: 6.4.17) that are considered within this chapter are as follows.

- Construction site establishment (Site Preparation and Clearance works and the Main Construction phase), including:
  - Establishment of the Main Site Compound and satellite and material compounds. Compounds would not be constructed within 15m of main rivers or 8m of ordinary watercourses.
  - The Main Site Compound and associated construction establishment facilities would be surfaced with different surface materials depending on operational, safety and security requirements.

Hardstanding with falls to drainage trenches would be used for the Main Site Compound and other areas where required. Graded and compacted stone would be used in other areas and would enable rainfall to percolate into the ground rather than forming surface water runoff. Drainage (comprising stone-filled trenches or perforated pipes) would be installed beneath the surfacing to prevent runoff onto the Existing Power Station access road. This would be channelled and discharged to swales located adjacent to all areas of the site establishment facilities.

- Construction of temporary parking areas associated with the Main Site Compound for office workers and the workforce.
- Creation of laydown areas.
- A fuel store would be constructed within the Main Site Compound and used to supply the double-skinned mobile fuel bowser. Fuel would be delivered to the compound for storage within a single 15,000L tank with a bund capacity 110% of the storage volume. The tank would be located in a facility on a concrete hardstanding area with secondary containment systems (such as bunds) with vehicle damage protection and integrated drainage. The drainage would pass through an oil/water interceptor prior to discharge to a swale.
- Mobile fuel bowsers would be transported around the Wylfa Newydd Development Area to refuel plant and machinery.
- The Material Compounds would be located around the Wylfa Newydd Development Area and would be used for the temporary storage of materials from building demolition, removal of walls etc. during the Site Preparation and Clearance works.
- Where practicable, the Satellite and Material Compounds would be sited partially on existing areas of hardstanding with the remaining areas surfaced with crushed stone.
- Creation of laydown areas for the Main Construction works principally in the south-west and east of the Wylfa Newydd Development Area and creation of areas for delivery and storage of hazardous materials and storage and removal of waste. On completion of construction work, the western laydown area would become a building platform and landscape Mound D. The eastern platform would become the location of landscape Mound B.
- Construction of concrete batching plant in the north-west of the Wylfa Newydd Development Area.
- Demolition of remaining buildings, clearance of stone walls, gates and field boundaries down to ground level.
- Removal of trees and hedges to ground level and above-ground features.

- Ground improvement works comprising removal of contaminated soils from areas of potential concern and treatment or removal of invasive non-native species. Contaminated soils would be treated in an on-site remediation processing compound.
- Construction of access roads, haul roads and a security track adjacent to the perimeter fence. This would include diversion of the Existing Power Station access road including a temporary bridge (this is a land bridge and does not cross a watercourse). Creation of construction routes and temporary bridges/culverts, including the Afon Cafnan crossing. The haul road bridge over the Afon Cafnan would be clear span and of an appropriate construction and design (to be agreed with the regulators), to reduce the potential for flooding as far as practicable.
- Topsoil and subsoil would be stripped from all areas required for development. All topsoil and subsoil removed during construction would be temporarily stored within the Wylfa Newydd Development Area and ultimately re-used to top landscape mounds. The maximum duration of temporary soil storage would be approximately eight years. Topsoil would be stripped from a number of areas including: the footprints of the land-based Power Station Site; Site Campus; haul roads; satellite and material compounds; and, the proposed new channel of the watercourse realignment.
- Watercourse (Nant Caerdegog Isaf) realignment.
- Installation of surface water site drainage, including construction of outfalls (these may require appropriate permits from NRW or the IACC depending upon the nature of the work and the watercourse). The surface water drainage scheme for site construction is detailed in appendix D8-8, Summary of preliminary design for construction surface water drainage (Application Reference Number: 6.4.33). The surface water drainage system would be installed prior to any major earth works (including topsoil stripping) and would remain in place throughout the construction works. To control suspended solid concentrations, an active treatment system would be installed which, when required, would use a polyelectrolyte to aid settlement. Following construction, most of this drainage system would remain, and that remaining would be a passive system (i.e. the ditches and swales and settlement ponds would remain but the active polyelectrolyte treatment equipment and any additional temporary measures such as silt fences, would be removed).

- Construction of temporary buildings:
  - Construction of security access and site entrance plaza to the south-east of the Power Station Site.
  - Creation of the Site Campus in the northern part of the Wylfa Newydd Development Area, partly within the Tre'r Gof Catchment. This would

be constructed, operated and decommissioned during the construction period for the Power Station.

  - Temporary buildings to be erected on the Main Site Compound to provide office and welfare facilities during the early site clearance works. The amount of office and welfare facilities provided would then increase to suit the workforce profile as Main Construction progresses.

- Major civil groundworks:
  - Creation of a series of level platforms including at the cooling water intake, for the two Units, for the laydown areas, and for numerous structures associated with the two Units.
  - Bulk earthworks.
  - Deep excavation for reactor and turbine building basements, including groundwater dewatering. Both Units would be constructed within a single excavation together with the excavation for the cooling water intakes and tunnels from the intakes to the reactor building. The excavations for the reactor and turbine buildings would be down to an elevation of approximately -18mAOD. With the platform at between 6mAOD and 22mAOD, this means that the excavations would be around 22m to 38m deep. The target dredge depth for the MOLF would be -10mAOD down to -13mAOD at the berthing pockets.
  - Excavation for other features including for the cooling water outfall tunnels in the cut-and-cover section of the tunnel. The cut-and-cover sections of the cooling water outfall tunnel would be the sections of tunnel closest to the excavation for the Units and at the outfalls to the north of the Existing Power Station. The remaining section of cooling water outfall tunnel would be constructed by road header and drill and blast methods depending on depth and ground conditions.
- Groundwater dewatering:
  - In order to work deep excavations in the dry, dewatering of the excavations would be required to remove groundwater and rainfall ingress to the excavations. Drawdown of water levels in the deep excavation would be to just below the base of the excavations at -16.9mAOD, so groundwater levels would be pumped to a level of about -18mAOD. Water levels would need to be controlled to this depth over an area of around 150,000m^2 for approximately 2 to 3 years. The proposed method of dewatering would be to manage the inflows by a combination of drains, ditches and surface grading within the excavation to collect the water in the excavations and pump it to sediment settlement ponds located on the working platform. This water would then be discharged to the sea (see chapter D13,

Application Reference Number: 6.4.13 for an assessment of the effects of this discharge).

- A groundwater model has been established to assess the effects of dewatering on the groundwater receptors. This model also provides an estimate of how much water may be removed from the excavation by pumping (appendix D8-7, Application Reference Number: 6.4.32). The model results show that for the most likely modelled scenario, an estimated 175m^3/day of groundwater would be abstracted from the excavations (45m^3 from the seaward excavation and 130m^3/day from the inland excavation) with typically a further 750m^3/day of direct rainfall being abstracted. The amount of rainwater removed would vary greatly from day to day. The model results based on the historical rainfall data show a range of 0m^3/day to in excess of 5,500m^3/day of rainfall being removed from the inland and seaward excavations.
- To reduce groundwater inflow to the excavation, particularly through fractures, the walls of the deep excavations would be sprayed with concrete ('shotcrete') as the excavation deepens. As such, the model results are likely to be an overestimate of the extent of drawdown and the groundwater volumes that would need to be abstracted (the direct rainfall volumes to be abstracted, however, would not be affected by this mitigation measure).
- To reduce surface water inflows running into the excavations, a bund and surface water drains would be installed around the periphery of the excavation.

- Material stockpiles and mounding:
  - Creation of temporary stockpiles of material.
  - Creation of landscape mounds. Following creation of the mounds with site-won material, the landscape mounds would be covered with topsoil collected from the temporary topsoil mounds and vegetated as soon as practicable.
- Marine construction:
  - MOLF.
  - Construction and removal of temporary cofferdam and dewatering from behind the dam to provide a dry working area.
  - Construction of cooling water intake and outfall facilities with local dewatering to provide a dry working area. The excavation for the intake facilities would form one combined excavation with the excavation for the deep basements required for the Units.
- Building and infrastructure construction:
  - Unit 1 and Unit 2 reactor and control buildings.
  - Other main plant buildings.

  - Construction of the Power Station Site permanent drainage, security fencing and parking.
  - Construction of utilities infrastructure.
- De-mobilisation and removal of temporary facilities:
  - Removal of the contractor(s) compounds and fuel storage facilities.
  - Removal of the concrete batching plant.
  - Clearance and landscaping of material storage and laydown areas.
  - Demolition of the Site Campus in the north-east of the Wylfa Newydd Development Area.
  - Removal of temporary haul roads and any temporary bridges.
  - Removal of water treatment facilities and conversion of the active drainage system around the landscape mounds to a passive system.

8.4.13 All water supplies for construction activities and for potable supply in the Site Campus and elsewhere around the construction site would be provided from the water main by Dŵr Cymru Welsh Water (DCWW) (Application Reference Number: 6.4.17). It has been estimated by Horizon that during the construction phase, a peak demand of potable water would be 2,550m^3/day excluding potable water required for the Site Campus which would be around 400m^3/day (so a potential maximum of 2,950m^3/day although over any given day the peak potable water use within the site campus will be at a different time of day to that of the construction site). However, the requirements of the latter would vary during the construction programme depending upon the number of workers housed at the Site Campus and this has been discussed with DCWW.

8.4.14 This supply would be provided from within DCWW's existing licensed abstractions with no requirement for new abstractions or increase in licensed quantities for existing abstractions. As these licensed quantities were subject to detailed environmental assessment at the time of issue and subsequently as part of water management plans, any impacts of water supply are not considered within this Environmental Statement.

8.4.15 As set out in appendix D1-1 (Application Reference Number: 6.4.17) construction sewage would be dealt with by the construction sewage package plant, with sewage from the Site Campus treated at the existing DCWW Cemaes Waste Water Treatment Works, with the latter likely to be extended as required by the number of workers staying at the Site Campus. There would be no discharges of treated foul sewage to fresh surface water and all discharges would be to the sea and are therefore assessed in chapter D13 (Application Reference Number: 6.4.13).

Embedded mitigation

8.4.16 As detailed in chapter D1 (Application Reference Number: 6.4.1) a buffer zone around the Tre'r Gof SSSI would be put in place. This zone would be a minimum of 20m to the north and west adjacent to the Site Campus, a 50m buffer around the south of the SSSI, with approximately 100m on the SSSI's south-eastern and eastern sides where the most sensitive areas within the

SSSI have been identified. Although there would be some work inside the buffer this would be limited to the installation of drainage on the northern side of the SSSI associated with the Site Campus and drainage around the south, east and north-east of the SSSI to manage runoff from the landscape mounds. The drainage around the northern side of the SSSI would seek to maintain the shallow groundwater flow to the SSSI.

8.4.17 The drainage design detailed in appendix D8-8 (Application Reference Number: 6.4.33) has incorporated the following features for the Tre'r Gof SSSI:

- A permeable drainage blanket made up of inert rock material beneath the Mound A to the south and east of the Tre'r Gof SSSI. This will allow the shallow groundwater and surface water runoff flowing from the south and east of Mound A to flow under the mound into the SSSI as it currently does. The drainage blanket would be continued beneath the drainage ditch so that water can seep from the base of the drainage ditch into the drainage blanket and move towards the Tre'r Gof SSSI (see appendix D8-8, Application Reference Number: 6.4.33 for more detail). The use of inert rock will seek to ensure that the shallow groundwater chemistry does not change appreciably from the baseline conditions.
- Overflow features (e.g. low points in the ditch bank, gravel fill in patches of the bank or pipes) at intervals of about 50m in the drainage ditch to the north and west of Mound A. This will mean that during times of higher rainfall, water will flow from the ditch to the ground adjacent to the drain, allowing overland flow to the Tre'r Gof SSSI to be maintained. The effect of this will be monitored and the overflow features modified where necessary to control the flow to the SSSI.
- The drainage system has been designed to incorporate as much flexibility as possible so that changes can be made to drainage water treatment and to the volume of water being released to various discharge points during the construction period.

8.4.18 As set out in the Landscape Principles of the Landscape and Habitat Management Strategy (Application Reference Number: 8.16) the landscape mounding has been designed to avoid changes in catchment boundaries as far as practicable. This notwithstanding, some changes do result from the mounding and these have been taken into account in this assessment. The designs have reduced the potential for changes in baseline flow in watercourses around the mounds by trying to keep the runoff volume the same (i.e. by not significantly changing the extent of the catchment) although where mounds would become steeper the speed of runoff would increase. These changes have been considered in this assessment.

8.4.19 As set out in the Phasing Strategy (Application Reference Number: 8.29), Horizon would install appropriate drainage on-site prior to main construction to manage run-off. This would include combined attenuation and sediment settlement ponds, with the attenuation being sized to manage 1 in 100 year events to greenfield runoff rates. The sediment settlement pond and

associated treatment would be employed to meet water quality thresholds. An application would be made for an Environmental Permit which would set limits on the concentrations of substances which could be discharged to protect the receiving surface water.

8.4.20 As set out in the Main Power Station Site sub-Code of Construction Practice (CoCP) (Application Reference Number: 8.6) surface water runoff from exposed topsoil during construction and later from the newly formed landscape mounds will be managed by a treatment train of sustainable drainage system (SuDS) features, as detailed in appendix D8-8 (Application Reference Number: 6.4.33). Sediment settlement ponds would be used in conjunction with other measures including silt traps, silt curtains, silt fences and vegetated channels. Ditches would be constructed around the base of the landscape mounds to allow flows to be captured and discharged to the drainage system. The discharge limit for suspended solids for each discharge point would be set in the construction Environmental Permit with the limit set based on baseline conditions so that there would be no significant effect on the receiving water. The design has been prepared to meet a minimum treatment standard of between 40mg/l and 70mg/l total suspended solids (depending upon the background concentration in the receiving watercourse) during normal rainfall conditions.

8.4.21 During rainfall events that exceed the 1 in 2 year return period the treatment systems would all continue to operate, but it is likely that the volume of water entering the system would be greater than that capable of being treated. In these instances, where practicable water would be retained in the sediment settlement ponds (which are also flow attenuation ponds, designed to manage up to a 1 in 100 year event) and the stored water treated when flows into the system decline. In the event that the storage and sediment treatment system is overwhelmed, overflow discharge would be direct to stream without treatment of the overflow water (treatment would continue for water routed through the treatment train). At these times sediment will naturally be higher in the receiving watercourses, as identified during background monitoring (appendix D8-1, Application Reference Number: 6.8.26) where concentrations of over 1000mg/l total suspended solids have been measured.

8.4.22 Chemical dosing using polyelectrolyte coagulant may be required to meet the concentrations specified in the Environmental Permit and would almost certainly be required during the construction stage if there is insufficient settlement of solids in the settlement ponds (e.g. due to high flow rates). Details are provided in appendix D8-8 (Application Reference Number: 6.4.33). The 40 to 70mg/l limits could be met for the majority of the time by the passive system of settlement ponds and swales, with the active treatment system when required. Ultimately the outfall concentration would need to meet the conditions for each outfall set in the construction Environmental Permit which would be agreed with NRW.

8.4.23 In order to manage the risks to Cemlyn Lagoon, the drainage to Nant Cemlyn would be modified as part of construction activities as detailed in appendix D8-8 (Application Reference Number: 6.4.33). Prior to construction commencing the drainage system would be installed around the base of Mound E. Once topsoil stripping and soil movement commences the drainage

from Mound E would be collected, treated and routed to the Afon Cafnan. There would therefore be no discharges to the Nant Cemlyn during construction, until the western side of Mound E is vegetated and there is no risk of sediment runoff (except that which would naturally occur). Once fully vegetated the drainage would be re-routed back to the Nant Cemlyn via the attenuation pond which would be used to attenuate flows to greenfield runoff rates.

8.4.24 The Site Campus would be constructed in a phased manner. The first construction would be to the northwest of, and as far as practicable from, the Tre'r Gof SSSI. As on-site accommodation increases, then construction would come closer to the Tre'r Gof SSSI. As set out in volume 3 of the Design and Access Statement (Associated Developments and Off-Site Power Station Facilities) (Application Reference Number: 8.2.3) all surface water during construction of the Site Campus will run into a drainage channel to the east and west and discharge into attenuation ponds, to allow appropriate sedimentation control. After each phase of Site Campus construction, surface water drainage from the completed elements of the Site Campus will either run into the ground around the site, or into surface water channels to the east of the site. Discharges to the west will be taken to the outfall currently used by the foul water treatment plant. Drainage design for operation of the Site Campus will include attenuation of discharge to surface water (e.g. geocellular attenuation tank) and recharge of storm water runoff (e.g. via infiltration trenches, reno mattress, swales) in order to reduce potential hydrological effects on the SSSI arising from surface water flows.

8.4.25 Water would be pumped from the car park runoff system to a recharge trench along the boundary with Cae Gwyn SSSI.

8.4.26 As set out in appendix D1-1 (Application Reference Number: 6.4.17) oil interceptors would be provided to areas of hardstanding where there is a potential risk from oil/fuel contamination (e.g. at car parking areas). This would mitigate potential effects of oil/fuel on water quality.

8.4.27 As set out in volume 2 of the Design and Access Statement (Power Station Site) (Application Reference Number: 8.2.2), appropriate construction drainage will be installed prior to construction of the Spent Fuel Store, including any necessary treatment of runoff water prior to discharge. Detailed construction drainage will be designed to prevent any increases in flood risk to off-site receptors through the inclusion of appropriate attenuation.

8.4.28 Horizon will develop a passive engineered drainage system by completion of construction as set out in the Landscape and Habitat Management Strategy (Application Reference Number: 8.16). The drainage system will be managed in relation to sensitive ecological receptors and incorporate appropriate attenuation to prevent any increases to flood risk off-site and reduce significant effects on water availability.

8.4.29 As stated in volume 2 of the Design and Access Statement (Application Reference Number: 8.2.2), surface water drainage will discharge to the sea, subject to qualitative and quantitative control measures set in an Environmental Permit authorising the discharge.

Good practice mitigation

8.4.30 Horizon will comply with relevant legislation (including, but not limited to, the Water Resources Act 1991, the Environmental Permitting Regulations 2016 and the Land Drainage Act 1991 (as amended)), as set out in the water management strategy of the Wylfa Newydd CoCP (Application Reference Number: 8.6).

8.4.31 Horizon will implement working methods to protect surface water and groundwater from pollution and other adverse impacts, including changes to flow, flood storage volume, water levels and water quality as set out in the water management strategy of the Wylfa Newydd CoCP (Application Reference Number: 8.6).

8.4.32 The water management strategy of the Wylfa Newydd CoCP (Application Reference Number: 8.6) and the water management strategy of the Main Power Station Site sub-CoCP (Application Reference Number: 8.7) set out the strategies to be applied throughout the construction period to protect water resources. As stated in the water management strategy of the Wylfa Newydd CoCP (Application Reference Number: 8.6) Construction Industry Research and Information Association (CIRIA) Guidance will be adopted as appropriate from the following publications:

- Environmental Handbook for Building and Civil Engineering Projects (3 Parts: C512 [RD18], C528 [RD19] and C529 [RD20]).
- Control of water pollution from construction sites. Guidance for consultants and contractors (C532) [RD21].
- Environmental good practice on site guide (fourth edition) (C741) [RD22].
- Land use management effects on flood flows and sediment – guidance on prediction (C719D) [RD23].
- The SuDS Manual (C753) [RD24].
- Development and flood risk – guidance for the construction industry (C624) [RD25].
- Culvert Design and Operating Guide (C689) [RD26].

8.4.33 Horizon will ensure suitable procedures are in place to provide protection for watercourses, such as appropriate control measures and resources to manage the risk of spills and accidents, as set out in the water management strategy of the Wylfa Newydd CoCP (Application Reference Number: 8.6) and the Main Power Station Site sub-CoCP (Application Reference Number: 8.7).

8.4.34 In line with CIRIA Guidance C741, Environmental Good Practice on Site Guide [RD22], buffer zones will be established adjacent to watercourses. Requirements for buffer zones for specific surface water receptors are set out in the Wylfa Newydd CoCP (Application Reference Number: 8.6).

8.4.35 To protect surface waters, suitably demarcated buffer zones will be established adjacent to the following watercourses that have been identified as potentially most affected, as set out in the Main Power Station Site sub-CoCP (Application Reference Number: 8.7):

- A 15m buffer zone along the Nant Cemlyn and Nant Cemaes where the watercourses cross the Wylfa Newydd Development Area.
- A 15m buffer around watercourses draining into the Tre'r Gof SSSI.
- A 15m buffer zone along the Afon Cafnan and its main tributary (Nant Caerdegog Isaf). For the watercourse realignment on the Nant Caerdegog Isaf, a risk assessment approach will be undertaken with relevant approval and consents for works from NRW.

8.4.36 Where unavoidable small scale works are identified as being required within these buffer zones, detailed methodologies and risk assessments will be developed by Horizon that ensure those works can be undertaken without adversely affecting the designated areas or their special interest features. Examples of small scale works that may be required include installing appropriate types of fencing, vegetation management, and undertaking monitoring surveys within the buffer zones.

8.4.37 Horizon will carry out a risk assessment for all works within surface water buffer zones, including but not limited to, vegetation management adjacent to watercourses, construction of bridges and drainage outfalls. Furthermore, a risk assessment will be undertaken for use of any cementitious materials within 50m of any active watercourse. Appropriate controls, proportionate to the level of risk identified, will be applied to the works.

8.4.38 As set out in the water management strategy of the Wylfa Newydd CoCP (Application Reference Number: 8.6) adequate drainage systems will be installed prior to construction works with appropriate treatment prior to discharge. This will include sediment treatment and the inclusion of oil separators where necessary. The drainage system will be appropriately maintained throughout the works such that it remains efficient. Sediment would go to sediment lagoons.

8.4.39 As set out in the water management strategy of the Wylfa Newydd CoCP (Application Reference Number: 8.6) measures will be taken to prevent the deposition of silt or other material arising from work operations in existing watercourses or catchment areas. The measures will accord with the principles set out in industry guidelines, including NRW's Works and maintenance in or near or water: Guidance for pollution prevention (GPP) 5 [RD27]. Measures include use and maintenance of temporary lagoons, tanks, bunds, silt fences or silt screens, as well as consideration of the type of plant used and the time of year for working in watercourses.

8.4.40 As set out in the Wylfa Newydd CoCP (Application Reference Number 8.6) the following guidance, which is provided at [RD27] will be followed:

- Understanding your environmental responsibilities – good environmental practices: Pollution Prevention Guidelines (PPG) 1. This general guidance includes elements of relevance to surface water and groundwater that will be applied across the Wylfa Newydd Development Area, including details on understanding what is required to protect the environment, making a drainage plan, understanding and maintaining

treatment facilities, chemical storage and spill avoidance, and flood risk. More detail is provided on certain aspects in other PPGs or GPPs.

- Working at construction and demolition sites: PPG 6. With regard to the water environment and controls that will be applied across the Wylfa Newydd Development Area, this PPG provides guidance regarding understanding and management of drainage, excavations, controlling risks from stockpiles and exposed ground, storage and use of cement and concrete, land contamination and chemical storage and use. The PPG contains a number of checklists of activities that will be used as the basis for managing pollution risks across the Wylfa Newydd Development Area.
- Vehicle washing and cleaning: GPP 13. This GPP will be applied to vehicle washing across the Wylfa Newydd Development Area. It details the importance of understanding drainage and having a drainage plan, water treatment, management of cleaning chemicals and disposal of wash effluent. The types of controls that would be used include having a drainage plan and only washing vehicles in controlled areas, and not on bare ground.
- Dewatering underground ducts and chambers: GPP 20. This GPP would be applied to dewatering activities across the Wylfa Newydd Development Area and in particular the options for water management and control of silt. The GPP also outlines the control of oil and chemicals. The types of controls that would be used include use of oil / water separators on any discharges at risk from oil contamination and avoiding disturbance of silt during pumping.
- Pollution incident response planning: GPP 21. This guidance would be used as the basis for developing an incident response plan for construction activities, including risks assessment, contacts, chemical inventory, drainage plans, training and waste management.
- Safe storage – drums and intermediate bulk containers: PPG 26. This guidance, which is applicable to storage up to 1000L, would be used as part of pollution prevention activities across the Wylfa Newydd Development Area. In particular, the guidance on storage, secondary containment and spill response would be implemented.

8.4.41 Horizon's management of construction activities would be updated by NRW's GPPs [RD27] as they are made available, replacing PPGs in time.

8.4.42 As set out in the water management strategy of the Wylfa Newydd CoCP (Application Reference Number: 8.6) measures would be taken with regard to any works within a watercourse to restrict the release of suspended sediment and solids into the water column as far as practicable.

8.4.43 As set out in the water management strategy of the Wylfa Newydd CoCP (Application Reference Number: 8.6) where practicable, sustainable methods will be utilised for discharges including site drainage, surface runoff and dewatering discharges.

8.4.44 Horizon will ensure runoff is managed appropriately, according to the controls within the Wylfa Newydd CoCP (Application Reference Number: 8.6) and Main Power Station Site sub-CoCP (Application Reference Number 8.7) as well as any permits or other relevant approvals being obtained. This will include use of sediment settlement ponds and other appropriate treatment to manage flows and meet water quality thresholds as per the findings of the Wylfa Newydd DCO Project Water Framework Directive Compliance Assessment.

8.4.45 Horizon will ensure sufficient drainage is installed prior to topsoil strip or major works occurring in a particular area (including construction of site compounds) to comply with the requirements in the Wylfa Newydd CoCP (Application Reference Number: 8.6) and the Main Power Station Site sub-CoCP (Application Reference Number 8.7).

8.4.46 As set out in the water management strategy of the Wylfa Newydd CoCP (Application Reference Number: 8.6), Horizon will ensure all relevant construction activities are managed within the limits of an obtained Environmental Permit, for example keeping within limits on the concentrations of substances to be discharged, as far as possible, to protect receiving surface waters.

8.4.47 All temporary hardstanding (on non-foreshore sites) as far as is reasonably practicable, will incorporate permeable surfacing unless there is a risk of surface water or groundwater pollution from contaminants.

8.4.48 Horizon will employ protective measures to control the risk of pollution to groundwater, which will, in particular, be consistent with the Environmental Permitting (England and Wales) Regulations 2016. Furthermore, as detailed in the Main Power Station Site sub-CoCP (Application Reference Number: 8.7) prior to, and during construction of the cooling water tunnels, quarterly monitoring would be undertaken. Where practicable, existing boreholes would be used. If the monitoring identifies that the proposed installation of the cooling water tunnels will lead to a statistically significant increase in contaminant levels compared to baseline, additional mitigation would be required and agreed with the regulator. Options could include (1) detailed quantitative risk assessment to provide further information on the risk posed by the changes in concentration (2) remediation of groundwater using an appropriate technique to reduce contaminants concentrations – the actual remedial option would be identified by a remediation options appraisal.

8.4.49 Horizon will address the handling of material from excavations being a potential source of contamination. Horizon will ensure measures will be put in place to prevent contaminated runoff reaching open ground.

8.4.50 In addition, Horizon will avoid using materials that could result in direct or indirect discharge of hazardous substances or non-hazardous pollutants to groundwater.

8.4.51 Horizon will ensure that flood risk is managed safely throughout the construction period and that all designs comply with the FCA in appendix D8-4 (Application Reference Number: 6.4.29).

8.4.52 Horizon's flood risk compliance will be based upon a risk-based precautionary approach, using the source-pathway-receptor concept, drawing information

from NRW's online flood warning advice [RD28] or other such reputable service as appropriate.

8.4.53 As stated in the water management strategy of the Main Power Station Site sub-CoCP (Application Reference Number: 8.7) there will be no discharge of drainage from the construction areas to the Cae Gwyn SSSI.

8.4.54 Soils would be managed as set out in the waste and materials management strategy of the Wylfa Newydd CoCP (Application Reference Number: 8.6). As set out in the Wylfa Newydd CoCP (Application Reference Number: 8.6) where soils would be stored for longer than 60 days, stockpiles will be seeded with an appropriate low-maintenance seed mix.

8.4.55 As shown in the air quality management strategy in the Main Power Station Site sub-CoCP (Application Reference Number: 8.7) hard surfaced haul routes would be damped down with fixed or mobile sprinkler systems, or mobile water bowsers, and cleaned regularly. All sites across the Wylfa Newydd Development Area would implement a wheel washing system (with rumble grids to dislodge accumulated dust and mud prior to leaving the site).

8.4.56 As set out in the water management strategy of the Wylfa Newydd CoCP (Application Reference Number: 8.6) Horizon will ensure that protection measures to control the risk of pollution to surface water are adopted, including the following:

- All deemed requirements of the Environmental Permitting (England and Wales) Regulations 2016.
- Any containers of contaminating substances on-site will be leak-proof and kept in a safe and secure building or compound from which they cannot leak, spill or be open to vandalism. The containers will be protected by temporary impermeable bunds (or drip trays for small containers) with a capacity of 110% of the maximum stored volume. Areas for transfer of contaminating substances (including refuelling areas) will be similarly protected and have appropriate spill kits.
- In addition, any permanent oil storage tanks and temporary storage of over 200L of oil in drums and mobile bowsers, as well as ancillary pipe work, valves, filters, sight gauges and equipment will be stored within secondary containment, e.g. bunding (Water Resources (Control of Pollution) (Oil Storage) (Wales) Regulations 2016) with a capacity of at least 110% of the maximum contents of the container's storage capacity.
- No fuel, oil or chemical substances will be stored within 15m of a watercourse.
- Above-ground pipework will be properly supported and underground pipework will be protected from physical damage and subject to adequate leakage detection. Mechanical joints on oil pipes would be inspectable. Oil and hydrocarbon underground pipes will not extend into the groundwater saturated zone without a risk assessment being undertaken.

8.4.57 As stated in the water management strategy of the Wylfa Newydd CoCP (Application Reference Number: 8.6) measures would be taken to prevent the deposition of silt or other material arising from work operations in existing watercourses or catchment areas. The measures will accord with the principles set out in industry guidelines, including NRW's Works and maintenance in or near or water: GPP 5 [RD27]. Measures include use and maintenance of temporary lagoons, tanks, bunds, silt fences or silt screens, as well as consideration of the type of plant used and the time of year for working in watercourses. Appropriate measures will be taken to protect erodible earthwork surfaces, such as the use of sheeting.

8.4.58 As stated in the water management strategy of the Wylfa Newydd CoCP (Application Reference Number: 8.6):

- All refuelling, oiling and greasing would take place above drip trays or on impermeable surfaces (e.g. plant nappy) with sealed drainage and an oil interceptor, which provides protection to underground strata and watercourses, and away from drains as far as is reasonably practicable. Vehicles and plant would not be left unattended during refuelling. Appropriate spill kits would be easily accessible during these activities.
- All construction equipment and vehicles will be maintained in line with manufacturer's instructions to ensure it is in good working order. Should any oil or fuel leaks occur, corrective action will be taken.
- Drip trays will be placed below static mechanical plant.
- All washing-down of vehicles (including wheel washing) and equipment will take place in designated areas and wash water will be prevented from passing untreated into watercourses and groundwater in accordance with NRW's GPP 13 [RD27] and subject to Environmental Permit requirements if discharged to controlled waters.
- NRW's GPP 5 [RD27] will be followed when carrying out maintenance of structures over water. Where practicable, only biodegradable hydraulic oils will be used in equipment working in or over watercourses.
- Appropriate measures will be taken to protect erodible earthwork surfaces.

8.4.59 As stated in the water management strategy of the Main Power Station Site sub-CoCP (Application Reference Number: 8.7) water used in the concrete batching plant for plant wash-down, cleaning and other similar activities will be recycled where possible (estimated to be 90% of the water used). Any excess water shall be tankered off-site for treatment and disposal at a permitted waste facility.

8.4.60 As stated in the water management strategy of the Main Power Station Site sub-CoCP (Application Reference Number: 8.7) for the watercourse realignment works on the Nant Caerdegog Isaf, a risk assessment will be undertaken, with relevant approval and consents for works from NRW.

8.4.61 The watercourse realignment will be constructed using techniques to control sediment release. These may include:

- leaving a minimum 2m 'plug' of uncut channel at either end of the new channel until all work is completed and the realigned section is ready to be connected to the existing stream;
- completing all works along the bank of the new channel prior to connecting to the existing channel;
- using plant with a low ground bearing pressure to avoid damage to newly dug banks;
- completing any revegetation as early as possible to reduce the potential for sediment from bare areas moving into the completed channel;
- compacting the stream bed sufficiently so that there is not substantial loose sediment to be entrained;
- removing the 2m plug from the downstream end prior to the upstream end;
- if flows are high, consider delaying connection; and
- pump water from upstream of the connection to downstream prior to breaking through, with gradual cessation in pumping once the connection is made.

Operation

Basis of assessment and assumptions

8.4.62 The aspects of the commissioning and operation works outlined below are relevant to surface water and groundwater receptors.

- Presence of the Power Station buildings, impermeable hardstanding and the Power Station Site surface water drainage and infrastructure. These buildings, hardstanding and drains would alter the natural recharge to groundwater and runoff to surface waters. The drainage systems of building and hardstanding areas would comprise drainage pipes, ditches and channels with surface water being discharged to the sea. In terms of the buildings and hardstanding areas, as set out in the it is assumed (based on designs in volume 2 of the Design and Access Statement, Application Reference Number: 8.2.2) that 90% or more of the developed Power Station Site would be impermeable, with 10% of the Power Station Site allowing rainwater infiltration.
- Presence of landscape mounds and associated mound drainage. Once the landscape mounds are vegetated and the risk of increased sediment loads to the watercourses has been reduced, the construction phase drainage system would be transitioned from the actively managed system during construction to a passive system. This passive system would remain in place for the operation of the Power Station. The drainage system of the landscaped areas post-construction has been developed

to ensure that surface water flows from landscaped areas outside of the Power Station platform would not impact on the platform itself. The ditches/swales created for drainage for the construction works around the landscape mounds would remain for the operational phase with the discharge points remaining the same. The settlement / attenuation ponds would remain but there would be no active treatment of the discharge. The concept design for surface water drainage in the landscaped areas post-construction is contained in appendix D8-8 (Application Reference Number: 6.4.33).

- Car parking areas and vehicular movements.
- Storage and use of fuels and oils (including waste oils) including that required for Emergency Diesel Generators and other emergency equipment. The principal storage of fuels as set out in Chapter D1 (Application Reference Number: 6.4.1) will be as follows:
  - The light oil tanks for the two emergency diesel generators would contain approximately 225,000L of fuel each (a total of 450,000L). The fuel day tank for each generator would contain approximately 20,000L of fuel. A lubricant oil system provides lubrication and cooling for the generators and the supply tanks for this oil would contain 7,100L of oil (one required for each emergency diesel generator).
  - The four Back-up Building Generators would each have a fuel oil day tank of approximately 8,000L and both tanks in each Unit will be fed from a common light oil tank which would contain approximately 170,000L of fuel. These generators would also have a lubricant oil system and the oil tank for each generator would contain 7,100L of oil.
  - There would be two Auxiliary Standby Generators and each generator would have a 240,000L fuel storage tank supplemented by a day tank at each generator location with eight hours' worth of fuel storage.
- A fuelling station would comprise an area of hardstanding within the southern part of the Power Station Site, which would contain a fuel pump for refuelling site vehicles.
- Storage and use of chemicals. In most cases the quantities of these chemicals are relatively small and storage would be in tins or drums rather than in bulk containers. Based on the design information in chapter D1 (Application Reference Number: 6.4.1) chemicals likely to be present in larger quantities are shown below.
  - Sodium hypochlorite (for biocide dosing) stored in bulk tanks in the cooling water pump house. Estimated storage volume of 600m^3 with an annual consumption of 31,200m^3.

  - Sodium nitrite (corrosion inhibitor) stored inside the reactor and turbine building. Estimated annual consumption of 500kg.
  - Ethylene glycol (antifreeze) to be held within stores and then added to the equipment.

- Collection, treatment and discharge of sewage. During operation all sewage would be piped to and treated at DCWW's Cemaes Waste Water Treatment Works and the treated effluent would be discharged to the sea via an existing consented discharge point. If required, process waste water would be disposed of following treatment via the cooling water outfall tunnel direct to the sea. These discharges are detailed in chapter D13 (Application Reference Number: 6.4.13).
- The waste and recycling facility (Conventional and Hazardous Waste Building and Conventional Waste Storage Compound) within the outer perimeter of the Power Station Site would be for conventional waste streams (such as fluorescent tubes, batteries, flammable liquids, paints, or aerosols) including a specific area for the storage of hazardous waste. The waste and recycling facility is likely to comprise a combination of containers such as wheelie bins and skips of varying sizes. The waste compound has been designed to be compliant with NRW's permit requirements and waste exemptions. The waste and recycling facility would have sealed drainage and hazardous waste would be suitably contained to prevent any spillages entering the drainage system.
- Construction of a spent fuel store in the south of the Power Station Site approximately 10 years after the start of the Power Station operation.

8.4.63 For the operation of the Power Station, no active groundwater dewatering of the ground outside of basements would be required. However, a passive (gravity) drainage system at approximately 6mAOD would be installed around the deep basements with water collected in the drain being directed to the sea. The inflow to this drainage system is likely to be limited by the shotcreting of the excavation walls following excavation.

8.4.64 All fresh water supplies for operation activities and to be used for potable purposes would be provided from the water main by DCWW. It is estimated that the typical potable water demand from DCWW mains would be 830m^3/day. During a single unit outage for planned maintenance, daily water requirements would rise to 2,330m^3/day. The water supply would be provided from within DCWW's existing licensed abstractions with no requirement for new abstractions or increase in licensed quantities for existing abstractions. There is no intention for surface water, groundwater or seawater to be abstracted by Horizon for supply of potable water specifically to meet the project demand for potable supply.

8.4.65 The cooling water used for the power station during operation would be abstracted from, and discharged back to, the marine environment and so is assessed in chapter D13 (Application Reference Number: 6.4.13).

8.4.66 No other effects on the freshwater environment would be present for the commissioning or operation of the Power Station as set out in chapter D1 (Application Reference Number: 6.4.1).

Embedded mitigation

8.4.67 As stated in the Wylfa Newydd Code of Operational Practice (CoOP) (Application Reference Number: 8.13) foul water discharge would be to existing DCWW Sewage Treatment Works and to on-site package treatment plants. Foul water would not be discharged to the fresh surface water environment.

8.4.68 As set out in the Wylfa Newydd Code of Operational Practice (CoOP) (Application Reference Number: 8.13), Horizon will develop a passive engineered drainage system by completion of construction as set out in the Landscape and Habitat Management Strategy. Such a drainage system will be managed in relation to sensitive ecological receptors and incorporate appropriate attenuation to prevent any increases to flood risk off-site and reduce significant effects on water availability.

Good practice mitigation

8.4.69 The Wylfa Newydd CoOP (Application Reference Number: 8.13) would set out the overarching pollution management principles to be applied throughout the operation of the Power Station, as set out below.

8.4.70 All fuel and chemical storage at the Power Station will be within engineered containment facilities, including (where appropriate) suitably bunded tanks, and will comply with the requirements of the project's Environmental Permit(s). As set out in the Mitigation Route Map (Application Reference Number: 8.14) any below-ground fuel storage tanks will comply with the Association for Petroleum and Explosives Administration's guidance including their 'Blue Book' [RD29] and will meet the requirements of The Environment Agency's approach to groundwater protection (which has been adopted by NRW) [RD30]. Above-ground fuel storage of over 200L will comply with the Water Resources (Control of Pollution) (Oil Storage) (Wales) Regulations 2016.

8.4.71 At all sites, storage areas for fuel and chemicals will be located more than 15m away from watercourses, and protected to avoid damage by plant and vehicles.

8.4.72 Operational pollution prevention controls will be defined at all sites and will include measures relating to:

- the designation of refuelling areas and areas handling liquid chemicals;
- operational controls around access to and use of refuelling and chemical storage facilities;
- regular inspection and maintenance of fuel and chemical storage facilities and associated equipment, including oil interceptors;
- spill response and clean-up procedures;
- regular maintenance of any on-site sewage pipes, and any on-site treatment systems or related sewage infrastructure;

- cleaning out of any sediment traps on the drainage system; and
- regular inspection of the parking areas for fuel and oils.

Decommissioning

Basis of assessment and assumptions

8.4.73 The Power Station Site would be landscaped and restored to an 'equivalent' land use and ecological condition to that prior to construction (i.e. as similar as possible to baseline, although recognising it would be impossible to exactly recreate previous situations). The decommissioning works as outlined below are relevant to surface water and groundwater receptors.

- Decommissioning of Unit 1 and Unit 2 would be undertaken simultaneously.
- All reactor buildings will be sealed with concrete according to the Decommissioning Strategy. Civil structures greater than 1m depth which contain voids would be left *in situ* and backfilled or grout filled, including the discharge water channel and the discharge water tunnels. The puncturing of basements below the bedrock and superficial groundwater table to allow groundwater to enter. Structures would be removed to 1m below site grade level. Structures below this level would be punctured to allow drainage, and voids below this level would be infilled with inert rubble/aggregate.
- Removal of hardstanding areas.
- Removal of operational drainage from the Power Station Site. All drainage systems, pipes and ducting located less than 1m below finished ground level would be removed and disposed of via a licenced process. Any uncontaminated drainage, pipework or ducting located greater than 1m below finished ground level would be flushed out and then grouted up.

8.4.74 In this assessment, it has been assumed that, following any necessary de-contamination, demolition would be as per any large civil demolition project using relatively standard techniques.

8.4.75 It has also been assumed that for the decommissioning of the Power Station, landscape mounds created during the construction of the Power Station would not be removed and the drainage system established during the operational phase around the landscape mounds would remain.

Embedded mitigation

8.4.76 Mitigation embedded into the design has been taken into consideration in determining the potential effects of the decommissioning works, although given that much of these works would not be undertaken for at least another 70 years, the mitigation measures have not been fully developed.

Landscaped areas outside of the Power Station Site, including landscape mounding and associated pasture and planting, will be retained, with no

removal of topsoil, or major earthworks. Following decommissioning, no major restoration works would therefore be required to areas outside of the Power Station Site, because landscaping created during construction would not be affected by decommissioning works. This is to be set out in a Decommissioning Plan.

Good practice mitigation

8.4.77 Good practice mitigation has been taken into consideration in determining the potential effects of the decommissioning works. For the purposes of this chapter, good practice mitigation to protect the surface water and groundwater environment would be largely the same as for the construction phase.

8.4.78 The Power Station Site, once hardstanding has been removed, would incorporate appropriate drainage channels. These would be installed in parallel with the removal of the operational Power Station drainage whenever practicable. This is to be set out in a Decommissioning Plan.

8.4.79 All reactor buildings will be sealed appropriately, for example, with concrete, according to relevant regulations at the time of decommissioning. This is to be set out in a Decommissioning Plan.

8.5 Assessment of effects

8.5.1 This section presents the findings of the assessment of effects associated with the construction, operation and decommissioning of the Power Station (including the cooling water system), the other on-site development (as detailed in chapter A2, Application Reference Number: 6.1.2) within the Wylfa Newydd Development Area, including the Site Campus.

8.5.2 A WFD compliance assessment has been undertaken in parallel with the assessment of the surface water and groundwater receptors detailed within this chapter. The potential compliance against the legislation as a consequence of the development of the Wylfa Newydd Development Area is provided in the WFD Compliance Assessment (Application Reference Number: 8.26).

8.5.3 As detailed in chapter B8 (Application Reference Number: 6.2.8), this assessment has adopted a precautionary approach. Due to uncertainties in some elements of the assessment, where there is a range of possible effects, the worst of the options is selected so that a level of conservatism is included. The MODFLOW computer model which is used to assess a number of groundwater effects is also conservative as it assumes, for example, that dewatering operations during construction would take place for an indefinite period and does not allow for any shotcreting in the deep excavations to seal the principal flowpaths.

8.5.4 An FCA (appendix D8-4, Application Reference Number: 6.4.29) has been undertaken for development proposed within the Wylfa Newydd Development Area. The method applied within the FCA to determine the significance of effect (which is informed by TAN 15 [RD6] as outlined in appendix D8-1.4 of the FCA) differs from the methodology used for this Environmental Impact Assessment (see section 8.4 in chapter B8, Application Reference Number:

6.2.8). The key differences relate to how the value of the receptor and the magnitude are assigned, which therefore drives slightly differing significances of effect. The FCA assigns the value of a receptor based on categories defined within TAN 15 that are specific to flood risk only and are not applicable to other aspects of surface water and groundwater. The FCA assigns an absolute magnitude to the flood hazard which includes, but is not confined to, the extent, depth and duration of flooding, and the velocity of flood waters. The Environmental Impact Assessment only considers the change to the flood risk that would be caused by the development.

8.5.5 In order to assess the flood risk consistently with other surface water and groundwater effects within this Environmental Statement, the following assessment of flood risk during operation of the Power Station considers changes that would potentially be caused by the development. The assessment therefore assigns a magnitude of change to the risk of flooding to receptors based on the method stated in chapter B8 (Application Reference Number: 6.2.8). The FCA is the key source of information for this assessment; however, given the difference in methods between the FCA and the Environmental Statement, the magnitude of change within this assessment is not directly comparable to the magnitude of hazard or flood risk within the FCA. Nevertheless, whilst the significance of effect may vary between the FCA and the Environmental Statement, the overall conclusions are consistent (i.e. significant or not significant effect).

Construction

8.5.6 The following sections provide an assessment of the effects specific to each receptor or group of receptors identified for surface water, fluvial geomorphology and groundwater.

Surface water

8.5.7 The value of the surface water receptors is given in table D8-5 which has identified that the value ranges from low for the Power Station Catchment up to high for the catchments in which there are SSSIs. These values are used in the assessment of effects detailed below. The key potential effects of construction on the surface water environment include issues relating to water quality, water availability and changes in flood risk. Potential effects have been assessed and where, following consideration of the embedded mitigation and good practice mitigation, potential effects of moderate or major significance are considered likely, these have been recorded within table D8-9. Where the embedded mitigation and good practice mitigation mean that potential effects would not be significant, these have been discounted.

8.5.8 To allow the discharge of water from the construction phase drainage scheme, an Environmental Permit issued by NRW would be required. To support the application for this permit, an “H1 assessment” has been undertaken [RD31] to determine the concentration of potentially polluting substances in the discharges, including metals, nutrients and polyelectrolyte. The modelling work has utilised the Environment Agency’s River Quality Planning (RQP) modelling package utilising predicted substance concentrations and flows

from each discharge pond and existing (measured) and predicted flows and water quality in the receiving watercourses. This assessment identifies that concentrations of bioavailable copper, iron and bioavailable lead and the nutrient orthophosphate could leach from soils and cause deterioration of the surface water quality for certain construction discharges. The assessment also shows that the concentration of polyelectrolyte used for the treatment of the discharged water to reduce sediment concentrations could cause deterioration of surface water quality (deterioration is defined here as causing the existing surface water quality to deteriorate by more than 10% of the EQS for that substance). Furthermore, the assessment shows that for orthophosphate the concentrations in the receiving watercourses could exceed the Annual Average EQS for this substance and for lead, the short term Maximum Acceptable Concentration, again only at certain locations. Where the H1 assessment has identified the potential for deterioration in water quality or exceedance of an EQS this is identified in the following sections for each catchment.

Tre'r Gof Catchment and Tre'r Gof SSSI

8.5.9 Almost the whole of the Tre'r Gof Catchment is within the Wylfa Newydd Development Area and there are a number of construction activities proposed within this area. However, no works would take place within the boundary of the Tre'r Gof SSSI. The activities within the Tre'r Gof Catchment, and activities which could potentially affect this catchment, include:

- site clearance and construction, operation and removal of temporary haul roads and car parks, including minor watercourse crossings;
- construction, operation and removal of the Site Campus, including installation and removal of drainage from the campus;
- demolition of Horizon site office and Existing Power Station visitor centre, and construction of a car park;
- construction, operation and removal of the Main Site Compound and satellite compounds and material compounds;
- construction and operation of drainage which would include drains to the south and east of the SSSI to manage runoff from landscape Mounds A and B (figure D8-4, Application Reference Number: 6.4.101);
- topsoil strip, storage and replacement;
- material storage areas and landscape mound creation;
- dewatering of deep excavations; and
- construction of the cut-and-cover section of the cooling water tunnels in the vicinity of Wylfa Head, although this is likely to be outside of the Tre'r Gof surface water catchment.

8.5.10 Some sections of the cooling water tunnels would not be constructed using cut-and-cover methods. They would likely be constructed by blasting and excavation or bored methods using a road header and are not anticipated to have an effect on Tre'r Gof Catchment.

8.5.11 A cut-and-cover section of the tunnel may be constructed at its northern end for around 200m, which would be outside of the Tre'r Gof surface water catchment and would not affect surface water flows to the SSSI. Based on the groundwater level contours for the superficial deposits, these excavations are also unlikely to affect shallow groundwater flows into the SSSI. If dewatering of the bedrock aquifer is required for the northern cut-and-cover section of the tunnel, drawdowns of groundwater levels in the bedrock at the Tre'r Gof SSSI could occur. However, as dewatering would be short-term (inflows would be sealed as tunnelling progresses) and only have a local effect, and bedrock groundwater inputs to the SSSI are a minor component of the SSSI's water balance, tunnel construction would not affect the Tre'r Gof SSSI overall water balance (see chapter D9, Application Reference Number: 6.4.9 for consideration of potential effects to plant assemblages within the SSSI).

8.5.12 The assessment has been completed on the basis of the Tre'r Gof SSSI being a naturally complex hydrological system and one in which there can be substantial variation in hydrological parameters over the short, medium and long-term. The SSSI is evolving and changing and it has been noted during site walkover surveys for example that the location of some seeps and flushes move even over short time periods. It is also recognised that there are considerable seasonal changes. This also influences the level of certainty that can be applied to the likely success of mitigation.

8.5.13 Potential effects from the above activities on surface water within the Tre'r Gof Catchment are summarised below.

- The landscape mounding and drainage would alter an area of the Tre'r Gof Catchment, resulting in changes to surface water flows within the catchment. These changes could particularly affect the south and west compartments of the Tre'r Gof SSSI, which are reliant on multiple sources of inflows (see appendix D8-5, Application Reference Number: 6.4.30). The hydrological 4Rs Model (4R) (see appendix D8-7 (Application Reference Number: 6.4.32) for further details) has quantified changes to water availability within the Tre'r Gof SSSI, and the summary of this can be found within appendix D8-7 (Application Reference Number: 6.4.32). The modelling results show that the mean change in outflow from the baseline to the construction scenario across the Tre'r Gof SSSI at VN5 (the outfall from the SSSI) is an increase of 129m^3/day. Negative change in flow has been modelled at one of the four inflow points within the SSSI at VN1 in the west compartment where a decrease of 59m^3/day is predicted. Based on the percentage impact of operation on the flow duration curve, the increase in flow of 129m^3/day (or 1.5l/s) presents a temporary change equivalent to +/-10% or more of the Q_{95}. This equates to a medium magnitude of change (see criteria for water availability in table B8-12 in chapter B8, Application Reference Number: 6.2.8). However, given the small size of the Tre'r Gof drains and intermittent flows which range throughout the year from dry to flood conditions, variable flow conditions are a key hydrological function of the Tre'r Gof

SSSI. The criteria for water availability in table B8-12 in chapter B8 (Application Reference Number: 6.2.8) is less applicable to such small, intermittent watercourses and therefore the magnitude of change on water availability within the Tre'r Gof SSSI is considered to be small (partly as the change in flows would be temporary and short-term). This would result in a moderate effect which is significant. As stated in chapter B8 (Application Reference Number: 6.2.8) due to uncertainty in the assessment of changes to water availability, the assessment of effect has taken a precautionary approach and so a moderate adverse rather than minor adverse significance of effect has been identified. Although the change represents an increase in water availability in Tre'r Gof, which could potentially be beneficial, as it is a change from baseline and there is uncertainty regarding the hydrological functioning of the SSSI, a precautionary approach is followed and a significant adverse effect has been ascribed.

- A potential reduction in water availability from diffuse seeps within the Tre'r Gof SSSI could have subsequent effects on the water quality of the SSSI. The inflow of shallow groundwater in the soils, superficial deposits and potentially the top of the bedrock into the SSSI brings mineral enriched water into the SSSI via a series of small springs, seeps and flushes. The subsequent build-up of calcium concentrations in the peat fen is an important supporting condition for rare plant communities within the SSSI (appendix D8-5, Application Reference Number: 6.4.30). A reduction in diffuse inflows could therefore reduce calcium concentrations within the SSSI, particularly in the west compartment where negative water availability has been modelled. The overall magnitude of change on the whole SSSI is assessed as small, with the resulting effect being moderate adverse. This is a significant effect. It should be noted that, despite the embedded mitigation (as described above) there is a high degree of uncertainty in the likely effectiveness of the drainage system. Therefore, the assessment of effect has taken a precautionary approach.
- Rainfall onto the exposed bare earth surfaces from site clearance, demolition of structures, haul roads, car parks, construction and subsequent removal of the Site Campus, soil storage and landscape mound creation could all result in a high sediment loading in runoff. This could affect water quality within the Tre'r Gof drains. There is a particular risk of high suspended sediment concentrations in runoff from Mound A and Mound B before vegetation is fully established. The drainage system would incorporate settlement ponds, ditches/swales and an oil separator from the Site Campus prior to discharge of runoff to the Tre'r Gof drains, and stone-filled trenches set below ground to aid natural dispersion of flows into the Tre'r Gof SSSI. Initially these gabions could have a filtering effect that would trap silt, and as they fill with silt they would promote the growth of vegetation which would act as a natural filter. During construction of the Site Campus surface water would run into drainage

channels to the east and west and discharge into attenuation ponds. However, it is possible that suspended sediment concentrations would increase in the Tre'r Gof drains due to the permitted discharge limit being exceeded at discharge point B1 for very short periods while the system responds and active treatment by dosing is implemented (i.e. there is a lag between sediment increasing and additional treatment being implemented, although where practicable, in such situations the discharge could be temporarily halted). In addition, it is possible that the annual sediment load could increase even when the permitted limit is not exceeded. This is because small rainfall events that do not currently result in elevated suspended sediment could result in elevated sediment during construction when the area to be mounded is exposed soil. Furthermore, there could be additional loading due to storms beyond the 1 in 2 year event that could result in increased sediment input to Tre'r Gof drains. With application of the water management strategy set out in the Wylfa Newydd CoCP (Application Reference Number: 8.6) and the Main Power Station Site sub-CoCP (Application Reference Number: 8.7) and management of suspended sediment within the drainage design, including the use of settlement ponds and treatment (see appendix D8-8 (Application Reference Number: 6.4.33) for further details), and taking uncertainty into account, the magnitude of change on water quality would be medium. The potential effect would therefore be major adverse, and is considered to be significant.

- Topsoil strip, movement and replacement could result in mobilisation of nutrients and potentially metals that are currently not exposed to leaching (soil leaching tests have identified that both nutrients and metals could exceed freshwater EQSs). Leaching tests have indicated that elevated concentrations of nutrients could be released from topsoil and these could therefore change water quality. The RQP modelling undertaken in [RD31] has identified that within the Tre'r Gof Catchment, discharges from the surface water treatment ponds could cause the concentration of the nutrient orthophosphate to exceed the Annual Average EQS. In addition, the metal lead could exceed the short term Maximum Acceptable Concentration. In the case of orthophosphate, the existing measured upstream concentration already exceeds the EQS. In addition, [RD31] also shows that potentially the discharges to the catchment of bioavailable copper, iron, bioavailable lead and polyelectrolyte (from chemical dosing for water treatment) could cause the exiting surface water quality in the receiving watercourse to deteriorate by more than 10% of the Annual Average EQS and for lead, 10% of the short term Maximum Acceptable Concentration. However, any effect would be limited to the time periods when topsoil was being disturbed and the majority of increase in nutrients may pass through the Tre'r Gof SSSI in the drainage ditches rather than entering the peat fen. Furthermore, there would only be a finite amount of leaching which would reduce

rapidly with time. The magnitude of any change would therefore be small, which would result in a minor adverse effect, which is not significant.

- The dewatering during construction of the Power Station would change groundwater levels and groundwater flow direction in the bedrock, which may result in effects on base flow to the SSSI. The potential effect of dewatering on the water flow is contained in the groundwater section of this chapter.

8.5.14 The following potential effects from construction activities have been assessed as likely to result in negligible effects and therefore are not significant.

- The magnitude of change on water quality from leaks and spillages of fuels or oils is considered to be negligible due to the application of buffer zones (ranging from 20m to 100m) and emergency management procedures in accordance with the environmental emergency management strategy set out in the Wylfa Newydd CoCP (Application Reference Number: 8.6). Therefore, the potential effect would be negligible.
- The magnitude of change caused by spillages of cementitious materials from construction of structures is considered to be negligible. This is due to the limited number of concrete structures to be built within the catchment, the use of pre-cast concrete where practicable and through application of the buffer zones along watercourses, specific risk assessment for use of cementitious material within 50m of a watercourse, and emergency management procedures in accordance with the environmental emergency management strategy set out in the Wylfa Newydd CoCP (Application Reference Number: 8.6). Therefore, as the magnitude of change is negligible, the potential effect would also be negligible.
- Leaks of sewage from the Site Campus could affect the nutrient balance within the Tre'r Gof SSSI. Emergency management procedures in accordance with the environmental emergency management strategy set out in the Wylfa Newydd CoCP (Application Reference Number: 8.6) would result in a negligible magnitude of change and a negligible effect. Foul sewage generated at the Site Campus would be discharged to the sea following treatment. On this basis the magnitude of change on (freshwater) surface water is considered to be negligible with the resulting effect also being negligible. Effects on the marine environment are considered separately in chapter D13 (Application Reference Number: 6.4.13).
- There is potential for adverse effects on water quality in Tre'r Gof drains from the use of polyelectrolytes for water treatment associated with drainage from Mound B, and potential for carry over into the SSSI. However, the system has been designed so that it would largely operate without chemical dosing (appendix D8-8, Application Reference Number: 6.4.33) and the chemical selected would have limited potential for carry

over. Providing that the water treatment systems are designed, maintained and managed appropriately, the magnitude of change and the effect would both be negligible.

- Increases to flooding could arise due to decreases in permeable area, increased steepness of the catchment, the creation of preferential flow pathways and flow constrictions at minor watercourse crossings within the Tre'r Gof Catchment. These effects have been assessed quantitatively with a pluvial flood model, which is summarised in the FCA in appendix D8-4 (Application Reference Number: 6.4.29). No fluvial modelling of the Tre'r Gof Catchment was undertaken. The pluvial model has taken into account mitigation through the drainage design and permeable surfacing for tracks and haul roads, where practicable. The drainage has been designed to prevent increased runoff rates and changes to shallow groundwater recharge by restricting off-site discharge to greenfield rates (as outlined in appendix D8-8, Application Reference Number: 6.4.33). The quantitative model outputs relate to the specific locations of drainage features, therefore it has not been reflective of flood risk to compare the construction phase (including drainage features) with the baseline (excluding drainage features). Instead, flood depth mapping outputs (appendix D8-4, Application Reference Number: 6.4.29) have been assessed to indicate the magnitude of change to flood risk. The mapping indicates that the magnitude of change is negligible and therefore not significant.

Afon Cafnan Catchment including Cae Gwyn SSSI

8.5.15 The construction works would only take place in a small percentage (approximately 12%) of the Afon Cafnan Catchment but the works would potentially affect the Afon Cafnan, Nant Caerdegog Isaf (including the realigned section of this watercourse) and unnamed tributaries and drains. The activities which could affect this catchment, include:

- site clearance, including demolition of buildings, walls, Cemlyn Road and removal of trees;
- construction, operation and removal of the Main Site Compound and satellite compounds and material compounds, construction offices and parking areas;
- construction of car parking and simulator and training building;
- construction of security access and site entrance plaza;
- creation and operation of laydown areas;
- construction, operation and removal of temporary haul roads, including temporary crossing of the Afon Cafnan and minor watercourse crossings;
- material storage areas and landscape mound creation (Mounds B, C, D and E);

- bulk earthworks including creation of platform levels for Unit 1 and Unit 2;
- dewatering of deep excavations; and
- construction of drainage, including temporary diversion of flow from the western side of Mound E, which would have discharged into Nant Cemlyn, being diverted to the Afon Cafnan.

8.5.16 Potential effects from the above activities on surface water within the Afon Cafnan Catchment are summarised below.

- Water availability in the Afon Cafnan Catchment may be affected due to construction of laydown areas, creation of platform levels, construction of facilities (including the simulator and training building), creation of mounds and the drainage. The hydrological 4R model has quantified potential changes to water availability within the Afon Cafnan Catchment, and the summary of this can be found within appendix D8-7 (Application Reference Number: 6.4.32). The modelling results show that the mean change in flow duration from the baseline to the construction scenario at the downstream point on the Afon Cafnan Catchment (Caf11) is a decrease in flow of 424m^3/day. All except one of the 11 points modelled on the Afon Cafnan were found to have a reduction in flow. Based on the percentage impact on the flow duration curve, the decrease in flow of 424m^3/day (or 4.9l/s) represents a temporary change equivalent to less than +/-10% of the Q_{95}. This equates to a small magnitude of change (see criteria for water availability in table B8-12 in chapter B8, Application Reference Number: 6.2.8) which would result in a minor adverse effect. This is not a significant effect. It should be noted that due to uncertainty in the assessment of changes to water availability, the assessment of effect has taken a precautionary approach. It should also be noted that the predicted reduction in flow in the Afon Cafnan excludes the temporary increase due to diverting flow from the western side of Mound E from Nant Cemlyn into Afon Cafnan. This would partly offset the reduction in flow. A sensitivity model run (as reported in section 7.5 of appendix D8-7 (Application Reference Number: 6.4.32) was undertaken to assess the temporary effect on river water levels of moving the runoff from the western side of Mound E to discharge point E2 on the Afon Cafnan. This indicated a change in level of between 0.07m to 0.01m depending upon the return period and location modelled.
- The landscape mounding would locally increase the steepness of land surfaces and the drainage and haul roads would provide preferential flow pathways for surface water. All factors would alter the rainfall/runoff response, and could result in a decrease in the long-term base flow to the Afon Cafnan. In addition, where practicable, permeable surfacing would be used on minor roads, haul roads, compounds and laydown areas. The surface water drainage system has been designed to provide sufficient attenuation to control surface water flows. However, landscape

mounding may have localised effects on water availability to Nant Caerdegog Isaf. The magnitude of change has been assessed as small, with the resulting effect being minor adverse meaning it is not significant.

- The construction of the laydown areas and drainage would result in the loss of the natural catchment of a small tributary of the Nant Caerdegog Isaf. As the tributary is small with very low flow in comparison to that in Nant Caerdegog Isaf, the magnitude of change to the Nant Caerdegog Isaf has been assessed as small, with the resulting effect being minor adverse, which is not significant.
- The provision of welfare facilities may carry the risk of leaks of sewage, which could cause degradation of water quality in any adjacent watercourses. However, timely maintenance of facilities and regular checking of pipes for leaks, as well as emergency management procedures, in accordance with the environmental emergency management strategy set out in the Wylfa Newydd CoCP (Application Reference Number: 8.6) would reduce the risk of leaks. The magnitude of change for this effect has been assessed as small, with the resulting effect being minor adverse, which is not significant.
- Rainfall onto the exposed bare earth surfaces (topsoil strip, bulk earthworks, storage, mound creation and all construction activities) and in-channel works could result in high sediment loading in runoff, which could affect the water quality within the catchment. It is planned that during the construction phase the drainage system would include soil management, silt fences, silt traps, swales and settlement ponds and, if required, other pollution control features including chemical dosing, allowing sediment to be retained before flows are discharged to the surrounding surface water features. However, there is the potential that an effect could still occur under some scenarios. For example, in the event that finer particles are abundant in a section of mounding that is exposed during an extended period of rainfall, and it is considered appropriate to undertake chemical dosing to achieve a discharge level equivalent to the proposed construction Environmental Permit limit only (i.e. 40mg/l to 70mg/l during normal rainfall events), then this may result in an increase in the annual sediment loading. In addition, rainstorms greater than the 1 in 2 year event could result in increased loading to the Afon Cafnan. This would in turn affect water quality in comparison to baseline. Our approach in the assessment methodology is, where there is absence of information, to adopt a highly precautionary approach. Since the drainage design is still in development and that there are some unknowns, for the purpose of this assessment we have concluded that the magnitude of change to water quality could be medium (following a precautionary approach the significance of effect has been assessed assuming a medium magnitude of change) and consequently the resulting effect is concluded as being moderate adverse. This is a significant effect.

- There is the potential that metals and nutrients could leach from topsoil, used at the surface of the landscape mounds or temporarily stored in the catchment as they are stripped from the area. These dissolved phase substances could then be discharged to watercourses in the catchment. The RQP modelling undertaken in [RD31] has identified that within the Afon Cafnan Catchment, discharges from the surface water treatment ponds could cause the nutrient orthophosphate to exceed the Annual Average EQS, although the existing measured upstream concentration already exceeds the EQS. In addition, [RD31] also shows that potentially the discharges to the catchment of bioavailable lead and orthophosphate could cause the existing surface water quality in the receiving watercourse to deteriorate by more than 10% of the Annual Average EQS and for lead, 10% of the short-term Maximum Acceptable Concentration. However, any release would be limited to 'first flush' during topsoil movement (assuming that it rains sufficiently to exceed any soil moisture deficit at the time of movement), would only apply to seepage water (rather than direct runoff) and would be subject to dilution by runoff and in the Afon Cafnan. Once topsoil is removed there would be no further potential leaching as the glacial drift and bedrock is low in metals and nutrients. As such, the magnitude of change is considered to be small and the effect on watercourses within the catchment would be minor adverse. This is not a significant effect.
- Increases to flooding could arise due to decreases in permeable area, increased steepness of the catchment, the creation of preferential flow pathways and flow constrictions at minor watercourse crossings within the Afon Cafnan Catchment. These effects have been assessed quantitatively with fluvial and surface water flood models, which are summarised in the FCA in appendix D8-4 (Application Reference Number: 6.4.29). The models have taken into account mitigation through the drainage design and permeable surfacing for tracks and haul roads, where practicable, but not the temporary diversion from the western side of Mound E. The drainage has been designed to prevent increased runoff rates and changes to shallow groundwater recharge by restricting off-site discharge to greenfield rates (as outlined in appendix D8-8, Application Reference Number: 6.4.33). The modelling results indicate that there are increases to flood depths where Cemlyn Road crosses the Afon Cafnan and to land adjacent to the realigned section of Nant Caerdegog Isaf. The increases in fluvial flood depths during the 1 in 100 year event are 0.14m and 0.06m, respectively, whilst the increases in surface water flood depths are 0.12m and 0.04m, respectively (appendix D8-4, Application Reference Number: 6.4.29). In both instances the flood extents do not change significantly. The magnitude of change associated with these depth increases is medium. With Cemlyn Road being assigned a high value, the significance of effect would be major adverse. However, flood depths on Cemlyn Road would remain below 0.3m, hence

allow passage of vehicles. In addition, after the granting of the Development Consent Order the property at Cafnan that is accessed by Cemlyn Road at this point would become owned by Horizon and it would also be unoccupied during the construction period. Use of the road is likely to be limited to construction related traffic, and therefore exposure to this increased flood risk is expected to be significantly reduced. No additional mitigation measures are therefore proposed. For the land at Nant Caerdegog Isaf the increase in flood depths (up to 0.06m) would not alter the use of the land adjacent to the watercourse as the land is part of the buffer within which construction works are generally excluded. The magnitude of change in flood depths and increase in flood risk on the land adjacent to Nant Caerdegog Isaf is therefore not significant and no further mitigation is required. This assessment excludes the effect of the temporary pumping from discharge point E1 to E2 (see figure D8-4 in Application Reference Number: 6.4.101). As indicated above, a sensitivity model (see section 7.5 in appendix D8-7, Application Reference Number: 6.4.32) has been run for this scenario and it indicates an increase in stream level at Cemlyn Road of up to 0.07m for the 1:30 year AEP. Downstream of Cemlyn Road the modelled effect is predicted as up to 0.03m for the 1:30 year AEP. Although the diversion is temporary the sizing of the attenuation pond for the E1 discharge would be reviewed at detailed design and may be increased to provide a higher level of attenuation of flows into the Afon Cafnan.

8.5.17 The following have been assessed as likely to result in negligible effects on the Afon Cafnan Catchment, and therefore are not significant effects.

- Degradation of water quality could occur through leaks and spillages of fuels or oil from construction plant. This could affect downstream watercourses and features. However, through application of a buffer zone and the environmental emergency management strategy set out in the Wylfa Newydd CoCP (Application Reference Number: 8.6) and the water management strategy set out in the Main Power Station Site sub-CoCP (Application Reference Number: 8.7) (including measures such as establishing a buffer zone, the provision of spill kits and defined areas for fuel storage) the magnitude of change is considered to be negligible. The resulting effect would therefore be negligible.
- The spillage of cementitious materials from construction is also considered to have a negligible magnitude of change and a negligible effect. This is due to many concrete structures being pre-cast off-site, while on-site concrete batching would take place outside the catchment and concrete would be brought to the catchment as and when needed. In addition, there would be bespoke risk assessments for any activities using cement within 50m of a watercourse.
- Increases to flooding could arise due to decreases in permeable area due to construction works, increased steepness of the catchment, the

creation of preferential flow pathways and minor watercourse crossings restricting flow. With the exception of the Cemlyn Road where it crosses the Afon Cafnan, these effects have all been mitigated through the drainage design and these effects have been assessed quantitatively with a flood model, which is summarised in the FCA in appendix D8-4 (Application Reference Number: 6.4.29). The drainage has been designed to prevent increased runoff rates and changes to shallow groundwater recharge by restricting off-site discharge to greenfield rates. There is a negligible change in pluvial flood depths within the Afon Cafnan Catchment in rainfall events up the 1 in 100 year event. The magnitude of change to flood risk has been assessed as negligible with the resulting effect being negligible.

- The realignment of part of Nant Caerdegog Isaf would be constructed using techniques to control sediment release, such as not connecting the realigned section until it is complete, opening the downstream end first and pumping water around the upstream end of the aligned section whilst the realigned section is connected. It would also be designed to provide floodplain storage up to the 1 in 100 year event (including climate change projections) preventing flood increases off-site. On this basis the magnitude of change to water quality has been assessed as negligible with the resulting significance of effect being negligible.
- There is potential for adverse effects on water quality in the Afon Cafnan from the use of polyelectrolytes for water treatment and potential for carry over. However, the system has been designed so that it would largely operate without chemical dosing (appendix D8-8, Application Reference Number: 6.4.33) and the chemical selected for dosing would have limited potential for carry over when used correctly. Providing that the water treatment systems are designed, maintained and managed appropriately, the magnitude of change and the effect would both be negligible.

Cae Gwyn SSSI

8.5.18 No works would take place within the boundary of the Cae Gwyn SSSI. However, the activities taking place nearby which could affect the SSSI include the following.

- Clearance of topsoil for landscape mounding within a small part of the Wylfa Newydd Development Area to the east of the Cae Gwyn SSSI.
- Landscape mound creation (Mound C) within the Cae Gwyn SSSI topographic catchment area. This is potentially within the catchment area of the primary outfall basin (see appendix D8-6, Application Reference Number: 6.4.31 for the extent of this area) rather than the whole of the Cae Gwyn SSSI, although there is some uncertainty regarding this. It is possible that the catchment outside and to the east of the SSSI drains directly to drains or to the Nant Caerdegog Isaf such that mound creation would only alter water movement into the SSSI to a small degree.

- Construction of car parking within the Cae Gwyn SSSI topographic catchment area and potentially within the catchment area of the primary outfall basin.

8.5.19 Potential effects from the above activities on surface water within the Cae Gwyn SSSI are summarised below.

- The SSSI is at the upstream end of Nant Caerdegog Isaf and direct rainfall and surface water runoff from the immediately surrounding area provide the only surface water inflow into the Cae Gwyn SSSI (see appendix D8-6, Application Reference Number: 6.4.31). During dry periods the water table drops so that any base flow that discharges to Cae Gwyn SSSI in winter declines in summer. Thus, the dry period is important as this is the time when the potential for effects on the SSSI are greatest. Although there could be a minor groundwater inflow component (and groundwater inputs may be locally important for particular plant assemblages), this is unlikely to be substantial given the elevation and location of the SSSI. There could be some changes to the catchment area due to the construction of Mound C. However, as noted above, this is likely to have minimal effect on the primary outfall basin. Taking into account the uncertainties highlighted above, the potential magnitude of change to water flows to the primary outfall basin and to the rest of the Cae Gwyn SSSI is therefore likely to be small with the significance of effect being minor. This is not a significant effect.

8.5.20 The following have been assessed as likely to result in negligible effects, and therefore are not significant.

- There is little if any risk to water quality from leaks and spillages of fuels or oils as no construction works would take place within up to 15m of the Cae Gwyn SSSI and it is up hydraulic gradient of the majority of the Wylfa Newydd Development Area. Furthermore, with application of pollution management principles as set out in the water management strategy of the Wylfa Newydd CoCP (Application Reference Number: 8.6), the magnitude of change is assessed as negligible with the resulting effect being negligible.
- As the majority of construction works are downstream of the Cae Gwyn SSSI, there would be no flood risk effects on the SSSI.

Cemaes Catchment

8.5.21 There are few construction activities occurring within the Cemaes Catchment, and only a small part of the Cemaes Catchment (approximately 5%) is within the Wylfa Newydd Development Area. The activities within this area which could affect the catchment include:

- site clearance and topsoil strip;
- construction and operation of drainage, which would include construction of a drainage outfall; and

- landscape mound creation.

8.5.22 Potential effects from the above activities on surface water within the Cemaes Catchment are summarised below.

- Creation of the landscape mound may affect water availability within the catchment. The hydrological 4R model has quantified potential changes to water availability within the Cemaes Catchment, and the summary of this can be found within appendix D8-7 (Application Reference Number: 6.4.32). The modelling results show that the mean change in flow duration from the baseline to the construction scenario across the Cemaes Catchment (Cae7) is a decrease of 166m^3/day. All except one of the seven points modelled were found to have a reduction in flow. Based on the percentage impact on the flow duration curve, the decrease in flow of 166m^3/day (or 1.9l/s) represents a temporary change equivalent to less than +/-10% of the Q_{95}. This equates to a small magnitude of change (see criteria for water availability in table B8-12 in chapter B8, Application Reference Number: 6.2.8) which would result in a minor adverse effect, meaning it is not significant. It should be noted that due to uncertainty in the assessment of changes to water availability, the assessment of effect has taken a precautionary approach.
- Rainfall onto the exposed bare earth surfaces (site clearance, topsoil strip, bulk earthworks and landscape mound creation) and in-channel works could result in high sediment loading in the runoff from the Cemaes Catchment, which would affect the water quality within the catchment. It is planned that during the construction phase the drainage system would include drainage trenches that would incorporate settlement ponds and other pollution control features, allowing sediment to be retained before flows are discharged to the Nant Cemaes. However, there is the potential that an effect on water quality could still occur, either due to delays in implementing active water treatment systems following the on-set of rainfall, or due to the proposed 40mg/l limit being met for a 1 in 1 year storm event, but annual sediment loading increasing thereby affecting water quality in comparison to baseline. Therefore, considering this embedded mitigation, taking into account uncertainty, the magnitude of change to water quality has been assessed as small to medium, with the resulting effect being moderate adverse. This is a significant effect.
- There is the potential that metals and nutrients could leach from topsoil used at the surface of the landscape mounds. These dissolved phase substances could then be discharged to watercourses in the catchment. The RQP modelling undertaken in [RD31] has identified that within the Nant Cemaes Catchment, discharges from the surface water treatment ponds could cause the nutrient orthophosphate to exceed the Annual Average EQS, although the existing measured upstream concentration already exceeds the EQS. In addition, [RD31] shows that potentially the discharges of lead to the catchment could cause the existing surface

water quality in the receiving watercourse to deteriorate by more than 10% of the short-term Maximum Acceptable Concentration. However, any release would be limited to first flush during topsoil movement (assuming that it rains sufficiently to exceed any soil moisture deficit at the time of movement), would only apply to seepage water (rather than direct runoff) and would be subject to dilution by runoff and dilution in the Nant Cemaes. As such, the magnitude of change is considered to be small for nutrients and negligible for metals with the effect on watercourses within the catchment being minor adverse for nutrients and negligible for metals. This is not a significant effect.

- Increases to flooding could arise due to decreases in permeable area, increased steepness of the catchment, the creation of preferential flow pathways and flow constrictions at any minor watercourse crossings downstream within the Cemaes Catchment. These effects have been assessed quantitatively with fluvial and surface water flood models, which are summarised in the FCA in appendix D8-4 (Application Reference Number: 6.4.29). The models have taken into account mitigation through the drainage design and permeable surfacing for tracks and haul roads, where practicable. The drainage has been designed to prevent increased runoff rates and changes to shallow groundwater recharge by restricting off-site discharge to greenfield rates (as outlined in appendix D8-8, Application Reference Number: 6.4.33). The modelling results indicate that there are increases in flood depths to land and residential properties upstream of Cemaes village including Brookside Garages and on Ffordd Y Traeth, which are already at risk of flooding. Increases in fluvial flood depths are predicted to be 0.04m during the 1 in 100 year event, whilst increases in surface water flood depths are 0.05m during the same event (appendix D8-4, Application Reference Number: 6.4.29). In both instances the flood extent does not change significantly. Despite minimal changes on flood extent and a small absolute change in flood depth, any increase in flood depth presents an increased risk of flooding to a residential property. The magnitude of change in flood depth is therefore small to medium. With residential properties being a high value flood risk receptor (appendix D8-4, Application Reference Number: 6.4.29) the significance of effect would be major adverse and this would be a significant effect. There is no change in fluvial flood risk to residential properties within Cemaes village itself but there is a small magnitude of change to surface water flood depths (a decrease in water depth of up to 0.07m). This is because Mound A drainage alters the surface water flow path and conveys surface water to the east towards the sea and around Mound A to the north.

8.5.23 The following have been assessed as likely to result in negligible effects, and are therefore not significant.

- Degradation of water quality could occur through the leaks and spillages of fuels or oil from construction plant. This could affect downstream

watercourses and features. However, through application of buffer zones and the water management strategies set out in the Wylfa Newydd CoCP (Application Reference Number: 8.6) and Main Power Station Site sub-CoCP (Application Reference Number: 8.7) including measures such as limited use of machinery in close proximity to watercourses, the provision of spill kits and defined areas for fuel storage, the magnitude of change is considered to be negligible, with the resulting effect being negligible.

- The spillage of cementitious materials from construction is considered to have a negligible magnitude of change and a negligible significance of risk. This is due to the very limited use of concrete in this catchment and the concrete surface water outfall structure being pre-cast off-site.
- Increases to flooding could arise due to decreases in permeable area, increased steepness of the catchment, the creation of preferential flow pathways and minor watercourse crossings restricting flow. These effects have all been mitigated through the drainage design, in particular incorporation of an attenuation pond in the discharge to the Nant Cemaes. These effects have been assessed quantitatively with a flood model, which is summarised in the FCA in appendix D8-4 (Application Reference Number: 6.4.29). The drainage has been designed to prevent increased runoff rates and changes to shallow groundwater recharge by restricting off-site discharge to greenfield rates. With the exception of the properties upstream of Cemaes village (outlined above) there is a negligible change in pluvial flood depths within the Cemaes Catchment in rainfall events up to the 1 in 100 year event. The magnitude of change to flood risk has been assessed as negligible with the resulting effect being negligible.

Cemlyn Catchment and the Cemlyn Bay SSSI

8.5.24 Nant Cemlyn and a small drain (which falls outside of the study area) flow into Cemlyn Lagoon which forms part of the Cemlyn Bay SSSI, SPA and SAC. Given this, the Nant Cemlyn and the lagoon have been assessed together. Cemlyn Lagoon is a coastal lagoon with a brackish environment and is assessed in this chapter and in chapter D13 (Application Reference Number: 6.4.13) to ensure that all potential effects are assessed. In particular, this chapter focusses on the area within the lagoon where the Nant Cemlyn flows into it.

8.5.25 There are few construction activities occurring within the Cemlyn Catchment, and only a small part of the Cemlyn Catchment (approximately 5%) is within the Wylfa Newydd Development Area. The activities within this small area which could affect these receptors are outlined below.

- Site clearance and topsoil strip.
- Construction and operation of drainage which would involve construction of an outfall at location E1 (figure D8-4, Application Reference Number: 6.4.101) on the Nant Cemlyn as well as temporary pumping infrastructure. This outfall would only be used once the western side of

Mound E is vegetated and there is no risk of high suspended solids due to construction discharging to the watercourse. Whilst the risk of sediment mobilisation from Mound E exists, all surface runoff from Mound E would be gravity drained or pumped, treated and discharged to the Afon Cafnan, either at discharge point E2 (figure D8-4, Application Reference Number: 6.4.101), or potentially further downstream in order to manage flood risk (see below). This would be a temporary diversion in place only whilst there are earthworks on the western side of Mound E and there is a risk of increased sediment in runoff.

- Landscaping mound creation.

8.5.26 Potential effects from the above activities on surface water within the Cemlyn Catchment and the Cemlyn Bay SSSI are summarised below.

- The landscape mounding has been designed to avoid changes in catchment boundaries as far as practicable. The hydrological 4R model has quantified any changes to water availability within the Cemlyn Catchment, albeit excluding the temporary diversion of flow from the western side of Mound E to the Afon Cafnan. A summary of the 4R model is presented in appendix D8-7 (Application Reference Number: 6.4.32). The modelling results show that the mean change in flow duration from the baseline to the construction scenario at the downstream point on the Cemlyn Catchment (Cem4) prior to inflow into the Cemlyn Lagoon is an increase of 51m^3/day (or 0.6l/s). Based on the percentage impact on the flow duration curve, this increase in flow represents a temporary change equivalent to less than +/-10% of the Q_{95}. This equates to a small magnitude of change with regard to water availability in the catchment (see criteria for water availability in table B8-12 in chapter B8, Application Reference Number: 6.2.8) which would result in a minor adverse effect on the Nant Cemlyn and the Cemlyn Lagoon. This effect is not significant. The magnitude of this effect would be reduced by operation of the pumping infrastructure during construction to convey runoff from the western side of Mound E to discharge point E2 on the Afon Cafnan. A model sensitivity run (section 7.5 in appendix D8-7, Application Reference Number: 6.4.32) was completed to assess the effect of pumping from the western side of Mound E to discharge point E2 on the Afon Cafnan. This indicated that the potential change in depth at CemL7 on the Nant Cemlyn downstream of the outflow at E1 would be a reduction of between 0.01 and 0.02m for the 1 in 100 year event for pluvial and fluvial scenarios. The effect would therefore remain as minor adverse.
- As stated in the Shadow Habitats Regulations Assessment (Application Reference Number: 5.2), the volume of inflow from the Nant Cemlyn to the Cemlyn Lagoon is small in comparison to the size of the lagoon. The minimum flow recorded was 0.1l/s in September 2016 (appendix D8-1, Application Reference Number: 8.4.26), whilst the Q_{95} is about 4l/s.

However, only about 5% of this is derived from the western side of Mound E so the flow contribution from this area to the lagoon is very small. The effect on salinity is less than 1% (Shadow Habitats Regulations Assessment, Application Reference Number: 5.2) based on a 15 day period to account for the tidal effect. Therefore, the change in the volume of freshwater inflow from the Nant Cemlyn would not have a significant effect on salinity, even close to the point where the Nant Cemlyn flows into the lagoon. In addition, any changes would be small compared to changes caused by rainfall events of varying magnitude and seasonal changes. Therefore, the magnitude of change of inflow to Cemlyn Lagoon on water availability and salinity is predicted to be small, with a minor significance of effect meaning it is not significant. It should be noted that due to uncertainty in the assessment of changes to water availability, the assessment of effect has taken a precautionary approach.

8.5.27 The following has been assessed as likely to result in negligible effects, and are therefore not significant.

- There would be no discharge from Mound E to the Nant Cemlyn until the earthworks on the western side of the mound are complete and the mound is vegetated and there is no risk of sediment inflow above that which could occur naturally. The magnitude of change and the effect of suspended sediment on the Nant Cemlyn and Cemlyn Lagoon would therefore both be negligible.
- There would be no discharge from Mound E to the Nant Cemlyn until all topsoil movement and placement is complete and the mound is vegetated. The magnitude of change and the effect of leaching of nutrients and metals from topsoil on the Nant Cemlyn and Cemlyn Lagoon would therefore both be negligible.
- There would be no treated water discharged to Nant Cemlyn so there is no potential for carry over of polyelectrolytes into Nant Cemlyn or Cemlyn Lagoon.
- The fluvial modelling results indicate that there is an increase in flood risk (increase in water depth of 0.02m in the 1 in 100 year event) at the outfall of the Nant Cemlyn into Cemlyn Lagoon (see appendix D8-4, Application Reference Number: 6.4.29) for details). As the increase in flood level in the Nant Cemlyn is relatively small and the size of the Cemlyn Lagoon is large in comparison to the Nant Cemlyn, the potential magnitude of change in water level in the lagoon is negligible and the flood risk to Cemlyn Lagoon is therefore also negligible. The significance of effect is therefore negligible to minor adverse, which is not a significant effect. The surface water flood depth at the outfall decreases by 0.02m during the 1 in 100 year event. The reason for this decrease in depth is because Mound E alters the surface water flow path.

Power Station Catchment

8.5.28 The Power Station Catchment is within the Wylfa Newydd Development Area and the majority of the catchment would be subject to construction works as it is the site of the Power Station and associated infrastructure, including:

- establishment of construction site compounds, offices and welfare facilities;
- bulk earthworks including creation of platform levels for cooling water intake, Unit 1, Unit 2, laydown areas and buildings associated with operation of the Power Station;
- deep excavation of Unit 1 and Unit 2, and other features (including cooling water tunnels);
- marine construction activities including construction of the MOLF, and associated land-based works;
- construction of Unit 1 and Unit 2 reactor and control buildings; and
- construction of the spent fuel store and radioactive waste storage and processing facilities.

8.5.29 Prior to most of the above activities occurring, establishment of the construction phase drainage would result in the loss of the natural catchment of Nant Porth-y-pistyll. The drainage system has been designed to accommodate the flows that would have been received by Nant Porth-y-pistyll and any remaining surface flows would drain directly to the coast via settlement ponds. Despite the embedded mitigation to compensate for the loss of Nant Porth-y-pistyll, the total loss of the watercourse and its catchment would result in a large magnitude of change, but due to the low value of this watercourse the significance of the effect would be minor adverse. This is not a significant effect.

8.5.30 The magnitude of change on water quality due to leaks and spillages of fuels or oils is considered to be negligible through application of emergency management procedures in accordance with the environmental emergency management strategy set out in the Wylfa Newydd CoCP (Application Reference Number: 8.6). There would be secondary containment systems in fuel, oil and chemical storage areas with the engineered facilities following good practice and meeting statutory requirements (including the Oil Storage Regulations and Environmental Permitting guidance [RD32]). Due to the low value of this watercourse the significance of the effect would be negligible which is not a significant effect.

8.5.31 As this catchment drains to the coast and there are no remaining water features in the area, the main receptor for the above activities is the marine environment. Effects on the marine environment are assessed separately in chapter D13 (Application Reference Number: 6.4.13).

Other areas

8.5.32 Areas within the study area adjacent to the coast, and not within the catchments defined above, are believed to drain informally directly to the sea. The construction activities proposed within these areas include:

- construction of the concrete batching plant in the north-west of the Wylfa Newydd Development Area; and
- construction of the cooling water intakes and outfalls.

8.5.33 Due to their locations, neither the cooling water intakes and outfalls nor the concrete batching plant would affect the (fresh) surface water environment. As such, these areas have not been assessed further in this chapter. Effects on the marine environment are assessed separately in chapter D13 (Application Reference Number: 6.4.13).

Fluvial geomorphology

8.5.34 The value of the fluvial geomorphological receptors is given in table D8-5 which has identified that the value ranges from low to medium. This section presents the findings of the assessment of potential effects from works within the Wylfa Newydd Development Area to the identified fluvial geomorphology receptors with any effects identified as being moderate or greater, pre-additional mitigation, summarised in table D8-10.

Tre'r Gof SSSI drains

8.5.35 One new outfall would discharge into the Tre'r Gof SSSI drains (discharge point B1 which then discharges to the SSSI via a culvert at monitoring point VN1). However, this would be discharged to an existing culvert and would not require a new headwall structure and channel modification during construction. However, there is the potential for fine sediment input into the channel from in-channel construction and removal of riparian vegetation. The discharge from the outfall during construction would increase the quantity of water and alter flow and sediment processes in the drains, particularly during high flow conditions. However, due to the modified nature of the existing channel, the re-use of an existing structure and the implementation of the water management strategies set out in the Wylfa Newydd CoCP (Application Reference Number: 8.6) and the Main Power Station Site sub-CoCP (Application Reference Number: 8.7) (including sediment management such as silt fences) during the construction period, the magnitude of change is considered to be small. Combined with a low receptor value, this results in a minor adverse effect, which is not significant.

8.5.36 In addition, there would be the potential for fine sediment input from bare earth surfaces within the vicinity of the Tre'r Gof SSSI drains during construction. Changes to overland flow paths from modifications to the land surface would also potentially alter flow and sediment processes within the channels. Due to the inclusion of a 15m buffer around watercourses draining into the SSSI, and the use of an existing structure (thereby minimising the extent of in-channel working) the potential magnitude of change is considered to be small. Combined with a low receptor value, this results in a minor adverse effect, which is not significant.

Afon Cafnan

8.5.37 Three new outfall structures are proposed along the Afon Cafnan. These would require in-channel working for construction, as well as the removal of a

short length of the vegetated riparian corridor and the adjoining channel banks. Fine sediment would be likely to enter the channel from the works. As the outfalls begin to discharge there would be the potential to alter flow processes (and consequently sediment processes) within the channel. This would lead to scour around the structure and of the opposite bank. The presence of the physical outfall structures would remove a small length of natural bed and bank, as well as riparian vegetation during construction.

8.5.38 With the implementation of the water management strategies set out in the Wylfa Newydd CoCP (Application Reference Number: 8.6) and the Main Power Station Site sub-CoCP (Application Reference Number: 8.7) (including sediment management such as silt fences) as well as following good design practice for the outfalls, the effects on the Afon Cafnan and on the downstream channel would be reduced. As a consequence, the potential magnitude of change for the outfall construction is considered to be medium, based on the methodology and definitions detailed in chapter B8 (Application Reference Number: 6.2.8). Combined with a medium receptor value, this would often result in a moderate effect. However, in this instance, based on professional judgement and previous experience of the likely type, magnitude and duration of change associated with the work, the effect has been reduced and so would result in a minor adverse effect, which is not significant.

8.5.39 Works within the vicinity of the Afon Cafnan, such as topsoil storage, stockpiling, drainage construction and landscape mounding, would have the potential to lead to fine sediment input into the channel (i.e. from bare earth surfaces). This could smother bed substrate (mostly gravels) and lead to changes in the sediment processes within the channel. A 15m buffer has been embedded into the design, with the vegetated buffer acting to trap sediment and maintain natural processes locally within the channel. As a consequence, the magnitude of change is considered to be small, which, combined with a medium receptor value, results in a minor adverse effect on the Afon Cafnan. This is not a significant effect.

Nant Caerdegog Isaf

8.5.40 Channel realignment would require in-channel working on Nant Caerdegog Isaf (approximately 400m of channel is to be realigned). This could release sediment altering deposition and erosion regimes and disturb existing downstream channel bed forms (such as pools, riffles, depositional features etc.). The new channel would be constructed and only connected to the Nant Caerdegog Isaf once complete. The method of making the connection would be designed to limit sediment release (e.g. opening the downstream connection first, use of temporary flow control at the upstream end at the time of breakthrough etc.) and the timing of the connection (i.e. avoiding periods of heavy rainfall) would be such that there would be limited potential for an increase in downstream sediment concentrations. The magnitude of change would therefore be small and very short-term such that the effect, when combined with a low receptor value, would be negligible. This is not a significant effect.

8.5.41 Destabilisation of watercourse banks could occur through adjacent working encouraging lateral erosion. The extent of working along the banks of the

existing watercourse would be limited to the upstream and downstream connection points associated with channel realignment. Once the new watercourse is completed there would be very limited requirement for plant movement along the banks. In addition, appropriate plant would be used allowing a standoff from watercourse banks to be maintained and/or low ground-loading plant to be used. By these means the magnitude of any changes would be small and the effect, when combined with a low receptor value, would be negligible and not significant.

8.5.42 One new outfall would be built to discharge to the Nant Caerdegog Isaf during construction. The construction of the outfall headwall would require in-channel working, removal of a very small part of the existing bank and bed, and removal of a small area of riparian vegetation. The presence of the new structure within the channel would remove a very short length of the natural bank and potentially alter local interaction of flows with the floodplain. The new discharge during the construction phase would augment flows, particularly during higher flow periods, potentially leading to scour of the bed and banks in the vicinity of the outfall and changes to localised flow and sediment processes. The effects are likely to be localised and due to the nature of the watercourse, i.e. largely modified with a low receptor value, it would lead to a small magnitude of change, resulting in a minor adverse effect with appropriate good practice mitigation in the design (including angling the outfall downstream and tying in the structure with the natural bed and banks). This is not a significant effect.

8.5.43 Construction activities including topsoil stripping, topsoil storage, haul road construction and construction of parking areas would be within close proximity to Nant Caerdegog Isaf. These activities could potentially cause disturbance of fine sediment which could enter the channel, smothering the bed and altering morphological processes and forms. However, with embedded and good practice mitigation in place, including the implementation of the water management strategies set out in the Wylfa Newydd CoCP (Application Reference Number: 8.6) and the Main Power Station Site sub-CoCP (Application Reference Number: 8.7) (including sediment management such as silt fences), the magnitude of change is considered medium resulting in a minor adverse effect. This is not a significant effect.

8.5.44 The construction phase would also involve complete removal (infilling) of a tributary of the Nant Caerdegog Isaf. This would directly affect any flow and natural sediment delivery to the watercourse. However, due to the very small size of the tributary and limited amount of water within the channel for the majority of the year, it is thought (based on professional judgement) that connectivity and contribution of water to the Nant Caerdegog Isaf is minimal. As a result, the magnitude of change from removing this tributary is considered to be medium which, when combined with a low value receptor, results in a minor adverse effect that is not significant.

8.5.45 A new culvert to facilitate a haul road is also proposed on a small tributary of the Nant Caerdegog Isaf in its headwaters, approximately 350m downstream of the Cae Gwyn SSSI. The culvert would remove a portion of the bed and banks of this small watercourse and locally change flow processes within the structure (due to changes in bed roughness). Due to the small size of the

tributary and limited geomorphological features the magnitude of change from the addition of a culvert on this tributary is considered to be small. When combined with a low value receptor, this results in a negligible effect, which is not significant.

Nant Cemaes

8.5.46 One outfall would be constructed along the Nant Cemaes, discharging to the channel. The construction of the outfall would require in-channel working and removal of a very short length of the existing bed and bank, and riparian vegetation. During the in-channel working there is the potential for fine sediment input to the downstream channel, and destabilising of the existing banks. As the outfall begins to discharge during the construction phase there would be a change in existing flow processes in the Nant Cemaes, particularly during high flow conditions. This could lead to potential scour of adjacent bare earth banks at the structure or on the opposite bank. Changes to flow processes could also lead to alteration in the sediment being transported through the system, with a potential for increased delivery of fine sediment to Cemaes Bay.

8.5.47 However, due to the very short length of channel potentially affected by the outfall structure, and by following good design practice (including angling the outfall downstream and tying in the structure with the natural bed and banks) the new outfall would cause a small magnitude of change, which, when combined with a low receptor value would result in a minor adverse effect. This is not significant.

Nant Cemlyn

8.5.48 During the construction there would be a new outfall constructed to discharge to the Nant Cemlyn. The construction of the outfall would require in-channel working and removal of a short length of the existing bed and bank, and riparian vegetation. Construction would require in-channel working, with the potential for fine sediment input downstream. The removal of a small area of riparian vegetation is also anticipated due to the movement of plant which could result in an area of exposed bank. The outfall structure would potentially affect the connection between the channel and floodplain in a very small area.

8.5.49 Discharges from the outfall would have the potential to cause scour of the bed and banks and to change flow (by altering existing flow patterns and deflecting flows) and sediment processes. Although as stated in section 8.4, this outfall will not be flowing for the whole duration of the construction phase as during earthworks on the western side of Mound E the flow would be diverted to the Afon Cafnan. For this reason, and with the inclusion of the water management strategies set out in the Wylfa Newydd CoCP (Application Reference Number: 8.6) and the Main Power Station Site sub-CoCP (Application Reference Number: 8.7) as well as good practice design principles (including angling the outfall downstream and tying in the structure with the natural bed and banks), the magnitude of change would be small as a consequence of the construction of the outfall, with a minor adverse effect. This is not a significant effect.

Nant Porth-y-pistyll

8.5.50 The Nant Porth-y-pistyll would be completely removed as part of the construction phase to allow for construction of the development platforms. Although this would lead to complete removal of the channel, it is of low fluvial geomorphological value and has been extensively artificially modified for land drainage purposes and during the construction of the Existing Power Station. The magnitude of change is considered to be medium for fluvial geomorphology, which, when combined with a low receptor value, results in a minor adverse effect that is not significant.

Groundwater

8.5.51 The value of the groundwater receptors is given in table D8-5 which has identified that the value ranges from low (including the groundwater in the Secondary aquifers) up to high for some secondary receptors including the SSSIs and the services and ancillary buildings at the Existing Power Station. This section presents the findings of the assessment of potential effects from works within the Wylfa Newydd Development Area to the identified groundwater receptors with any effects identified as being moderate or greater, pre-additional mitigation, summarised in table D8-11.

8.5.52 The assessment for several of the identified receptors relies on the output of the groundwater model presented in appendix D8-7 (Application Reference Number: 6.4.32).

Tre'r Gof SSSI

8.5.53 For the Tre'r Gof SSSI, the assessment for shallow groundwater effects has been included in the surface water section of this report as shallow groundwater and surface water are intrinsically linked. The assessment of the SSSI monitoring data and formulation of the conceptual model has not identified a significant bedrock groundwater input directly to the SSSI, although there is some uncertainty regarding this and there could be small areas within the SSSI where bedrock groundwater influx is important. However, the streams that flow into the SSSI are supported by groundwater and the focus of this assessment is therefore on potential effects of groundwater on these.

8.5.54 Whilst it is noted that the groundwater model has not been established to model the water inputs to Tre'r Gof in detail, the model output can be used to provide indicative impacts on groundwater levels and flows in the vicinity of the SSSI. The groundwater modelling work (appendix D8-7, Application Reference Number: 6.4.32) predicts that drawdown compared to baseline on the SSSI's western boundary at a point closest to the dewatered excavation varies from 0.5m to 0.9m (for the wet and dry periods respectively). The model also predicts that a decrease of flow from groundwater to surface water within the SSSI boundary to be between 4.5m^3/day and 7.8m^3/day. This represents, compared to baseline, a reduction of bedrock groundwater input to the SSSI of 12% for the wet period and 46% for the dry period although it should be borne in mind that the bedrock groundwater only makes up a very small

component of the total flows into the SSSI and that deep bedrock groundwater is not significant in maintaining the wetland.

8.5.55 The bedrock groundwater model shows that during construction the groundwater flow direction beneath the SSSI would not be reversed from the baseline conditions. Bedrock groundwater would continue to flow to the coast, i.e. groundwater would not be drawn into the dewatered deep excavations from within the SSSI boundary.

8.5.56 The groundwater model overestimates the dewatering requirements and extent of drawdown and the effect on groundwater discharges to surface water. This is due to it being assumed in the model that the conditions modelled extend for an indefinite period of time (in reality dewatering is likely to only last for up to three years) and the model for this phase does not allow for the sealing of major inflows to the excavation once encountered by the use of shotcrete. As such, the magnitude of change of the construction works on bedrock groundwater inputs to streams that flow into the high value Tre'r Gof SSSI is considered to be small with an overall minor adverse effect, meaning it is not significant.

Cae Gwyn SSSI

8.5.57 The key issue in relation to potential groundwater effects on the Cae Gwyn SSSI during the construction works relates to the dewatering of deep excavations and construction of landscape mound and a temporary car park to the east of the SSSI's Primary Outflow Basin. This dewatering has the potential effect of drawing down groundwater levels at the Cae Gwyn SSSI and either reducing any groundwater input to the SSSI, or increasing leakage to groundwater from the SSSI. The car park has the potential to reduce groundwater recharge adjacent to the SSSI and reduce groundwater levels in the SSSI.

8.5.58 The bedrock groundwater model shows that the groundwater drawdown for the construction phase dewatering (appendix D8-7, Application Reference Number: 6.4.32) would be up to 0.02m at the north of the SSSI. The results also show that groundwater to surface water flows decrease by up to 2.2m^3/day (during a wet period) which is 4% of the predicted baseline groundwater to surface water flows of 55m^3/day. This reduction in groundwater input to the SSSI's surface water drains compares to the estimated total outflow from the SSSI calculated in the SSSI's water balance in appendix D8-6 (Application Reference Number: 6.4.31) of approximately 235m^3/day and represents a very small proportion (approximately 1%) of the total outflow. The magnitude of change for the construction works on the groundwater input to the high value Cae Gwyn SSSI is assessed as negligible with the resultant effect being minor adverse and therefore is not significant.

8.5.59 In addition to dewatering, the construction would include creation of a landscape mound and car parking adjacent to the east of the Cae Gwyn SSSI. The car park would collect surface water runoff and discharge it via an oil interceptor to the watercourse downstream of the SSSI. This mound and car park would result in a reduction of direct groundwater recharge and hence change in groundwater levels near the SSSI. However, the small scale of this

effect means that the magnitude of change for mound creation near the Cae Gwyn SSSI would be small for recharge to the deep groundwater. As such, the effects would be minor adverse and therefore are not significant.

8.5.60 Leaks of fuels and oils associated with the works near the Cae Gwyn SSSI and from cars using the car park have the potential to locally affect groundwater quality in this area. However, the car park is designed to collect infiltrating rainwater and discharge it to surface waters via an oil interceptor. As such, the magnitude of change is negligible as are the effects, which therefore are not significant.

Cemlyn Bay SSSI

8.5.61 With respect to the effects of change in groundwater inputs to the Cemlyn Bay SSSI and Nant Cemlyn (which flows into the SSSI) this has been considered with the aid of the groundwater model (appendix D8-7, Application Reference Number: 6.4.32). Groundwater dewatering has the potential to alter either direct flows into Cemlyn Lagoon or via groundwater recharge into Nant Cemlyn and this has been considered with the aid of the groundwater model results.

8.5.62 The model results show that the maximum drawdown in the area of aquifer in the vicinity of the Cemlyn Bay SSSI and Nant Cemlyn is up to 0.5m. The groundwater flow direction does not change appreciably and groundwater continues to flow into the Nant Cemlyn and Cemlyn Lagoon with no drawdown predicted adjacent to the lagoon or Nant Cemlyn.

8.5.63 The bedrock groundwater flow model shows that groundwater discharging to surface waters in the Cemlyn Bay SSSI does not significantly change during the construction phase, with the model showing a reduction in flow of only 0.1m^3/day. This compares to a total modelled bedrock groundwater inflow into the Cemlyn Bay SSSI of between 82m^3/day and 170m^3/day so a change of less than 0.1% of the total inflow.

8.5.64 On the basis of the groundwater modelling assessment, the magnitude of change for dewatering and changes to groundwater levels on the high value Cemlyn Bay SSSI is considered to be small with an overall minor adverse effect. This is not a significant effect.

Private water supplies

8.5.65 A change in groundwater levels, principally due to groundwater dewatering for deep basements, has the potential to result in the drawdown of water levels at the PWSs closest to the Wylfa Newydd Development Area. This could then cause the wells to dry out and lead to a loss of water supply. Groundwater modelling (appendix D8-7, Application Reference Number: 6.4.32) has been used to assess the potential effects of the dewatering on the water levels at the PWSs identified by the IACC at Foel Fawr, Cae Gwyn and Caerdegog Uchaf. The model results predict that there would be no significant change to groundwater levels for all the PWSs with the maximum predicted drawdown being 0.02m for the Foel Fawr and Caerdegog Uchaf PWSs. This change would be significantly less than is recorded for seasonal fluctuations (in the order of 2.5m) and would not be discernible from natural fluctuations. As such,

the magnitude of change for construction (including dewatering) on the water supply for the PWSs identified by the IACC would be negligible with the effect also being negligible. This effect is not significant.

8.5.66 As noted previously, as the PWSs are situated up hydraulic gradient of the Wylfa Newydd Development Area, if contamination were to occur it would not flow towards the wells. As such, the effects of the construction works on water quality in the PWSs identified by the IACC have been assessed as negligible and the effect would also be negligible, and therefore is not significant.

8.5.67 For properties outside the Wylfa Newydd Development Area which may be reliant on groundwater supplies, but not known to the IACC, the effects of dewatering on the water levels have also been considered by assessment of the drawdown predicted by the groundwater model. The only areas identified by the model where there could be a reduction in groundwater levels are to the south-east, primarily around Tregele, and to the west. In these two areas the dry period model predicts a drawdown of less than 1m, whilst the wet period model predicts a drawdown of less than 0.2m. These predicted drawdowns are highly conservative due to the way the model has been built and run and in reality any drawdown would be significantly less than predicted.

8.5.68 There are approximately 27 properties shown on Ordnance Survey maps for the south-east area within the 1m zone of drawdown, with all of these properties being in the village of Tregele to the east. DCWW service plans show there is a mains water supply in this area and it is very unlikely that these properties rely on groundwater for supply. The only property identified in the west area is Felin Gafnan which is an isolated farm to the west of the Wylfa Newydd Development Area. DCWW service plans show a water main running along the road to which the farm track joins and no well is shown on historical plans as being present at this farm. As such, it is considered unlikely that the property relies on groundwater.

8.5.69 Therefore, in the unlikely event of there being properties with water supply wells in the two areas within the predicted zone of drawdown, the magnitude of groundwater level change predicted by the model is assessed as small. Any change would be short-term, reversible and less than 1m in the dry period and less than 0.2m in the wet period. The potential effect is therefore considered to be minor adverse, and is not significant.

Historical public wells

8.5.70 The construction works would remove two of the three identified historical public wells within the mounding area in the Tre'r Gof Catchment. During a walkover survey in May 2017, the two wells were visited and, based on visual appearance, have not been used for many years as a water supply. There is no record held by the IACC of these being in current use, and the vast majority of properties in the area are now on mains water. As these two historical public wells are located within Horizon's land holding, they would not be used in the future. As the wells have a low value, even though their loss would result in a large magnitude of change, this would only represent a minor adverse effect, which would not be significant.

8.5.71 The third identified historical public well within the Wylfa Newydd Development Area (to the west of Penrhyn and also identified as being disused) would be outside the mounding area and physically would not be affected by the construction works. The magnitude of change would therefore be negligible, which with a low value receptor, would not result in a significant effect.

Existing buildings

8.5.72 Lowering of groundwater levels for construction of the deep basement and the cut-and-cover sections of tunnel construction has the potential to cause settlement of the ground as water in pore spaces in sands, gravels and clays is removed. This ground settlement then has the potential to cause subsidence of existing buildings outside the Wylfa Newydd Development Area. Given that the nature of the rock which would be dewatered within the Wylfa Newydd Development Area is a hard bedrock with flow in fractures, the effects of dewatering would be due to removal of pore pressure in the overlying superficial deposits fractured bedrock where these are in hydraulic continuity with the bedrock. As such, potential effects would be to larger buildings constructed on raft foundations on the superficial deposits or fractured bedrock or houses or other smaller structures constructed on shallow foundations. Smaller structures may be less susceptible to subsidence as it is differential settlement (that is the difference in which the earth moves more on one side of the building compared to the other) that is important and with smaller buildings this differential settlement would be less. This differential settlement can be caused by significant differences in water levels on either side of the structure or where structures are constructed on ground which has significant variability in composition and compactness is encountered. Based on the observed ground conditions and information in [RD33], where the predicted drawdown is less than 2m, settlement related issues are unlikely to be of significance unless the ground conditions are poor.

8.5.73 The Wylfa Newydd Development Area bedrock groundwater model (appendix D8-7, Application Reference Number: 6.4.32) has assessed the extent of drawdown that there could be at the Existing Power Station during construction and the model predicts that the effects are such that there could be up to around 10m of drawdown (this being for a dry period). The safety-critical buildings at this location are likely to be founded on the bedrock and as such would not be susceptible to subsidence. However, other smaller ancillary buildings or below ground services may be more susceptible to subsidence.

8.5.74 Discussions with Magnox has identified the following buildings and structures as being potentially at greatest risk from subsidence:

- Million Gallon Reservoir – failure could lead to a flooding event and also reduce fire-fighting capability.
- Fire-fighting systems within Turbine hall.
- Secondary Dry Cells (contaminated facilities constructed on piles).
- Active Incinerator Building used as an active waste facility with associated tall stack.

- Active Effluent Discharge line running along overhead gantry (North of Reactor Building).

8.5.75 These buildings and structures are not on the Existing Power Station's southern boundary, where drawdown from pumping would be greatest, and the model shows that the drawdown at these locations would be in the order of 1.5m to 3.5m.

8.5.76 The magnitude of change for subsidence on the Existing Power Station site from drawdown due to groundwater dewatering is considered to be small. Given the value of the Existing Power Station (high) the effect on ancillary buildings and services is considered to be moderate adverse and is significant.

8.5.77 For the off-site properties (including houses and farms) the bedrock groundwater modelling results show the predicted maximum drawdown at properties to the west of the Wylfa Newydd Development Area (situated between the Wylfa Newydd Development Area and Cemlyn Bay) to be approximately 0.75m with the maximum drawdown being around 1m in the village of Tregele to the east. Given the small size of these properties, the conservative nature of the model which predicts less than 2m of drawdown and the relatively shallow bedrock groundwater table gradients produced at these points by the dewatering, the settlement over the length of the buildings would be negligible. As such, the magnitude of change is considered to be negligible. Given the value of these properties (high) the effects are considered to be minor adverse and are not significant.

Secondary aquifers

Groundwater quality – saline intrusion into the aquifer

8.5.78 There is the potential that groundwater dewatering could cause the drawdown of water at the coast such that groundwater flow direction is reversed from that currently observed with the result that sea water would be drawn into the aquifer (a process known as 'saline intrusion'). This saline water would then cause contamination of the aquifer and affect its resource potential. Effects on the WFD water body status are assessed separately in the WFD Compliance Assessment (Application Reference Number: 8.26).

8.5.79 The likelihood of saline intrusion has been assessed by consideration of the groundwater model, which has modelled the direction of groundwater flow during the construction period, when there would be dewatering of deep excavations, the MOLF and for the construction of the cut-and-cover sections of the cooling water tunnels. The model results predict that saline intrusion would occur although the quantities of saline water drawn into the excavation would be small at around 6.5m^3/day. Compared to the estimated total groundwater abstraction from the seaward and inland excavations of around 175m^3/day it can be seen that this is a relatively small quantity of the total abstraction.

8.5.80 The excavation phase of construction, when groundwater dewatering would be at its peak, would be in the region of two years' duration. Groundwater dewatering would continue after the excavation is completed, but following shotcreting of the excavation walls the groundwater inflow is likely to be

minimal. As such, the effects of saline intrusion would be short-term. Furthermore, they would be reversible as, following cessation of the dewatering, the groundwater flow regime would be re-established with groundwater discharging to the sea as shown in the groundwater model (appendix D8-7, Application Reference Number: 6.4.32) for the operational Power Station.

8.5.81 The construction phase bedrock groundwater model indicates, as would be expected, that the water drawn into the aquifer would all be captured by the dewatering system and this water would then be discharged back to the sea. The model results show only a small length of coast (approximately 200m long) to the north of the MOLF would draw water into the aquifer before that water discharges into the excavation. It is recognised that if a fracture (or fractures) connects the area of dewatering to the coast, then the volume of saline water drawn into the aquifer may be greater. However, even under this scenario, as the saline water would only affect a small volume of aquifer (i.e. only that within the fracture zone) and would ultimately be discharged back to sea, the environmental effects would remain negligible. Furthermore, the embedded mitigation of spraying concrete onto the walls of the excavation would seal these fractures and as such, any flows through fractures would be temporary.

8.5.82 Even with the mitigation described above for sealing fractures, inflow through the base of the excavation would occur until the excavation reached full depth and the concrete slab was laid. However, the hydrogeology is such that at greater depths, fracture density and permeability reduce and flows through the base when the excavation is at full depth would be relatively small (appendix D8-3, Application Reference Number: 6.4.28 and D8-7, Application Reference Number: 6.4.32 provides data and an assessment of the reduction of permeability with depth).

8.5.83 Due to all saline water being captured in the excavation, no saline groundwater would be drawn into PWSs or local surface waters and the magnitude of change in groundwater quality for saline intrusion is considered to be medium. Given the low value of the aquifer, the effect of saline intrusion would be minor adverse and it would be short-term (in the order of 2 to 3 years) and reversible. This is not a significant effect.

Groundwater quality and quantity in the aquifer during Site Preparation and Clearance Works due to demolition of existing buildings, clearance of vegetation and formation of contractor's compounds

8.5.84 The demolition of buildings and vegetation removal would not have a direct effect on groundwater quality. Due to the proposals for engineered containment of fuel storage in the compound and management procedures for use, the magnitude of any change in groundwater quality from fuel or oil leaks from plant for the Site Preparation and Clearance Works would be negligible and there would be a negligible effect. This is not significant.

8.5.85 There could potentially be changes to groundwater recharge rates and areas due to the removal of trees and hedges. This could potentially be a small increase in recharge as tree removal would reduce water loss from the soil by transpiration, or it could be a decrease if vehicle movements compact the soil

surface such that rainfall runs off to surface waters rather than infiltrating the soil. However, given the limited activities of the Site Preparation and Clearance Works, the magnitude of change for recharge to the low value aquifer is considered negligible and the effect is also negligible and therefore not significant.

Groundwater quality in the aquifers and secondary receptors (local watercourses and PWSs) – leaching from exposed soils and rock during Site Preparation and Clearance Works

8.5.86 Protection of groundwater and surface water would be provided by targeted remediation of known contaminated land. The land would be remediated mainly due to its asbestos content (which does not affect the water environment), but it also contains other contaminants, albeit at relatively low concentrations. Remediation for a small area of land and groundwater contaminated with trichloroethene would also be undertaken. Due to segregation of contaminated soils from clean soils, control of runoff and control of drainage there would be limited potential for changes in groundwater quality. Once completed, the remediation would have a beneficial effect to the water environment (see chapter D7, Application Reference Number: 6.4.7 for further details of the remediation works) as there would no longer be any contaminant migration in groundwater.

8.5.87 Removal of topsoil and exposure of subsoil or rock, and the associated storage of the excavated material in mounds, has the potential to lead to increased leaching of substances such as nutrients or metals from the soils and rock. Leaching of substances may occur in areas where contaminated land is exposed during the soil remediation works. This leaching could in turn lead to deterioration in groundwater quality and effects on associated receptors such as PWSs and local watercourses.

8.5.88 Soil leaching tests have been undertaken to determine how much leaching of nutrients and metals there could be from the exposed soils (see chapter D7, Application Reference Number: 6.4.7 for further details). The results of the leaching tests show that in a small number of cases, metal and nutrient concentrations are higher than the concentrations commonly used as water quality standards for assessing the impacts of water quality on surface waters and groundwater. However, as the bulk of the rock does not have elevated metal and nutrients, as not all rainfall (and any associated contaminants that it may pick up) would reach the groundwater (a proportion would runoff to surface waters) and as there would be dilution of any contaminants leached in the underlying groundwater body. Furthermore, any change would be short-term and temporary as it would be limited to the period of excavation, movement and placement. Once soils and rock are placed, mounded and vegetated, leaching would return to that currently occurring. As such, for the low value aquifer, the magnitude of change for contaminants leaching from some of the exposed soils is considered to be small to medium and the effect would be minor adverse and therefore is not significant.

8.5.89 The PWSs are some distance from and up hydraulic gradient of the Wylfa Newydd Development Area and as such the effects of leaching from exposed soils and rock would have no effect on the PWSs. For the local watercourses,

which all have limited hydraulic continuity with the groundwater, the magnitude of change is considered to be small to negligible. This is largely due to the relatively small contribution of groundwater-supporting watercourses, with the majority of flow coming from direct rainfall runoff and/or shallow through flow in soil and subsoil. The resultant effect is therefore minor adverse and not significant.

Groundwater levels and flow direction in the aquifer– changes due to deep excavation, construction of tunnels, mounds and platforms, and hardstanding and building construction (including dewatering)

8.5.90 Lowering of groundwater levels for basement construction would cause the groundwater levels in the aquifer to fall. This would then cause a change to the groundwater flow direction. The effects of construction works (including groundwater dewatering) have been modelled (appendix D8-7, Application Reference Number: 6.4.32) and show that the change in groundwater level due to the construction activities does not extend greatly outside the Wylfa Newydd Development Area.

8.5.91 The removal of vegetation, the construction of rock and topsoil mounds and hardstanding (roads, car parks, storage compounds and buildings as they start to be constructed), and installation of the drainage system all have the potential to change groundwater recharge rates and therefore groundwater levels. However, the magnitude of change due to these activities would be considerably smaller than the effect of groundwater dewatering which the model shows to dominate the groundwater flow regime during the construction period.

8.5.92 In terms of platform construction, where the platforms are cut into the ground but remain above the groundwater level, there is the potential for higher groundwater recharge rates with a subsequent rise in the groundwater level as the unsaturated zone thickness would be reduced and potentially low permeability materials overlying the bedrock (which encourage surface water runoff) would be removed. In some cases, the removal of the overlying deposits may result in local perched groundwater horizons in the glacial till Secondary (Undifferentiated) aquifer deposits being totally removed such that all recharge would then reach the bedrock aquifer. Where platforms are constructed, there is the potential that platform construction would also compact the ground surface and reduce recharge to the underlying bedrock aquifer. The construction of an extensive drainage system across the building platform may also encourage rainfall to move away from the construction area in surface water, potentially leading to a reduction in groundwater recharge and levels. There is therefore some uncertainty as to how recharge would change and it is likely that it would vary greatly during construction.

8.5.93 As construction progresses, there is the potential that structures constructed below the shallow or bedrock groundwater tables would form a barrier to groundwater flow. This could potentially lead to higher groundwater levels up hydraulic gradient and lower levels down hydraulic gradient and locally alter the groundwater flow direction. Inputs of groundwater to local surface water features could then be affected. Buildings and structures that have been

identified which are likely to be built below the bedrock groundwater table include:

- deep basements associated with the reactor and generator buildings;
- cooling water inlet and outlet tunnels;
- cooling water intake and outlet structures; and
- the land-based elements of the MOLF.

8.5.94 In terms of effects on the aquifer for changes to groundwater levels due to the construction works (including dewatering, changes to recharge rates and presence of below ground structures), the magnitude of change is considered to be medium due to the temporary nature of the dewatering works (it is dewatering which would have the principal impact on groundwater levels and flow direction during the construction phase). Given the low value of the aquifer, the effects of the construction works (including dewatering, changes to recharge rates and presence of below ground structures) on the water levels and flow direction in the aquifer are considered to be minor adverse. This is not a significant effect.

8.5.95 With respect to the cooling water outfall tunnel, it is assumed that this would be constructed at an elevation of about 4mAOD near to the reactor and generator basement, falling gently to the coast to the north of the Existing Power Station. GI information [RD34] shows that the rockhead elevation along the majority of the cooling water outfall tunnel varies between 10mAOD and 15mAOD. A low point in the rockhead of 5mAOD is reached towards the northern end of the tunnel where the tunnel is close to its lowest elevation. As such, the majority of the cooling water outfall tunnel is likely to be constructed beneath the higher permeability fractured zone where groundwater flow is greatest. This would mean that there would be limited inflows of groundwater into the tunnel during construction. Furthermore, as the tunnel would only be some 5m to 7m in diameter, groundwater could easily move over and below it, such that it would not form a significant barrier to groundwater flow.

8.5.96 The construction technique of the tunnel would include the use of shotcreting to ensure tunnel wall stability and reduce groundwater inflow to the tunnel during construction and also the use of in situ cast permanent concrete lining. With this construction method, the tunnel is unlikely to form a high permeability flowpath for groundwater movement or act as a drain for groundwater.

8.5.97 The northern extent of the cooling water outfall tunnel would be constructed within the Gwna Group bedrock (rather than the New Harbour Group for the remainder of the tunnel) and at this location the tunnel may be constructed by cut-and–fill methods, with local dewatering. The Gwna Group bedrock at this location has been identified as being more fractured and broken than the New Harbour Group in the remainder of the study area. Drawdown from dewatering for the northern section of the cooling water outfall tunnel, if required, would be local due to the limited drawdown required to get the water levels to the required elevation (approximately 10m drawdown at the tunnel) and the relatively short time that the dewatering would be required. As such, the effects of dewatering in this area would not be widespread.

8.5.98 In terms of effects from construction of the cooling water outfall tunnel for changes to groundwater levels and flows, the magnitude of change is considered to be medium, principally due to dewatering works which would be local and temporary in nature. Given the low value of the aquifer, the effects of the cooling water outfall tunnel construction on the water levels and flow direction in the aquifer are considered to be minor adverse and therefore are not significant.

8.5.99 The hydrological studies have shown that the groundwater component of flow (base flow) in the streams is small due to the low permeability of the soils and bedrock. However, lowering of the bedrock groundwater table for construction works could reduce the amount of bedrock groundwater discharging to local watercourses which are considered as secondary receptors for groundwater. The groundwater model shows that the greatest effect of this would potentially be to the upper reaches of the medium value Nant Caerdegog Isaf and lower reaches of Afon Cafnan. For Nant Cemaes, the bedrock groundwater model shows that there would be drawdown of up to 0.5m in a stretch of the stream near to Cemaes. The model shows there would be no discernible effect for Nant Cemlyn in terms of drawdown at this watercourse. Measurements of groundwater and stream levels shown in appendix D8-3 (Application Reference Number: 6.4.28) indicate that during drier periods, groundwater levels in boreholes completed near to watercourses do fall below the base of the local streams, at least at certain locations. As such, during these drier periods, as groundwater levels are already below the base of the watercourses, drawdown from dewatering would not affect groundwater flow into the watercourses.

8.5.100 The groundwater model shows that over the whole model area (which is larger than the groundwater study area in order to avoid boundary effects in the modelling assessment), the groundwater dewatering would remove approximately 130m^3/day from the groundwater system. This compares to a total average stream outflow for the four major catchments (Cemaes, Cemlyn, Cafnan and Tre'r Gof) of around 15,000m^3/day (calculated from the 4R model results detailed in appendix D8-7, Application Reference Number: 6.4.32). As such, compared to the total stream flow, a reduction of 130m^3/day throughout the surface water system represents a reduction of 1% of the total flow (and this estimate does assume all the groundwater removed from the system was discharging to watercourses, whereas in reality a proportion of the 130m^3/day would have been discharging to the sea via the coast). The magnitude of the effect of changes to groundwater recharge and dewatering on watercourse flows is therefore considered to be small and with the watercourses potentially affected having a medium value, the effect of changes to stream flow due to reduction in groundwater levels is considered to be minor adverse and not significant.

Groundwater quality – spills and leaks of fuel and chemicals to the aquifer and secondary receptors

8.5.101 The potential effects include those associated with storage of fuel in the compound, fuel for generators, chemicals, refuelling operations/use of chemicals and leaks from plant and machinery. These can affect groundwater quality, and surface water via groundwater migration. As the PWSs are some

distance away and up hydraulic gradient of the Wylfa Newydd Development Area there is no potential to affect these.

8.5.102 The construction works would require large quantities of fuel to be stored within the Wylfa Newydd Development Area for site plant, with the potential for leaks from the tanks and spillage when fuel is being delivered. However, the fuel would be stored in tanks within areas with containment systems conforming to the Oil Storage Regulations. This would include the use of secondary containment systems and impermeable hardstanding in areas where fuel is stored. The tanks would be inspected on a regular basis with a record maintained of all inspections. Oils, such as engine oil and hydraulic oil, would be stored in smaller quantities on-site, but they would also be in areas with secondary containment systems and on hardstanding.

8.5.103 Where refuelling on permeable surfaces has to take place, then this would take place in line with good practice such as in CIRIA report C741 [RD22] as set out in the water management strategy in the Wylfa Newydd CoCP (Application Reference Number: 8.6) to include the use of drip trays or on impermeable surfaces (e.g. plant nappy) which provides protection to underground strata and watercourses.

8.5.104 There is the potential for leaks of fuels (and oils) from plant during the course of the construction works, but these incidents would be localised and good practice such as vehicle maintenance, the use of spill kits and drip trays would limit the potential for groundwater contamination. In line with good practice, such as in CIRIA report C741 [RD22], records of any incidents would be maintained in line with the environmental emergency management strategy in the Wylfa Newydd CoCP (Application Reference Number: 8.6).

8.5.105 For the aquifer which is considered to have a low value, the magnitude of change on groundwater quality due to storage, refuelling and leaks and spills of fuel and oil is considered to be small and as such the effect is considered negligible. The local watercourses, which form a secondary receptor for groundwater, have a value of up to high (for Nant Cemlyn). With the embedded and good practice mitigation measures, including storage and refuelling practices listed above, and the use of buffer zones adjacent to the watercourses, the magnitude of change for discharges of fuel to local watercourses via the groundwater pathway is considered to be negligible. The effect is also considered to be negligible and therefore is not significant.

8.5.106 A wide range of chemicals would be required for the construction works such as paints, cleaning solutions, and bituminous materials. The quantities of these chemicals would be relatively small (in comparison to fuels) and storage would generally be in tins or drums rather than in bulk containers (i.e. less than $1m^3$). Where practicable, the chemicals would be stored indoors and on hardstanding to protect the underlying groundwater. Due to the relatively small quantity of chemicals being used at any one place at any one time, and good practice such as spill response, the magnitude of change to groundwater quality from any spills of chemicals is considered to be negligible. The environmental effect on the aquifer (and secondary receptors) is also negligible and therefore is not significant.

8.5.107 The construction works would require a large quantity of concrete to be used and a concrete batching plant to be installed. The storage of cement and use of concrete has the potential to change groundwater quality locally, with the most likely effect being to change the groundwater's pH by making it more alkaline, and affecting major ion concentrations. This is most likely to occur when wet concrete is used in fractured bedrock as there is potential that cementitious material and affected water would move within the fractures (although in most cases it is likely that fractures would need to be dewatered prior to concrete pours which would mitigate the effect). Any leaks or spills of cement could affect the quality of water in the aquifer with migration of the groundwater affecting secondary receptors such as local watercourses.

8.5.108 The magnitude of change to groundwater in the aquifer from the storage and use of cementitious materials is considered to be small and given the low value of the aquifer, the effects are considered to be minor adverse and not significant. For the local watercourses (secondary receptors), due to the small inputs of groundwater to the watercourses, the magnitude of change for the watercourse quality is considered to be small. The value of the watercourses in areas where concrete is likely to be used in large quantities is up to medium in the Afon Cafnan Catchment. No significant usage of cement would take place in the Cemlyn Catchment, Cemaes Catchment or Tre'r Gof Catchment. As such, the environmental effect from the use and storage of cementitious material on all watercourses in the study area is considered to be minor adverse and is not significant.

Groundwater quality – spills and leaks of sewage to the aquifer and associated local watercourses

8.5.109 Two principal foul water (sewage) streams would be produced during the construction phase of the works; one associated with the construction area and one with the Site Campus. The foul water produced in the construction area would be diverted to a temporary treatment plant (package plant) near the coast at Porth-y-pistyll and that from the Site Campus would be treated in the existing DCWW Cemaes Waste Water Treatment Works. The DCWW plant would need to be upgraded and depending on the number of workers staying in the Site Campus may need to be supplemented by a package plant, although the discharge may be routed via the DCWW plant. Treated water would be discharged to the marine environment rather than the freshwater environment and is discussed in chapter D13 (Application Reference Number: 6.4.13).

8.5.110 There is potential for collection and treatment of foul water during the construction works to affect groundwater quality due to leaks or spills of sewage associated with the temporary sewage treatment plant and associated pipework. Contaminated groundwater could then flow to the local watercourses and also affect these.

8.5.111 Whilst the full design of the temporary sewage treatment plant is still to be undertaken (this would be the responsibility of the contractor undertaking the construction works), in accordance with good practice measures as set out in the water management strategy in the Main Power Station Site sub-CoCP (Application Reference Number: 8.7) the package treatment plant would be

maintained in line with the manufacturer's specifications. Appropriate protection in line with good practice would be put in place to protect the sewage pipeline and treatment plant from accidental damage to prevent the leakage of sewage to groundwater. This would include above-ground pipework being properly supported and underground pipework protected from physical damage and subject to adequate leakage detection. The magnitude of change for leakage of sewage to groundwater is assessed as small and for the aquifer, the effect is assessed as minor adverse and is therefore not significant. With respect to the potential for effects on local watercourse secondary receptors in the study area, the watercourses have a medium value (no sewage infrastructure is proposed for the Cemlyn Catchment, Cemaes Catchment or Tre'r Gof Catchment) and with a negligible magnitude of change the effects of leaks of sewage on local watercourses due to groundwater discharges are assessed as being negligible and are not significant.

Groundwater quality – dewatering causing inflow of contamination from existing contaminated land and groundwater

8.5.112 As stated above, areas of known contaminated land present in the Wylfa Newydd Development Area would be remediated prior to the Main Construction works, or during the construction works if contamination were identified during the soil stripping. However, the dewatering required for construction of the basements and cut-and-cover section of the cooling water tunnel could potentially draw in contaminated groundwater from areas outside the Wylfa Newydd Development Area if there were ground or groundwater contamination.

8.5.113 A review of historical potential contaminant sources in chapter D7 (Application Reference Number: 6.4.7) identified potential areas of contaminated land. However, groundwater monitoring detailed in appendix D8.3 (Application Reference Number: 6.4.28) has not identified groundwater contamination, other than the trichloroethene contamination which would be remediated, and to the north east of the Existing Power Station, where hydrocarbons have previously been detected in groundwater. By following the good practice mitigation (monitoring, assessment and appropriate remediation) detailed in the Main Power Station Site sub-CoCP (Application Reference Number: 8.7), the magnitude of any change on water quality in the aquifer is considered to be medium and with the low value of the aquifer the effect is assessed as minor adverse and so is not significant.

8.5.114 It is possible that there is unknown contamination beneath the Existing Power Station from when it was built. The groundwater modelling studies suggest that, during dewatering, groundwater could be pulled into the excavation from areas beneath the Existing Power Station, and any contamination could be drawn through the aquifer. Any contaminated groundwater drawn into the Wylfa Newydd Development Area from dewatering would be captured in the dewatering pumping system and would not cause contamination to secondary groundwater receptors such as the local watercourses and the PWSs. Discharges from the dewatering system would be subject to testing and if contamination were identified then it would be treated to mitigate any potential effects on the marine environment. However, there is the potential that the aquifer could become contaminated at locations where there is currently no

contamination. The magnitude of change on the aquifer is considered to be medium and with the low value of the aquifer the effect is assessed as minor adverse and so is not significant.

Operation

Surface water

8.5.115 The key potential effects of the operation of the Power Station and changes to the surrounding area, such as the landscape mounds and associated drainage, on the surface water environment include issues relating to water quality, water availability and changes in flood risk.

8.5.116 During the operational period the landscape mounds would all have well established vegetation cover and haul roads would have been removed (although any existing farm tracks are likely to remain) so there would no longer be a source for suspended sediment in the catchments, other than that which occurs naturally. There would therefore not be an effect on water quality from the landscape mounds and this is not considered any further in this assessment.

8.5.117 Due to the presence of highly engineered structures associated with the Power Station there would not be any pathway from any of the facilities storing or using radioactive substances to the surface water environment and so this potential effect is not considered further in the chapter.

8.5.118 The Overarching National Policy Statement for Energy (EN-1) [RD35] notes that a particular effect of air emissions (particularly NOx and ammonia) from some energy infrastructure may lead to eutrophication (the excessive enrichment of nutrients in the water environment). The effects on ecosystems can be short-term or irreversible, and can have a large impact on ecosystem services such as pollination, aesthetic services and water supply.

8.5.119 Whilst the operation of the Power Station is unlikely to have large emissions of NOx and ammonia emissions compared to other forms of energy generating infrastructure powered by fossils fuels, the use of combustion plant (such as the standby generators and boilers required for operation of the Power Station) would lead to emissions of NOx. Chapter D5 (air quality) (Application Reference Number: 6.4.5) assesses the deposition rates at ecological receptors for nitrogen during the operation of the Power Station. This shows that compared to the predicted future background deposition rates, the increases in nitrogen deposition due to operation of the Power Station would be very small (1% or less for the long-term scenario). As such, for all catchments the magnitude of change would be negligible and the effect would be negligible which is not significant. The effects of eutrophication on each catchment are therefore not considered further below.

Tre'r Gof Catchment

8.5.120 The changes to the environment which could affect this receptor include the presence of landscape mounds and associated drainage system. Potential effects on surface water within the Tre'r Gof Catchment are summarised below.

- The presence of landscape mounding and drainage would reduce the catchment area of the Tre'r Gof outflow by 9% (appendix D8-7, Application Reference Number: 6.4.32), resulting in lower flows within the catchment. The mounding and drainage could also alter the rainfall/runoff response and result in a decrease in the long-term base flow to the Tre'r Gof SSSI. The hydrological 4R model has quantified the changes to water availability within the Tre'r Gof drains, and the summary of this can be found within appendix D8-7 (Application Reference Number: 6.4.32). The modelling results show that the mean change in flow duration from the baseline to the operation scenario for the Tre'r Gof drains is a reduction in flow at all five model nodes within the SSSI. There is a decrease of 74m^3/day (0.86l/s) at the outflow from Tre'r Gof SSSI (VN5). Based on the percentage impact of operation on the flow duration curve, this decrease presents a long-term change equivalent to +/-10% or more of the Q_{95}. This equates to a large magnitude of change (see criteria for water availability in table B8-12 in chapter B8, Application Reference Number: 6.2.8). However, given the small size of the Tre'r Gof drains and intermittent flows which range throughout the year from dry to flood conditions, variable flow conditions are a key hydrological function of the Tre'r Gof SSSI. The criteria for water availability in table B8-12 in chapter B8 (Application Reference Number: 6.2.8) are less applicable to such small, intermittent watercourses and therefore the magnitude of change on water availability within the Tre'r Gof SSSI is considered to be medium. This magnitude takes into account the fact that the change would be long-term/permanent, in comparison to the construction scenario when it would be temporary and short-term. This change would result in a major adverse effect, which is significant. It should be noted that due to uncertainty in the assessment of changes to water availability, the assessment of effect has taken a precautionary approach.
- Landscape mounding could locally increase the steepness of land surfaces and the drainage would provide preferential flow pathways for surface water. This could increase overland flow rates, resulting in increased flooding. The use of ditches at the bottom of the landscape mounds, allowing flows to be captured and discharged to the drainage system, means that the magnitude of change is considered to be small and the effect is considered to be minor adverse. This is not significant.

Afon Cafnan Catchment and Cae Gwyn SSSI

8.5.121 The changes to the environment within the Afon Cafnan Catchment that could affect the receptors include:

- presence of landscape mounds and associated drainage system;
- presence of impermeable surfacing; and
- parking of cars and vehicular movements.

8.5.122 Potential effects from the above activities on surface water within the Afon Cafnan Catchment are summarised below.

- The presence of landscape mounding and drainage would reduce the catchment area of the most downstream modelled point (Caf11) by 6% (appendix D8-7, Application Reference Number: 6.4.32) resulting in slightly lower flows within the catchment. The landscape mounding and associated drainage could also alter the rainfall/runoff response and result in a decrease in the long-term base flow to watercourses within the catchment. The hydrological 4R model has quantified any changes to water availability within the Afon Cafnan Catchment, and the summary of this can be found within appendix D8-7 (Application Reference Number: 6.4.32). The modelling results predict that the mean change in flow duration from the baseline to the operation scenario across the Afon Cafnan Catchment is a decrease of 537m^3/day (6l/s) at the most downstream modelled point (Caf11). Based on the percentage impact of operation on the flow duration curve, this decrease presents a long-term change equivalent between +/-5% and +/-10% of the Q_{95}. This equates to a medium magnitude of change (see criteria for water availability in table B8-12 in chapter B8, Application Reference Number: 6.2.8) which is larger than during construction. This is because it takes into account the fact that the change would be long-term/permanent, in comparison to the construction scenario when it would be temporary and short-term. This change would result in a moderate adverse effect, which is significant. It should be noted that due to uncertainty in the assessment of changes to water availability, the assessment of effect has taken a precautionary approach.
- The modelling results indicate that there are increases to flood depths where Cemlyn Road crosses the Afon Cafnan and to land adjacent to the realigned section of Nant Caerdegog Isaf. The increases in fluvial flood depths during the 1 in 100 year event are 0.6m and 0.01m, respectively. The surface water flood depth during the 1 in 100 year event at Cemlyn Road decreases by 0.13m, whilst the flood depth at land adjacent to the realigned section of Nant Caerdegog Isaf increases only at the upstream end of the watercourse and only by 0.08m (appendix D8-4, Application Reference Number: 6.4.29). The magnitude of change associated with the depth increases is medium, which would result in a major adverse significance of change at Cemlyn Road and a minor adverse significance of effect for the land adjacent to the watercourse realignment. However, after the granting of the Development Consent Order the property at Cafnan affected by this increased flood risk would be owned by Horizon and only leased if appropriate. Use of Cemlyn Road and exposure to this increased flood risk is therefore expected to be reduced and no additional mitigation measures are currently proposed. No additional mitigation measures are required for land at Nant Caerdegog Isaf as the effect occurs within the existing floodplain.

8.5.123 The use of the car parking areas, and vehicular movements around the Power Station Site on roads, could result in leaks and spillages of fuels or oils, resulting in effects on water quality. This would be mitigated through the use of oil interceptors in the drainage system which would result in a negligible magnitude of change and a negligible effect and is not significant.

Cae Gwyn SSSI

8.5.124 No works would take place within the boundary of the Cae Gwyn SSSI. However, the construction of the car parking and simulator and training building; to the immediate east of the Cae Gwyn SSSI, and the presence of landscape mounds and associated drainage system, could affect the SSSI during Power Station operation.

8.5.125 Only a small area (approximately 300m^2) of the primary outfall basin of the Cae Gwyn SSSI falls within the Wylfa Newydd Development Area. The drainage from the simulator and training building, as well as Mound C, would discharge into toe drains prior to an outfall into Nant Caerdegog Isaf to the north, and downstream of the Cae Gwyn SSSI. The hydrological 4R model has quantified any changes to water availability within the Afon Cafnan and includes a point (Caf2) on Nant Caerdegog Isaf at its outfall from the Cae Gwyn SSSI (and upstream of the drainage outfall). The summary of this can be found within appendix D8-7 (Application Reference Number: 6.4.32). The modelling results do not predict any change in flow duration from the baseline to the operation scenario at Caf2. On this basis the magnitude of change on water availability is considered to be negligible, with the resulting effect also being negligible and is not significant.

Cemaes Catchment

8.5.126 The changes to the environment that could affect surface water within the Cemaes Catchment include the presence of landscape mounds and associated drainage system. The potential effects of these on surface water within the Cemaes Catchment are summarised below.

- The presence of landscape mounding and drainage would increase the catchment area of the most downstream modelled point (Cae7) by 2% (appendix D8-7, Application Reference Number: 6.4.32) resulting in slightly higher flows within the catchment. The mounding and drainage could also alter the rainfall/runoff response and result in a decrease in the long-term base flow to Nant Cemaes. The hydrological 4R model has quantified any changes to water availability within the Cemaes Catchment, and the summary of this can be found within appendix D8-7 (Application Reference Number: 6.4.32). The modelling results predict that the mean change in flow duration from the baseline to the operation scenario across the Cemaes Catchment is an increase of 54m^3/day at the most downstream model node (Cae7). Based on the percentage impact on the flow duration curve, this increase presents a long-term change equivalent between +/-5% and +/-10% of the Q_{95}. As it is a long-term/permanent change this equates to a medium magnitude of change (see criteria for water availability in table B8-12 in chapter B8, Application

Reference Number: 6.2.8) which would result in a moderate adverse effect and is significant. It should be noted that due to uncertainty in the assessment of changes to water availability caused by the drainage scheme, the assessment of effect has taken a precautionary approach.

- The fluvial and pluvial modelling results indicate that there are changes in flood depths to the Nant Cemaes near to Brookside Garages and residential properties upstream of Cemaes village. Fluvial flood depths on the Nant Cemaes upstream of Cemaes are predicted to increase by 0.04m during the 1 in 100 year event, whilst surface water flood depths are predicted to increase by 0.01m (appendix D8-4, Application Reference Number: 6.4.29). This increase in flood depth is considered to have a medium magnitude of change. Given the high sensitivity of the receptor to flood risk, the effect is considered to be major adverse, which is significant.

Cemlyn Catchment and the Cemlyn Bay SSSI

8.5.127 The changes to the environment that could affect surface water within the Cemlyn Catchment include the presence of landscape mounds and associated drainage system. The potential effects of these on surface water within the Cemlyn Catchment are summarised below.

- The presence of landscape mounding and drainage would increase the catchment area of the most downstream modelled point (Cem4) by 1% (appendix D8-7, Application Reference Number: 6.4.32) resulting in slightly higher flows within the catchment. The mounding and drainage could also alter the rainfall/runoff response and result in a decrease in the long-term base flow to Nant Cemlyn. The hydrological 4R model has quantified any changes to water availability within the Cemlyn Catchment, and the summary of this can be found within appendix D8-7 (Application Reference Number: 6.4.32). The modelling results predict that the mean change in flow duration from the baseline to the operation scenario across the Cemlyn Catchment is an increase of 27m^3/day (or 0.3l/s) at the most downstream model node (Cem4). This node is located at the outfall of the Nant Cemlyn into the Cemlyn Lagoon. Based on the percentage impact on the flow duration curve, this increase presents a long-term change equivalent of between +/-5% and +/-10% of the Q_{95}. As the change is long-term/permanent this equates to a medium magnitude of change to the Nant Cemlyn Catchment (see criteria for water availability in table B8-12 in chapter B8, Application Reference Number: 6.2.8) which would have a major adverse effect and is considered to be significant. Although an increase in water flow is often seen as beneficial (so long as it does not cause flooding) in this instance there is uncertainty in the effect of the change on the environment and therefore a precautionary approach has been adopted such that any change from baseline is considered to have an adverse effect.

- The Cemlyn Lagoon is a high value surface water receptor as the Nant Cemlyn discharges into it. Cemlyn Lagoon is part of the Cemlyn Bay SSSI, SPA and SAC, and so the effect of the mounding on the lagoon has been considered as well as the direct effect on the Nant Cemlyn (considered above). However, as stated in chapter D13 (Application Reference Number: 6.4.13), the Nant Cemlyn discharge is small in comparison to the size of the lagoon, therefore the magnitude of change on the lagoon is predicted to be small, with the significance of effect being minor adverse. This is not a significant effect. As it is not clear whether an increase in water availability would be beneficial or not it has been treated as an adverse effect as it is a move away from baseline, although this is not a significant effect. It should be noted that due to uncertainty in the assessment of changes to water availability, the assessment of effect has taken a precautionary approach.
- The fluvial modelling results indicate that there is an increase in flood risk (increase in water depth of 0.02m in the 1 in 100 year event) at the outfall of the Nant Cemlyn into Cemlyn Lagoon. The increase in surface water flood depth is 0.01m. As detailed in the FCA (appendix D8-4, Application Reference Number: 6.4.29) as the stream is small and Cemlyn Lagoon is large, the potential magnitude of change in water level in the lagoon is negligible and the flood risk to Cemlyn Lagoon is also negligible. The significance of effect is therefore negligible which is not a significant effect.

Power Station Catchment

8.5.128 Following construction, the Power Station Catchment (in the form referred to in section 8.3) would no longer exist due to the loss of Nant Porth-y-pistyll and its natural catchment. There would be a new and artificial operational plant drainage system which would drain the majority of surface water to the coast. Toe drains around the Power Station would also take runoff away from the Power Station and into the toe drains of landscape mounds surrounding the Power Station. These include Mound B (Tre'r Gof drains), Mound C (Nant Caerdegog Isaf) and Mound D (Afon Cafnan). For this reason, the Power Station Catchment would no longer be a surface water receptor during operation.

Other areas

8.5.129 There are no activities within the coastal areas that could affect the (freshwater) surface water receptors.

Fluvial geomorphology

8.5.130 This section presents the findings of the assessment of potential effects from the Power Station operation and changes to the environment within the Wylfa Newydd Development Area to the identified fluvial geomorphology receptors with any effects identified as being moderate or greater, pre-additional mitigation, summarised in table D8-10.

8.5.131 During operation all fluvial geomorphology receptors could potentially be affected by permanent site drainage (including outfalls). The Nant Porth-y-pistyll is not assessed as part of the operation of the Power Station as it would be removed during construction.

Tre'r Gof SSSI drains

8.5.132 The discharge from the outfall has the potential to alter flow (through deflection and changes to flow patterns) and sediment processes locally within one of the watercourses forming the Tre'r Gof SSSI drains. However, as the outfall is proposed to discharge into an existing culvert, these changes would not cause a direct effect on the channel bed and banks. Taking this into consideration alongside good practice and embedded mitigation, this would result in a small magnitude of change. When combined with a low receptor value, this would result in a negligible effect on the Tre'r Gof SSSI drains which is not a significant effect.

8.5.133 The permanent changes to the topography (mainly as a result of mounding) and site drainage within the Wylfa Newydd Development Area could also alter overland flow paths during operation of the Power Station. This could potentially alter flow and sediment processes within the Tre'r Gof SSSI drains. By taking into consideration the embedded mitigation (i.e. implementation of a surface water and groundwater strategy as set out in the Wylfa Newydd CoOP, Application Reference Number: 8.13) the magnitude of change on fluvial geomorphology is considered to be small. When combined with a low receptor value, this would result in a negligible effect, and so is not significant.

Afon Cafnan

8.5.134 The discharges from the three outfalls along the Afon Cafnan have the potential to increase water entering the channel causing flow and sediment processes to alter locally within the channel. This could lead to ongoing scour of the bed around the outfall structures and of the opposite bank. The changes in flow (through deflection and changes to flow patterns) could locally alter deposits or sediment build-up, with potential for changes to the morphological features present. For the Afon Cafnan, the magnitude of change is considered to be small, due to the local nature of the changes and taking into consideration embedded and good practice mitigation in the form of outfall design and controlled discharge rates. When combined with a medium receptor value, this would result in a minor adverse effect, and so is not significant.

8.5.135 The Afon Cafnan would be altered further by two toe drains running parallel to the watercourse on either side for an approximate distance of 580m, eventually discharging into the watercourse. This, along with the potential for changes in overland flow along the entire length of the channel, could potentially cause a localised change in the flow processes and consequently the morphological features. Due to the small proportion of the total length of the river affected, and the nature of the changes, this is considered to have a medium magnitude of change on the watercourse and therefore, when combined with a medium receptor value, a minor adverse effect. This is not a significant effect.

Nant Caerdegog Isaf

8.5.136 The discharge from the outfall proposed on the Nant Caerdegog Isaf has the potential to alter flow and sediment processes locally within the channel. This could lead to ongoing scour of the bed around the outfall structure and of the opposite bank. The changes in flow could locally alter deposits or sediment build-up, with potential for changes to the morphological features present. For the Nant Caerdegog Isaf, the magnitude of change is considered to be small, due to the local nature of the changes and taking into consideration embedded and good practice mitigation. When combined with a low receptor value, this would result in a negligible effect, which is not significant.

8.5.137 The changes to the topography and drainage (including newly created channels and discharge points) within the Wylfa Newydd Development Area could also alter overland flow paths. This could potentially alter flow and sediment processes within the Nant Caerdegog Isaf. By taking into consideration the buffers along the stream, the magnitude of change on fluvial geomorphology is considered to be small, which, when combined with a low receptor value, would result in a negligible effect. This is not a significant effect.

Nant Cemaes

8.5.138 The discharges from the outfall proposed on the Nant Cemaes have the potential to alter flow and sediment processes locally within the channel. This could lead to ongoing scour of the bed around the outfall structure and of the opposite bank. The changes in flow could locally alter deposits or sediment build-up, with potential for changes to the morphological features present. For the Nant Cemaes, the magnitude of change is considered to be small, due to the local nature of the changes, and taking into consideration mitigation such as angling the outfall pipe downstream and attenuation of stream flow. When combined with a low receptor value, this would result in a negligible effect and so is not significant.

8.5.139 The changes to the topography and drainage (including newly created channels and discharge points) associated primarily with Mound A could also alter overland flow paths. This could potentially alter flow and sediment processes within the Nant Cemaes. By taking into consideration the embedded mitigation, including a buffer along the stream and implementation of the drainage strategy, the magnitude of change on fluvial geomorphology is considered to be small. When combined with a low receptor value, this would result in a negligible effect and so is not significant.

Nant Cemlyn

8.5.140 The discharge from the outfall proposed on the Nant Cemlyn has the potential to alter flow and sediment processes locally within the channel. This could lead to ongoing scour of the bed around the outfall structure and of the opposite bank. The changes in flow could locally alter deposits or sediment build-up, with potential for changes to the morphological features present. For the Nant Cemlyn, the magnitude of change is considered to be small, due to the local nature of the changes and taking into consideration embedded and good practice mitigation (including angling the outfall downstream and

attenuation of stream flow). When combined with a low receptor value, this would result in a minor adverse effect and so is not significant.

8.5.141 The changes to the topography and site drainage (including newly created channels and discharge points) within the Wylfa Newydd Development Area could also alter overland flow paths. This could potentially alter flow and sediment processes within the Nant Cemlyn. By taking into consideration the embedded mitigation, including a buffer along the stream and implementation of the drainage strategy, the magnitude of change on fluvial geomorphology is considered to be small. When combined with a low receptor value, this would result in a negligible effect and so is not significant.

Groundwater

8.5.142 This section presents the findings of the assessment of potential effects from the Power Station operation and changes to the environment within the Wylfa Newydd Development Area to the identified groundwater receptors. Any effects identified as being moderate or greater, pre-additional mitigation, are summarised in table D8-11. In many instances the results of groundwater modelling have been used to assess the effect on groundwater levels, flow and discharge. The model assumes that during operation any major groundwater inflows to the deep basements would have been sealed by shotcreting during construction and that a drain would be installed around the deep basement at 6mAOD.

Tre'r Gof SSSI

8.5.143 For the Tre'r Gof SSSI, the assessment for shallow groundwater effects has been included in the surface water section of this chapter as the two are intrinsically linked. The assessment of the SSSI monitoring data has not identified a significant bedrock groundwater input to the SSSI, although it is recognised that bedrock groundwater inflows might be locally important to certain vegetation assemblages in the SSSI.

8.5.144 The groundwater modelling work (appendix D8-7, Application Reference Number: 6.4.32) predicts a reduction in water level during operation on the western boundary of the Tre'r Gof SSSI of up to 0.43m (this being for a dry period). The model predicts the bedrock groundwater discharging to surface water within the SSSI boundary increases by about 0.2m^3/day during the wet period and reduces by 2.6m^3/day during the dry period. This compares to a baseline outflow from the SSSI of around 800m^3/day so a predicted overall change of less than 0.5% of all flows. As noted above, the bedrock groundwater flowing towards the SSSI does not form a major component of the inputs to the Tre'r Gof SSSI. The 4R and MODFLOW results support this conceptual understanding as the 4R results show that the total average discharge from the SSSI (at VN5) is in the order of 800m^3/day. Therefore, the groundwater inputs estimated from the model as being between 17m^3/day and 37m^3/day for the dry and wet periods respectively represent a small component of the overall flow (around 3% of the total discharging from the SSSI). As such, the magnitude of change from the operational phase on bedrock groundwater inputs to the high value Tre'r Gof SSSI is considered to be negligible with a negligible effect, which is not significant.

Cae Gwyn SSSI

8.5.145 Drainage installed around the deep basements has the potential to reduce groundwater levels at the Cae Gwyn SSSI and reduce the bedrock groundwater input to the SSSI. The bedrock groundwater model (appendix D8-7, Application Reference Number: 6.4.32) predicts that there would be no significant reduction in water level at the Cae Gwyn SSSI compared to baseline. The model results predict that the maximum decrease of flow into the SSSI is 3.2m^3/day (this being for a wet period). This reduction in groundwater input to the SSSI's surface water drains compares to the estimated total outflow from the SSSI calculated in the SSSI's water balance in appendix D8-6 (Application Reference Number: 6.4.31) of approximately 235m^3/day and represents a small proportion (approximately 1.5%) of the total outflow. The magnitude of change for the operational works on the groundwater input to the high value Cae Gwyn SSSI is therefore assessed as small with the resultant effect being minor adverse, which is not significant.

8.5.146 A landscape mound would be constructed adjacent to the east of the Cae Gwyn SSSI. Long-term, through the Power Station's operation, this mound may result in a reduction of direct shallow groundwater recharge through the superficial deposits and hence change in groundwater levels near the SSSI. However, the scale of this effect is local and as such, the magnitude of change from mound creation near the Cae Gwyn SSSI would be small. The effect would therefore be minor adverse, which is not significant.

Cemlyn Bay SSSI

8.5.147 With respect to the effects of change in groundwater inputs to the Cemlyn Bay SSSI and Nant Cemlyn (which flows into the SSSI) during operation, this has been considered with the aid of the groundwater model (appendix D8-7, Application Reference Number: 6.4.32). The passive drainage system associated with basements and changes to groundwater recharge for the operational phase has the potential to alter direct flows into either Cemlyn Lagoon or Nant Cemlyn.

8.5.148 The bedrock groundwater model predicts the maximum reduction in groundwater level compared to baseline in the aquifer in the vicinity of Cemlyn Bay SSSI and Nant Cemlyn of up to 0.5m, but with no discernible reduction adjacent to the SSSI itself. The groundwater flow direction does not change and groundwater continues to flow into the Nant Cemlyn and Cemlyn Lagoon.

8.5.149 The bedrock groundwater flow model predicts that groundwater discharging to the Cemlyn Lagoon during the operation phase would reduce by 0.1m^3/day and 0.2m^3/day (for the dry and wet period respectively). This compares to a total bedrock groundwater inflow into the Cemlyn Bay SSSI of 81m^3/day and 170m^3/day for the two scenarios (so a change of 0.1% of the total inflow for both scenarios).

8.5.150 On this basis of the groundwater modelling results, the change in flows is unlikely to be measurable and the magnitude of change for groundwater flows into the SSSI for the operational phase on the high value Cemlyn Bay SSSI is considered to be negligible with an overall negligible effect. This is not significant.

Private water supplies

8.5.151 A change in groundwater levels, principally due to the passive drainage system used for deep basements and changes to groundwater recharge rates, has the potential to result in a reduction of water levels at the PWSs closest to the Wylfa Newydd Development Area. Groundwater modelling (appendix D8-7, Application Reference Number: 6.4.32) has been used to assess the effects of the operational phase on the water levels at the PWSs identified by the IACC at Foel Fawr, Cae Gwyn and Caerdegog Uchaf. The model results show that there would be no significant change to groundwater levels for all the PWSs for all modelled scenarios (the maximum predicted reduction in groundwater level compared to baseline is 0.01m for the Foel Fawr PWS). As such, the magnitude of change during operation on the water supply for the PWSs identified by the IACC would be negligible with the effect also being negligible, and so not significant.

8.5.152 As noted previously, as the PWS wells are situated up hydraulic gradient of the Wylfa Newydd Development Area, if contamination were to occur during operation of the Power Station it would not flow towards the wells. As such, there could be no effect from the operation of the Power Station and changes to the environment within the Wylfa Newydd Development Area on water quality in the PWSs.

8.5.153 For properties outside the Wylfa Newydd Development Area reliant on groundwater supplies but not known to the IACC, the effects of the passive drainage system and changes to recharge mechanisms on the water levels have been considered by assessment of the changes in groundwater levels predicted by the groundwater model. The only area of potential drawdown identified by the model is to the south-east, primarily around Tregele. In this area the dry period model predicts a decrease in groundwater level of less than 1m, whilst the wet period model predicts a decrease of less than 0.2m. All of the properties in the area of drawdown are within the village of Tregele and would appear to be served by mains water. As such, the magnitude of change from lowering of groundwater levels affecting PWSs is negligible with the effect also being negligible and therefore not significant.

Existing buildings

8.5.154 The Wylfa Newydd Development Area bedrock groundwater model (appendix D8-7, Application Reference Number: 6.4.32) has been used to assess the change in groundwater levels that could occur at the Existing Power Station during operation. The model predicts that there could be up to around 2m reduction in groundwater levels compared to the baseline (this being for a dry period). As significant subsidence effects are unlikely with less than 2m of drawdown unless the ground conditions are poor, ancillary buildings and services are unlikely to be susceptible to subsidence from the change in groundwater level (and this is assuming these structures are still present at the Existing Power Station at the time of operation). As such, the magnitude of change for subsidence at the Existing Power Station from reduction in groundwater level during the operational phase is considered to be small. Given the value of the ancillary buildings and services at the Existing Power

Station (high), the effects are considered to be minor adverse, and are not significant.

8.5.155 For properties other than the Existing Power Station, the bedrock groundwater modelling results show that the predicted maximum reduction in groundwater level compared to baseline at properties to the north-east of the Wylfa Newydd Development Area is less than 0.5m with the maximum reduction being less than 1m in the village of Tregele to the east. Given that the model is extremely conservative for the operational scenario, the small size of these properties, and that there would be less than 1m of drawdown, the settlement over the length of the buildings would be negligible. As such, the magnitude of change is considered to be negligible. Given the value of these properties (high), the effects are considered to be minor adverse and are not significant.

Secondary aquifers

Groundwater quality – saline intrusion to the aquifer

8.5.156 The bedrock groundwater model shows that during the operational phase, there would be no saline intrusion to the aquifer. Reduction of groundwater levels caused by the passive drainage system at 6mAOD could potentially cause upwelling of deeper, saline groundwater to shallower groundwater over the long term. However, from the groundwater quality monitoring (appendix D8-3, Application Reference Number: 6.4.28) there is no evidence of a saline wedge extending significantly into the aquifer. As such the magnitude of change for saline intrusion, or movement of any saline wedge beneath the Power Station, is considered negligible and the effects of saline intrusion for the operational phase is also assessed as negligible. These effects are not significant.

Groundwater levels and flow direction in the aquifer – changes due to the presence of mounds and platforms, hardstanding and buildings and passive drainage system

8.5.157 The presence of the completed landscape mounds and hardstanding (including roads, car parks, storage compounds and buildings) plus the presence of the passive drainage system around the reactor and generator buildings have the potential to change groundwater recharge rates and associated groundwater levels.

8.5.158 The groundwater model (appendix D8-7, Application Reference Number: 6.4.32) predicts that groundwater would continue to flow in broadly the same direction as the baseline conditions with no groundwater being pulled in from the coast. However, due to the reduction in water levels (compared to baseline) due to the drainage system, locally groundwater direction does change with groundwater from the west and east of the deep basements being captured in the drains, rather than flowing to the coast. As such, the magnitude of the effect of the Power Station operation and changes to the environment within the Wylfa Newydd Development Area for groundwater levels and flow direction in the aquifer is medium and the effect on the low value aquifer is assessed as being minor adverse. This effect is not significant.

8.5.159 For local watercourses, the model shows that the presence of the hardstanding and passive drainage system would not cause bedrock groundwater levels to alter significantly at the locations of most of the watercourses. The modelling results show that in relation to the local watercourses, the greatest reduction in groundwater level compared to baseline would occur in the Nant Caerdegog Isaf at the point closest to the deep basements and the lower reach of the Afon Cafnan. No discernible effects would be seen for Nant Cemlyn or Nant Cemaes. The groundwater model predicts that an average of 27m^3/day of water would be removed by the drainage system. Compared to flows in the streams (the total baseline flows from the 4R model for the four major catchments is 15,000m^3/day) this represents the removal of groundwater from the system of 0.2% of the total stream flow.

8.5.160 As noted previously, the groundwater component of surface water flows is small. Therefore, for the medium value watercourses, the magnitude of change is small and the overall effect of changes in groundwater levels to the local watercourses during the operation of the Power Station is considered to be minor adverse. This effect is not significant.

8.5.161 The presence of structures constructed below the bedrock groundwater table, including deep basements and the cooling water tunnels, could form a partial barrier to groundwater flow, particularly where these pass through the more fractured zone at the rockhead surface. This could potentially lead to higher groundwater levels up hydraulic gradient and lower levels down hydraulic gradient and locally alter the groundwater flow direction. Inputs of groundwater to surface water features could then be affected.

8.5.162 The largest features to be constructed below the bedrock groundwater table are the basement to house the reactor and generators and the cooling water outfall tunnels. For the deep basements, these would be surrounded by permeable rock fill which would provide a pathway for groundwater to move around the outside of the below ground structures and not affect groundwater flow levels either side of the building significantly. Where necessary, shotcrete would have been used on the walls of the excavation during construction of the basements to reduce groundwater inflow, and in this case the presence of the deep excavation would continue to locally affect the groundwater flow direction by acting as a local barrier to groundwater flow.

8.5.163 With respect to the cooling water outfall tunnels, as noted in the construction section of this assessment, the tunnels would be constructed largely beneath the principal fractured section of rockhead and the significant flowpaths would not be intercepted by the majority of the tunnel and construction techniques are such that a flowpath is unlikely to be created by the tunnel. As such, the cooling water outfall tunnel would not significantly affect groundwater flow levels or direction.

8.5.164 On the basis of the above, the magnitude of the change due to below ground structures affecting groundwater flow and levels during the operation of the Power Station would be small and when considering the aquifer as a whole and associated effects on the watercourses (i.e. secondary receptors) within the study area the effect would be negligible, and so not significant.

Groundwater quality – spills and leaks of hydrocarbon fuel and chemicals to the aquifer

8.5.165 Operation would require hydrocarbon fuel to be stored on-site for emergency diesel generators and other generators and for fuelling site vehicles and plant. To meet the nuclear safety case requirement for the Power Station, the emergency diesel generators are required to have seven days' supply of fuel.

8.5.166 There is the potential for leaks from the tanks or when fuel is being delivered to the Power Station. However, the emergency diesel generator tanks would be within buildings with impermeable hardstanding. The back-up building bulk diesel tanks and the standby generator bulk diesel tanks would be located above ground, along with all associated pipework and diesel delivery systems. As set out in the Wylfa Newydd CoOP (Application Reference Number: 8.13) all fuel would be stored in tanks with secondary containment systems (such as bunds) conforming to the Oil Storage Regulations. As such, the magnitude of the effect on groundwater quality from the potential for leaks and spills of fuel would be negligible with the effect on the low value aquifer also being negligible, and therefore not significant.

8.5.167 As with fuels, oils (such as engine oil and hydraulic oil) and waste oil would be stored on-site. It is estimated that there would be approximately 28m^3 of lubricating oil stored on the Power Station Site associated with the emergency generators and auxiliary boiler building, with further storage of associated waste lubricating oil. Further oil would be required for the plant (including turbines and pumps) within the reactor and turbine building. Oil tanks would be situated in buildings or on hardstanding with secondary containment systems conforming to the Oil Storage Regulations. As such, the magnitude of the effect on groundwater quality from leaks or spills of oil would be negligible with the effect on the low value aquifer also being negligible and therefore not a significant effect.

8.5.168 A wide range of chemicals would be required for the operation of the Power Station including for operation, routine maintenance and water treatment. The most substantial would be 600m^3 of sodium hypochlorite, used for biocide dosing. Where practicable the chemicals would be stored indoors and on hardstanding to protect the underlying groundwater. Procedures for storage of chemicals is included in the surface water and groundwater strategy of the Wylfa Newydd CoOP (Application Reference Number: 8.13). All chemical storage at the Power Station would be within engineered containment facilities, including (where appropriate) suitably bunded tanks. Furthermore, chemical storage would comply with guidance including that in NRW's How to Comply with Your Environmental Permit [RD32]. This guidance indicates that chemical storage areas must be designed and operated to minimise the risk of releases to the environment. The bulk storage of chemicals would also be subject to the arrangements set out in the Power Station's operational Environmental Permit, including routine inspections of tanks and secondary containment systems. As such, the magnitude of effects on groundwater receptors due to leaks or spills of chemicals would be negligible and the effect would also be negligible and therefore not a significant effect.

8.5.169 With the likelihood that the majority of chemical use would be indoors on plant located on hardstanding areas, the magnitude of effects from the use of chemicals on groundwater receptors would be negligible and the effect would be negligible. This effect is not significant.

8.5.170 For the operational phase, car parking would be on-site at the locations outlined in chapter D1 (Application Reference Number: 6.4.1). All car parks would be on hardstanding with drains to the Power Station Site's drainage system via oil interceptors. As such, the magnitude of change on groundwater quality from leaks of oil or fuel from parked cars would be negligible and the effect would also be negligible which is not significant. This would be the same for traffic using the Power Station, with road drainage and other hardstanding draining to surface water.

Groundwater quality – spills and leaks of sewage

8.5.171 It is proposed that sewage from the operational phase would be treated in the existing DCWW Cemaes Waste Water Treatment Works (these works would be upgraded to accommodate the extra discharge). During the Power Station operations, there would be potential for leaks of untreated sewage from below-ground pipework to affect groundwater quality although given that the sewers would be new and installed in line with good practice, they are unlikely to leak, particularly during the early years of operation. Any large leaks, if they were to occur, would likely be quickly noted due to changes of flows into the sewage treatment works. However, smaller leaks may go unrecorded although a management strategy in the surface water and groundwater strategy in the Wylfa Newydd CoOP (Application Reference Number: 8.13) would be in place so that below-ground pipes and drainage would be subject to regular inspection and maintenance.

8.5.172 As such, the magnitude of change of sewage leaking to the groundwater in the low value aquifer is considered to be small and the effects are considered to be negligible and not significant.

8.5.173 Given the location of the Power Station, the groundwater flow direction and location of local watercourses, the leakage of sewage and subsequent groundwater base flow would not affect local watercourses or PWSs.

Groundwater quality – effects during construction of the Spent Fuel Store

8.5.174 The potential effects on groundwater quality from the construction of the spent fuel store, approximately 10 years after the construction of the remainder of the Power Station is complete, would be similar to those from the construction of the Power Station, albeit on a much smaller scale. However, groundwater dewatering would not be required. The potential effects on groundwater quality would therefore be from the spills and leaks of fuel used in construction plant and the potential for cementitious material used below ground to contaminate groundwater. However, due to the relatively small scale of the works, and with the embedded and good practice mitigation that would be in place, including following the strategy set out in the water management strategy in the Wylfa Newydd CoCP (Application Reference Number: 8.6) produced for these construction works, the magnitude of effects on groundwater levels and quality in the aquifer from the construction of the

facility would be small and the effects would be minor adverse which is not significant.

8.5.175 The groundwater model for the operational phase (appendix D8-7, Application Reference Number: 6.4.32) shows that near the spent fuel store the groundwater would be flowing to the north-east, away from the local watercourses and towards the passive drainage system associated with the deep basements. As such, there would be no pathway in the groundwater to the local watercourses. Therefore, the magnitude of change of construction of the spent fuel store on local watercourses via a groundwater pathway would be negligible, and the effect would not be significant.

Decommissioning

8.5.176 The assessment of effects during decommissioning has been made against the current baseline. The works required to decommission the Power Station would be subject to a separate Environmental Impact Assessment produced at the time of decommissioning. This would assess in detail the effects against the baseline conditions at that time. The decommissioning activities are currently not known. Therefore, specific activities, and how they would affect the surface water and groundwater receptors, can only be assessed generically and based on the methods and equipment that would be used today. It is likely that by the time of decommissioning more environmentally friendly methods and equipment could be available, e.g. battery-operated plant and machinery.

Surface water

8.5.177 Some of the effects on the surface water receptors are likely to be similar to those identified in the construction process, with the key potential effects likely to include the following.

- Release of sediment during works associated with removal of hardstanding and operational drainage infrastructure within the Power Station Site and Afon Cafnan Catchment, and exposure and movement of soil associated with the Power Station Site restoration. This could affect the water quality of the Afon Cafnan Catchment. With application of similar pollution prevention practices applied during the construction process and a detailed restoration plan, that would be prepared as part of a future Environmental Impact Assessment, the magnitude of change is considered to be small, with an overall minor adverse effect. This effect is not significant.
- Spills or leaks of fuel and oils associated with plant could affect water quality. With application of pollution prevention practices, as well as secondary containment systems in fuel, oil and chemical storage areas, the magnitude of change is considered to be negligible, with the overall effect also negligible. This effect is not significant.
- Similarly, the magnitude of change of spillages of cementitious materials from removal of civil structures to 1m below site grade level is considered to be negligible by virtue of implementation of the pollution prevention

practices and as the material would be solid rather than liquid. Therefore, the potential effects would be negligible and not significant.

- The risk of flooding upstream of Cemaes village remains unchanged from the construction and operation scenarios (i.e. it is significant) at decommissioning as it is driven by the landscape mound / drainage designs.
- Changes in runoff associated with the decrease in the impermeable areas due to removal of hardstanding could restore a rainfall/runoff response similar to the baseline, increase recharge to groundwater and reduce flood risk. With application of a detailed restoration plan, the overall magnitude of change is considered to be small and beneficial, with an overall minor beneficial effect. This effect is not significant.

Fluvial geomorphology

8.5.178 This section presents the findings of the assessment of potential effects from the Power Station decommissioning to the identified fluvial geomorphology receptors which could potentially be affected through removal of existing structures (primarily outfalls) from within the channels.

8.5.179 The removal of any structure that has been *in situ* for a long period of time (i.e. decades) could lead to the local destabilisation of the channel, with potential for erosion and deposition in response.

8.5.180 Due to the type and nature of the watercourses within the Wylfa Newydd Development Area, the response to the structures could mean that the channel is in a state of adjustment (i.e. disturbed and moving towards a new equilibrium) for a long period of time. The types of channel found within the study area could take more than 1,000 years to adjust to a more natural form due to low channel slopes and water discharges, with low energies. This suggests that at the time of the decommissioning the channels would still be adjusting following the construction and operation of the Power Station.

8.5.181 The works to remove infrastructure and re-landscape the Power Station Site would likely lead to similar effects to those identified during construction and operation. These include: exposed bare earth surfaces causing high silt loadings; changes to flow patterns in watercourses receiving drainage (e.g. Afon Cafnan); in-channel working disturbing existing morphological features and changes to lateral connectivity of the channel with the floodplain.

8.5.182 The magnitude of change as a consequence of decommissioning is considered to be small taking into account the embedded and good practice mitigation. This includes implementing buffer zones along channels and undertaking a detailed restoration plan that would be prepared as part of a future Environmental Impact Assessment. This would lead to a minor effect for all fluvial geomorphology receptors. This effect is not significant.

Groundwater

8.5.183 This section presents the findings of the assessment of potential effects from the Power Station decommissioning to the identified groundwater receptors with any effects identified as being moderate or greater, pre-additional mitigation, summarised in table D8-11.

Groundwater levels and flow

8.5.184 Decommissioning would include removal of buildings, drainage and ducting to 1m below ground level, flushing and grouting of uncontaminated drains below 1m from ground level, removal of the majority of hardstanding, puncturing of existing basements to allow groundwater ingress and restoration of the land use to pre-construction conditions (as far as practicable). The groundwater level would then, over time, return to its pre-development level and flow directions would also be re-established. As such, the effect of decommissioning would be to restore the groundwater levels and flow to their pre-construction condition and the magnitude of change (from baseline conditions) would be negligible with the effects also being negligible and therefore not significant.

Groundwater quality – Storage, spills and leaks of hydrocarbon fuel and oils

8.5.185 There is the potential for changes to groundwater quality from leakage or spills due to the storage and use of fuels and oils used for demolition plant. To protect the underlying groundwater, fuels would be stored in line with the regulations and guidance documents pertaining at that time. As such, the magnitude of effect on groundwater quality from leaks or spills of fuel and oils associated with storage facilities would be negligible with a negligible effect and therefore not significant.

8.5.186 There is the potential for leaks of fuels (and oils) from plant during the course of the decommissioning works, but these incidents would be localised and good practice such as vehicle maintenance, the use of spill kits and drip trays would limit the potential for groundwater contamination. With respect to secondary receptors for groundwater, there would be no effects on the existing PWSs, as these are some distance up hydraulic gradient of the Power Station Site.

8.5.187 For the aquifer, which has a low value, the magnitude of the effect of leaks and spills of fuel and oil from decommissioning plant is considered to be small and as such the effect is considered negligible and not significant. For the local watercourses, these have a value of up to medium (for the Afon Cafnan; no decommissioning works would take place within the Cemlyn Catchment) and with the embedded and good practice mitigation measures including the use of spill kits and drip trays, the magnitude of the effect of leaks and spills of fuel from plant is considered to be negligible. The effect is also considered to be negligible and therefore is not significant.

Groundwater flooding

8.5.188 Following decommissioning of the Power Station's drainage system, including the passive drainage system used to control the groundwater levels around the reactor and generator buildings, groundwater levels would rise to 'natural' levels (likely to be similar to the groundwater levels identified in the baseline conditions). However, as ground levels would have been lowered in parts of the Power Station Site during the construction works to create the construction platform (with the proposed elevation of the platform for the reactors being in the region of 6mAOD to 22mAOD), there is the potential that groundwater levels could rise above the created platforms if the drainage channels on the platform could not drain water away quickly enough.

8.5.189 A groundwater model has not been run for the decommissioning scenario. Therefore, the baseline groundwater model (appendix D8-7, Application Reference Number: 6.4.32) has been used to assess whether groundwater levels are likely to rise above the platform when there is no artificial control of groundwater levels (i.e. the current scenario, but without reduced ground levels associated with development platforms). The model results predict that groundwater levels would be above the future platform level following decommissioning (this being the southern and western portion of the 22mAOD (post-construction) platform or the entire platform if this were created to 6mAOD) and so there is a risk of groundwater flooding. The magnitude of the effect is therefore assessed as medium and given the high value of the receptor (the land at the Power Station) the effect of decommissioning on groundwater flooding is assessed as moderate. This effect is significant.

Transboundary effects

8.5.190 There is the potential for the flow and quality in surface watercourses in the study area to be modified by the Power Station and to subsequently discharge to the marine environment. However, a drainage system would be designed as part of the construction of the Power Station to manage flows so that as far as practicable natural conditions can be maintained. Therefore, any changes to surface water quality and flow are likely to be limited and the marine modelling shows that any contaminants in the discharge are very rapidly diluted in the marine environment in the immediate vicinity of the Power Station Site such that there would not be any transboundary effects associated with the surface water environment.

8.5.191 Fluvial geomorphology effects would be restricted to within the 1km fluvial geomorphology study area due to the scale and nature of the proposed activities and the size and nature of the relevant receptors, with no transboundary effects possible.

8.5.192 The aquifers within the Wylfa Newydd Development Area are designated as Secondary B and Secondary (Undifferentiated) aquifers for the bedrock and superficial deposits respectively which have relatively low permeability and which are of local rather than regional or national importance. As shown by the groundwater modelling study, groundwater effects would therefore be restricted to the groundwater study area defined at the start of this chapter. No effects on groundwater would be seen beyond the study area and there

would not be any effects on the groundwater environment of another Member State of the European Economic Area.

8.5.193 In terms of the freshwater environment as a whole, taking into consideration the potential combined effects from changes to the groundwater and surface water environment, no transboundary effects would arise.

8.6 Additional mitigation

8.6.1 In accordance with chapter B1 (introduction to the assessment process) (Application Reference Number: 6.2.1), embedded and good practice mitigation measures relevant to surface water and groundwater were taken into account when determining the ‘pre-mitigation’ significance of effects. These are detailed in the design basis and activities section of this chapter.

8.6.2 Additional mitigation measures would be implemented to address potential significant effects identified in the assessment of effects section. These additional mitigation measures are summarised in table D8-6, table D8-7 and table D8-8 for construction, operation and decommissioning respectively.

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Construction

Table D8-6 Additional mitigation measures – construction

Additional mitigation measures	Objective	Achievement criteria and reporting requirements
Monitoring of the water environment will continue across the Wylfa Newydd Development Area up to the start of construction in order to improve the robustness of the baseline data. These monitoring data will then be used during detailed design to refine the drainage system to reduce potential effects on watercourse catchments in the Wylfa Newydd Development Area. Active management of the drainage system to include monitoring of every discharge point (a mixture of in situ sampling and laboratory analysis) and monitoring upstream and downstream of all outfall points to surface watercourses. Frequency will be a mix of continuous (using turbidity meters which will be calibrated to suspended solids concentrations), daily, weekly or monthly and dependent on the nature of the works and the weather (e.g. mounding would increase demands) but will continue into operation. Depending on the findings, additional mitigation may be required as agreed with the regulator. Options could include: (1) implementing dosing using polyelectrolytes, (2) installation of additional treatment capacity, (3) greater manual intervention/management of the system, (4) new drainage channels, (5) new pumping systems, (6) automated treatment and/or pumping systems. The drainage system has been designed to be as flexible as possible within the constraints of the current and future topography. This will allow changes to be made relatively easily and increase the potential for baseline conditions to be matched.	Reduce sediment loading to sensitive surface water features and prevent deterioration of surface waters.	Sampling of discharge water to check that concentration post-treatment does not exceed baseline water quality.

Additional mitigation measures	Objective	Achievement criteria and reporting requirements
Pre-construction building surveys and monitoring during construction to determine need for further mitigation. Options for further mitigation, as appropriate, will be discussed and agreed with Magnox.	Prevent subsidence of ancillary buildings and services at the Existing Power Station	No subsidence
The outline landform and drainage scheme would be revised at detailed design stage so as not to exacerbate any existing flood risk.	No significant flood risk to sensitive receptors	Hydraulic modelling to demonstrate that there is no significant flood risk

Operation

Table D8-7 Additional mitigation measures – operation

Additional mitigation measures	Objective	Achievement criteria and reporting requirements
Horizon will develop a passive engineered drainage system for the landform area. The system will match baseline conditions as closely as practicable, as part of the final landform design.	Match the flow and water quality in the watercourses during operation to that measured for the baseline conditions.	Monitoring of discharge water.

Decommissioning

Table D8-8 Additional mitigation measures – decommissioning

Additional mitigation measures	Objective	Achievement criteria and reporting requirements
At decommissioning, monitoring will be undertaken for a period of two years to establish if groundwater flooding has the potential to occur. If following monitoring, potential for groundwater flooding is identified, land drains could be used to drain the groundwater to either the sea or local watercourses. Alternatively, if functional and appropriate, the existing drainage from the operational stage could be left in place.	Keep the created platforms dry and prevent groundwater flooding.	No groundwater flooding.

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8.7 Residual effects

8.7.1 This section describes the residual effects for surface water and groundwater having taken into account the embedded, good practice and additional mitigation described above. Tables D8-9, D8-10 and D8-11 provide a summary of significant residual effects identified either prior to or post application of additional mitigation for surface water (construction and operation) and groundwater (construction and decommissioning).

8.7.2 No significant adverse effects were identified for fluvial geomorphology, surface water (decommissioning) and groundwater (operation).

8.7.3 Additionally, all effects of minor significance or greater identified in the assessment of effects section are summarised in appendix I3-1 (master residual effects table) (Application Reference Number: 6.9.8).

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Table D8-9 Summary of residual effects – surface water

Receptor (or group of receptors)	Value of receptor(s)	Description of potential effect	Nature of effect	Potential magnitude of change	Potential significance of effect	Additional mitigation	Post-mitigation magnitude of change	Significance of residual effect
Construction								
Tre'r Gof Catchment and water within the Tre'r Gof SSSI	High	Change in natural catchment area through landscape mounding and managed drainage, which could alter the rainfall/runoff rates and base flow from groundwater leading to changes to water availability	Adverse Local Temporary Short-term	Small	Moderate adverse	Monitoring would be undertaken to determine if there is a significant departure from baseline conditions. If the monitoring shows effects from the works then additional mitigation as shown in table D8-6 would be implemented.	Small	Moderate adverse (no change in residual effect due to high level of uncertainty in the likelihood of success of changes in this complex environment)

Receptor (or group of receptors)	Value of receptor(s)	Description of potential effect	Nature of effect	Potential magnitude of change	Potential significance of effect	Additional mitigation	Post-mitigation magnitude of change	Significance of residual effect
Tre'r Gof Catchment and water within the Tre'r Gof SSSI	High	Changes to surface water/ shallow groundwater inflows at seeps and flushes affecting water availability and quality due to managed drainage system.	Adverse Local Temporary Short-term	Small	Moderate adverse	Monitoring would be undertaken to assess the actual effect and if required the drainage system would be modified as detailed in table D8-6.	Small	Moderate adverse (no change in residual effect due to high level of uncertainty in the likelihood of success of changes in this complex environment)

Receptor (or group of receptors)	Value of receptor(s)	Description of potential effect	Nature of effect	Potential magnitude of change	Potential significance of effect	Additional mitigation	Post-mitigation magnitude of change	Significance of residual effect
Tre'r Gof Catchment and water within the Tre'r Gof SSSI	High	Effects of increased suspended sediment in runoff from landscape mounding prior to full vegetation growth could affect water quality.	Adverse Local Temporary Short-term	Medium	Major adverse	Monitoring would be undertaken and if required the drainage system would be modified as detailed in table D8-6 in order to reduce suspended solids concentrations.	Negligible	Minor adverse (high level of certainty that suspended solids can be reduced by active management once monitoring has identified the effect)

Receptor (or group of receptors)	Value of receptor(s)	Description of potential effect	Nature of effect	Potential magnitude of change	Potential significance of effect	Additional mitigation	Post-mitigation magnitude of change	Significance of residual effect
Afon Cafnan Catchment and Cemaes Catchment	Medium	Effects of increased suspended sediment in runoff from landscape mounding prior to full vegetation growth could affect water quality.	Adverse Local Temporary Short-term	Medium	Moderate adverse	Monitoring would be undertaken and if required the drainage system would be modified as detailed in table D8-6 in order to reduce suspended solids concentrations.	Negligible	Minor adverse (high level of certainty that suspended solids can be reduced by active management once monitoring has identified the effect)
Residential properties (Cemaes Catchment)	High	Increase in flood depth	Adverse Local Short-term	Small to medium	Major adverse	The outline landform and drainage scheme would be revised at detailed design stage so as not to exacerbate any existing flood risk.	Negligible	Negligible
Operation								
Tre'r Gof Catchment	High	Change in natural	Adverse	Medium	Major adverse	Horizon will develop a passive	Medium	Major adverse

Receptor (or group of receptors)	Value of receptor(s)	Description of potential effect	Nature of effect	Potential magnitude of change	Potential significance of effect	Additional mitigation	Post-mitigation magnitude of change	Significance of residual effect
Afon Cafnan Catchment	Medium	catchment area through landscape mounding and drainage, which could alter flow rates.	Local Permanent	Medium	Moderate adverse	engineered solution of the drainage system. The system will match baseline conditions as closely as practicable, in agreement with the regulator as part of the final landform design.	Medium	Moderate adverse
Cemaes Catchment	Medium			Medium	Moderate adverse		Medium	Moderate adverse
Cemlyn Catchment	High			Medium	Major adverse		Medium	Moderate adverse
Residential properties (Cemaes Catchment)	High	Increase in flood depth and increased risk to local receptors.	Adverse Local Permanent	Medium	Major adverse	Landform and drainage at detailed design to be modified to avoid any increase in flood risk	Negligible	Negligible
Decommissioning								
No residual effects anticipated (potential effect from groundwater flooding considered in table D8-11).								

Table D8-10 Summary of residual effects – fluvial geomorphology

Receptor (or group of receptors)	Value of receptor(s)	Description of potential effect	Nature of effect	Potential magnitude of change	Potential significance of effect	Additional mitigation	Post-mitigation magnitude of change	Significance of residual effect
Construction								
No residual effects anticipated.								
Operation								
No residual effects anticipated.								
Decommissioning								
No residual effects anticipated.								

Table D8-11 Summary of residual effects – groundwater

Receptor (or group of receptors)	Value of receptor(s)	Description of potential effect	Nature of effect	Potential magnitude of change	Potential significance of effect	Additional mitigation	Post-mitigation magnitude of change	Significance of residual effect
Construction								
Existing Power Station ancillary buildings and services	High	Subsidence due to drawdown caused by dewatering.	Adverse Local Permanent Long-term	Small	Moderate	Pre-construction building surveys and monitoring during construction to determine need for further mitigation. Options for further mitigation, as appropriate, will be discussed and agreed with Magnox.	Small	Minor
Operation								
No residual effects anticipated.								
Decommissioning								

Receptor (or group of receptors)	Value of receptor(s)	Description of potential effect	Nature of effect	Potential magnitude of change	Potential significance of effect	Additional mitigation	Post-mitigation magnitude of change	Significance of residual effect
Decomm-issioned area of Power Station	High	Groundwater flooding caused by removal of artificial drainage systems.	Adverse Local Permanent Long-term	Medium	Moderate	To control any flooding from groundwater, land drains could be used to drain the groundwater to either the sea or local watercourses. Alternatively, if functional and appropriate, the operational phase drainage could be left in place.	Negligible	Negligible

8.8 References

Table D8-12 Schedule of references

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