

## 4 SUMMARY OF CURRENT CONDITIONS

### 4.1 Approach to Current Conditions Assessment

The current conditions assessment was based on comprehensive baseline monitoring programs that measured meteorological conditions, streamflows and surface water quality across the study area. The baseline work was supported by analysis of available national datasets such as UK Met Office data and Northern Ireland Rivers Agency flow data. The results of the baseline assessments are reported in;

- The Project Climate Baseline Report
- The Project Surface Water Baseline Report

Key results are summarised below.

A climate change assessment was provided in the Surface Water Baseline Report. The UK Climate Projections (UKCP09<sup>1</sup>) indicate wetter winters and drier summers in the project site, with resulting increases in seasonality in streamflows. Given the relatively short mine life (20 years), this impact assessment focuses on current day conditions.

### 4.2 Climate

At Curraghinalt, the average hourly temperature recorded was 8.6°C with a high of 26.6°C and a low of -5.5°C. The overall patterns of seasonal temperature variations are as would be expected for this part of Northern Ireland and the on-site temperature data compares well with averages for the nearby Lough Fea and Baragher Met Office stations. The average, maximum and minimum monthly temperatures for the period 1981 to 2010 for the Lough Fea, Banagher and Castlederg Met Office meteorological stations are presented in Figure 4-1. June to August is the warmest period and December to February is the coldest period on average.

Analysis of rainfall data at the site CMS suggests that there is an under-catch of around 20 to 30% at the on-site station when compared to the UK Meteorological Office and NRFA data, due to relatively high wind speeds at the site. Monthly average rainfall recorded at the three nearby Met Office stations is shown in Figure 4-2, with data for Lough Fea considered as the most representative of site conditions. Statistical analysis of the Lough Fea data indicated that the 1 in 2 year (median) annual rainfall total for the site was 1,336 mm, with other return period totals in Table 4-1.

The maximum wind speed recorded at the CMS was 21.4 m/s (19/03/2014) with an average wind speed of 4.2 m/s. The dominant wind directions recorded at Curraghinalt were westerly and south-easterly (Figure 4-3). The CMS wind data is consistent with data for the nearby Met Office stations.

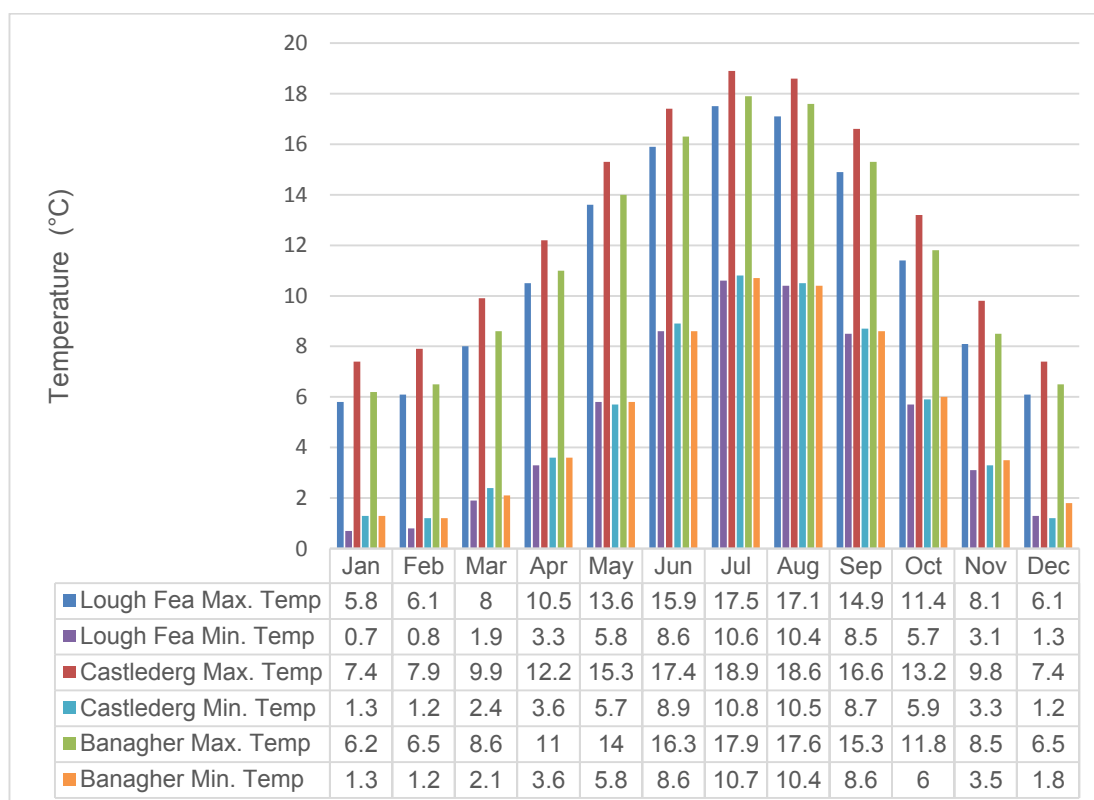
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<sup>1</sup> UKCP09 is the name given to the UK Climate Projections. The UKCP09 website allow users to access information on plausible changes in 21<sup>st</sup> century climate for the United Kingdom. UKCP09 provides future climate projections for land and marine regions as well as observed (past) climate data for the UK. <http://ukclimateprojections.metoffice.gov.uk/>

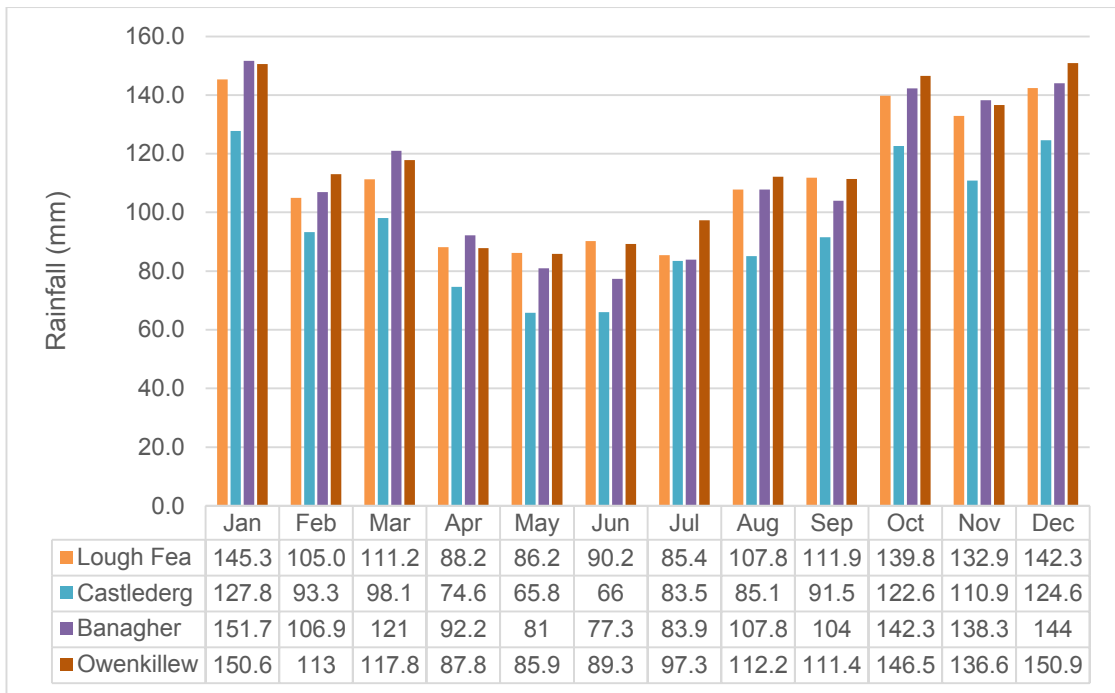
Solar radiation and ground temperature recordings at Curraghinalt displayed the expected seasonal variation; with low values in the winter period and higher values in the summer period.

**Table 4-1: Rainfall at Lough Fea Met Office station**

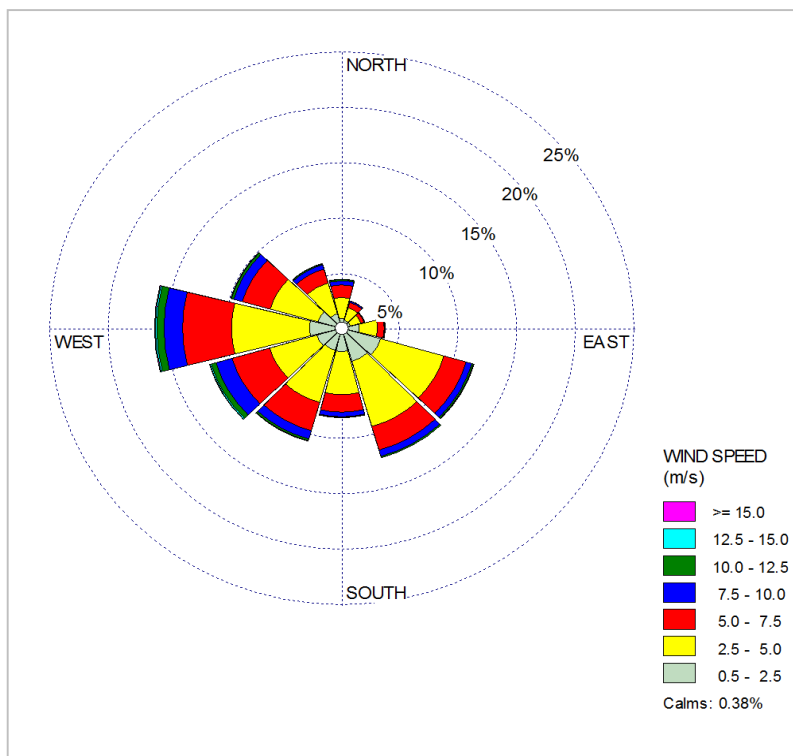
Likelihood of exceedance	Return Period	Lough Fea Rainfall (mm)
99.5%	1 in 200 dry	960
99%	1 in 100 dry	979
98%	1 in 50 dry	1,021
95%	1 in 20 dry	1,067
90%	1 in 10 dry	1,139
80%	1 in 5 dry	1,207
50%	Median	1,336
20%	1 in 5 wet	1,465
10%	1 in 10 wet	1,533
5%	1 in 20 wet	1,605
2%	1 in 50 wet	1,651
1%	1 in 100 wet	1,693
0.5%	1 in 200 wet	1,738



**Figure 4-1: Average monthly maximum and minimum temperature throughout the period 1981 to 2010 at Lough Fea, Castleberg and Banagher.**



**Figure 4-2: Monthly rainfall data for Lough Fea, Castleberg, Banagher Met Office stations and Owenkillev catchment**



**Figure 4-3: Wind Rose for the project CMS for the period January 2013 to September 2015**

### 4.3 Surface Water Hydrology

The existing infrastructure site lies adjacent to the Curraghinalt Burn, which drains to the Owenkillew River. The Attagh Burn is a small tributary to the Owenkillew River that lies immediately to the west of the Curraghinalt Burn. The proposed infrastructure site is within the catchments of the Pollanroe Burn and an Unnamed Watercourse, both of which flow into the Owenreagh River. The Owenreagh River then joins the Owenkillew River to the west of the proposed infrastructure site.

As noted in Section 3.1.3, the Owenkillew River is a tributary of the Strule River, which then joins the Mourne River, which is itself a tributary of the River Foyle. The catchment of the River Foyle is shown in Figure 4-4, with a summary of the relative catchment areas of the watercourses provided in Table 4-2. The Project is located in the headwaters of the River Foyle, within small catchments relative to the total catchment areas of the downstream watercourses, and especially the River Foyle.



**Figure 4-4: River Foyle catchment**

Map from; <http://www.fishpal.com/Ireland/Foyle/Map.asp?dom=Pal>

Note: the "Owenreagh" on this map is a different Owenreagh River to the one in the Owenkillew catchment

**Table 4-2: Catchment areas within River Foyle catchment**

Catchment	Catchment Area (km <sup>2</sup> )	Catchment as percentage of River Foyle catchment
Existing Infrastructure Site	0.01	0.0003%
Proposed Infrastructure Site	0.9	0.03%
Curraghinalt Burn at confluence with Owenkillew River	1.0	0.03%
Attagh Burn at confluence with Owenkillew River	0.6	0.02%
Owenkillew River at confluence with Owenreagh River	139.9	4.8%
Pollanroe Burn at confluence with Owenreagh River	2.04	0.07%
Unnamed Watercourse at confluence with Owenreagh River	1.39	0.05%
Owenkillew River at confluence with Strule River	454	15.5%
Strule River at Newton Stewart	1,330	45.5%
Strule River at Rivers Agency gauge 201010 near Strabane	1,844	63.0%
River Foyle near its mouth	2,925	100%

For the purpose of baseline flow monitoring, twelve streamflow gauges were constructed and operated to obtain data for the streams and rivers, immediately adjacent to the Project. In addition, daily streamflow data were acquired for selected Rivers Agency flow gauges on rivers either located close to the Project, or on sites (located a little further afield) which had similar catchment characteristics to the Owenkillew and Owenreagh Rivers.

The measured water levels at the Project gauged sites were converted to flows through the construction of stage-discharge relationships (or rating curves) for each gauge. A series of manual flow measurements were undertaken at each gauged site to obtain water level/flow pairs for a range of different flow conditions. The baseline flow data set provided a site-specific flow data that could then be compared to long-term, regional data sets obtained from the Rivers Agency.

The UK Flood Estimation Handbook (FEH) provides methods for calculating flood flows for gauged and ungauged catchments throughout the UK. These are the UK-wide standard methods for flood estimation. The FEH outlines methods appropriate for calculation of flood flows for a full range of return periods (e.g., 1 in 100 year) for catchments of different sizes and catchments with gauged flow records and those with no gauged flows. The FEH methods are used for the calculation of flood flows for catchments within the site.

Using the available data, a series of hydrological parameters were calculated for the site for use in engineering work and this study. The methods used and the resultant parameters are described in detailed in the Surface Water Baseline Report. The hydrological parameters considered were;

- Annual runoff and flow pathways
- Monthly flow conditions
- Low flow conditions
- Flood flow conditions

The reason for selecting these parameters is summarised in Table 4-3.

**Table 4-3: Hydrological parameters**

Key Hydrological Parameter	Reason for Study
Annual Runoff and flow pathways	The annual runoff rate can be compared directly to the annual precipitation rate to assess how much precipitation on a catchment is converted to flow in the river channel. Multiplying the runoff by the catchment area provides the total volume of water flowing through a site of interest in a year. An assessment of the impact of development on the annual runoff and flow volume will indicate the large-scale effects of the Project on the water available for aquatic and terrestrial life. Flow paths define the hydrological network in any catchment and describe linkages between different streams and river systems. Changes to flow paths or drainage areas can impact downstream flow rates, access to upper reaches of the watercourse and downstream supply of nutrients.
Monthly flow conditions	Within the study area streamflows vary throughout the year. The monthly flow distribution reflects the annual cycle of temperature and precipitation within the study area and is in balance with the natural life cycle of many aquatic organisms.
Low flow conditions	A minimum flow is required to maintain the health of aquatic ecosystems. A decrease in low flow conditions can impact aquatic life and water quality.
Flood flow conditions	Peak (i.e. flood) flows have impacts on human and natural environments. Floods can result in damage and loss of life, but also provide a natural source of sediment and water to sustain wetland and floodplain areas along river valleys. They can also impact stream morphology, triggering sediment movement and bank erosion.

The values for each of these parameters for locations used as calculation points later in this assessment (see Section 7.2.1 for details of reasons for selection of calculation points) are provided in Table 4-4 to Table 4-7. These values are used as baseline conditions for the effects assessment.

**Table 4-4: Annual runoff estimates**

<sup>a</sup> Catchment/Location	Catchment Area (km <sup>2</sup> )	Annual Average Runoff (mm)	<sup>b</sup> Annual average flow (m <sup>3</sup> /s)	<sup>b</sup> Annual average flow (L/s)
Curraghinalt Burn at confluence with Owenkillev River	1.0	700	0.022	22.2
Attagh Burn at confluence with Owenkillev River	0.6	700	0.013	13.3
Pollanroe Burn at confluence with Owenreagh River	2.0	700	0.044	44.4
Unnamed Watercourse at confluence with Owenreagh River	1.4	700	0.031	31.1
Owenkillev River at confluence with Owenreagh River	139.9	1025	4.55	4550
Owenreagh River, at confluence with Owenkillev River	85.5	875	2.37	2370

<sup>a</sup> For other locations in the catchment the runoff rate remains the same, by annual average flow can be calculated using relevant catchment area at the location selected.

<sup>b</sup> Calculated by multiplying annual runoff (mm) with catchment area (km<sup>2</sup>) and then dividing by number of seconds in year

**Table 4-5: Average monthly runoff percentage and average runoff rates**

Monthly Runoff Percentage												
Parameter	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Runoff %	14.4	10.0	9.4	6.3	4.8	3.6	3.5	5.4	6.2	10.8	11.8	13.7
Rainfall %	10.8	7.8	8.2	6.5	6.4	6.7	6.3	8.2	8.3	10.4	9.9	10.6
Catchment	Monthly Runoff (mm) – Year with average annual runoff											
Small Catchment <sup>1</sup>	147.6	102.5	96.4	64.6	49.2	36.9	35.9	55.4	63.6	110.7	121	140.4
Owenkillew River	126	87.5	82.3	55.1	42	31.5	30.6	47.3	54.3	94.5	103.3	119.9
Owenreagh River	100.8	70	65.8	44.1	33.6	25.2	24.5	37.8	43.4	75.6	82.6	95.9

Note 1: Curraghinalt Burn, Attagh Burn, Pollanroe Burn, Unnamed Watercourse

**Table 4-6: Flood flow estimates**

<sup>a</sup> Catchment/Location	Catchment Area (km <sup>2</sup> )	2-year flood flow (m <sup>3</sup> /s)	10 year flood flow (m <sup>3</sup> /s)	100 year flood flow (m <sup>3</sup> /s)
Curraghinalt Burn at confluence with Owenkillew River	1.0	1.12	1.78	3.29
Attagh Burn at confluence with Owenkillew River	0.6	0.67	1.07	1.97
Pollanroe Burn at confluence with Owenreagh River	2.0	2.24	3.56	6.58
Unnamed Watercourse at confluence with Owenreagh River	1.4	1.57	2.49	4.61
Owenkillew River at confluence with Owenreagh River	139.9	102.4	135.7	202.2
Owenreagh River, at confluence with Owenkillew River	85.5	62.6	82.9	123.6

<sup>a</sup> For other locations in the catchment the flood flows can be calculated by scaling for relevant catchment area at the location selected.

**Table 4-7: Low flow estimates**

<sup>a</sup> Catchment/Location	Catchment Area (km <sup>2</sup> )	95 <sup>th</sup> ile annual low flow (L/s)	95 <sup>th</sup> ile summer low flow (L/s)
<sup>b</sup> Curraghinalt Burn at confluence with Owenkillew River	1.0	5.7	4.2
<sup>b</sup> Attagh Burn at confluence with Owenkillew River	0.6	3.4	2.5
<sup>b</sup> Pollanroe Burn at confluence with Owenreagh River	2.0	11.4	8.4
<sup>b</sup> Unnamed Watercourse at confluence with Owenreagh River	1.4	8.0	5.9
<sup>c</sup> Owenkillew River at confluence with Owenreagh River	139.9	920	780
<sup>c</sup> Owenreagh River, at confluence with Owenkillew River	85.5	560	480

*a For other locations in the catchment the flood flows can be calculated by scaling for relevant catchment area at the location selected.*

*b Based on scaling the observed low flow at the Project monitoring station FLO2, as outlined in Surface Water Baseline Report*

*c Based on scaling with Rivers Agency gauged data at Owenkillew at Crosh, as outlined in Surface Water Baseline Report*

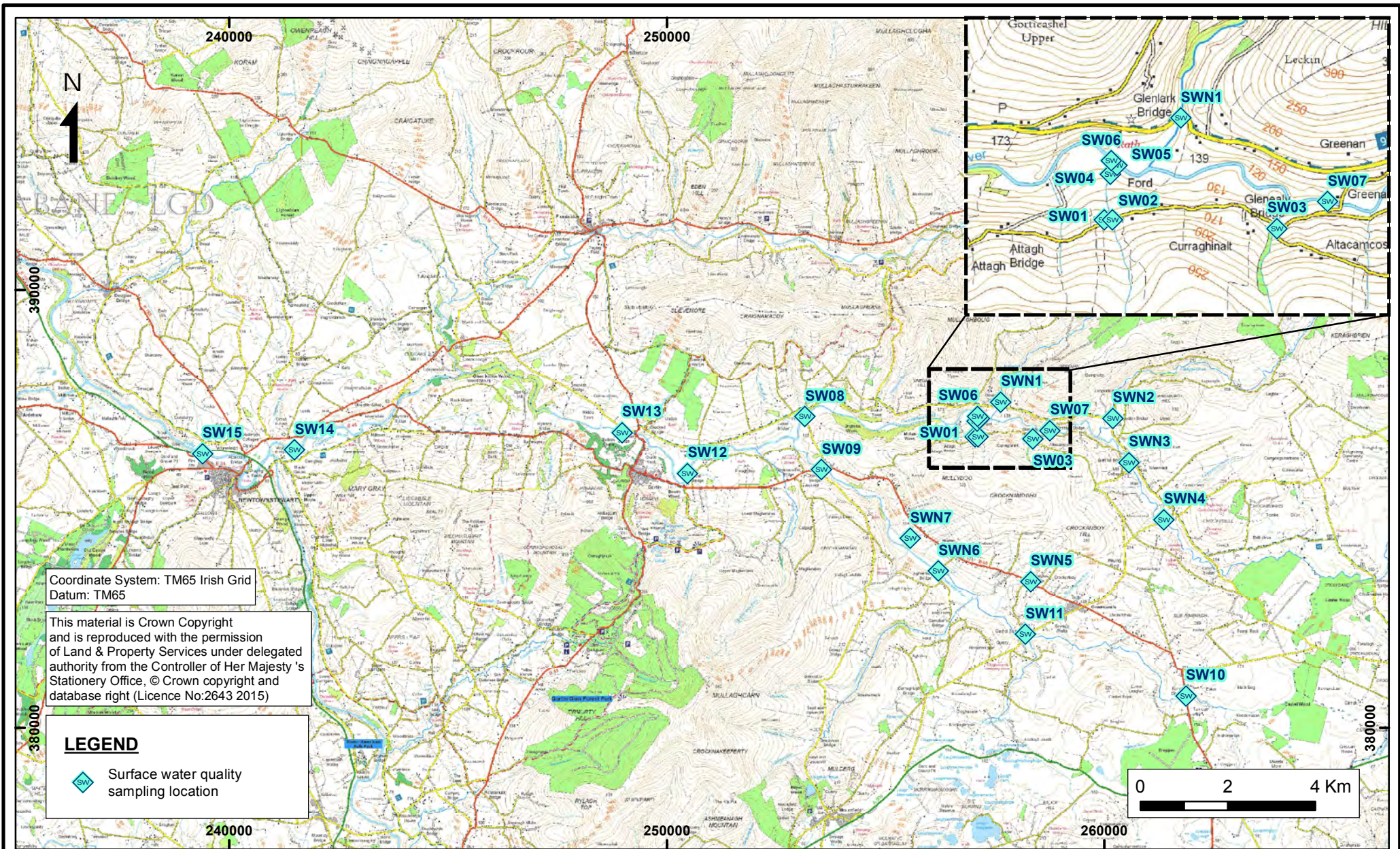
#### 4.4 Surface Water Quality

Surface water quality has been monitored at 20 locations to establish baseline conditions across the Project area. A total of 314 surface water quality samples and an additional 12 quality assurance quality control (QAQC) duplicates have been collected during 24 sampling rounds conducted between June 2012 and February 2016.

The sampling locations were selected to establish baseline water quality data but also to allow a comparison of water quality upstream and downstream of the Project in the Owenkillew River, the Owenreagh River and the Strule River.

The spatial extent of all the surface water quality monitoring locations are shown in Figure 4-5.

The full suite of parameters monitored are listed in Table 4-8.



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# Surface Water Quality Sampling Locations

Figure 4-5

**Table 4-8: Full list of parameters considered in Surface Water Baseline Assessment**

Parameters	Units	Parameters	Units
<b>Physical Parameters (Note 1)</b>		<b>Metals (Dissolved and Total)</b>	
pH (Lab)	s.u	Aluminium	mg/L
EC (Lab)	µS/cm	Antimony	mg/L
TDS	mg/L	Arsenic	mg/L
TSS	mg/L	Barium	mg/L
Temperature	°C	Beryllium	mg/L
<b>Anions and Nutrients</b>		Boron	mg/L
Alkalinity	mg/L as CaCO <sub>3</sub>	Cadmium	mg/L
Chloride	mg/L	Calcium	mg/L
Sulphate	mg/L	Chromium III	mg/L
Fluoride	mg/L	Chromium VI	mg/L
Calcium	mg/L	Total Chromium	mg/L
Potassium	mg/L	Cobalt	mg/L
Magnesium	mg/L	Copper	mg/L
Sodium	mg/L	Iron	mg/L
Total Ammonia	mg/L as N	Lead	mg/L
Nitrite	mg/L as N	Manganese	mg/L
Nitrate	mg/L as N	Mercury	mg/L
Phosphorous parameters (Note 2)		Molybdenum	mg/L
<b>Cyanide Parameters</b>		Nickel	mg/L
Free Cyanide	mg/L	Selenium	mg/L
Total Cyanide	mg/L	Silver	mg/L
<b>Organics</b>		Sodium	mg/L
TOC	mg/L	Strontium	mg/L
BOD	mg/L	Tellurium	mg/L
COD	mg/L	Thorium	mg/L
<b>Microbiological</b>		Tin	mg/L
Faecal Coliforms	CFU/100ml	Titanium	mg/L
Total Coliforms	CFU/100ml	Uranium	mg/L
Enterococci	CFU/100ml	Vanadium	mg/L
E. Coli	CFU/100ml	Zinc	mg/L
<b>Hydrocarbons</b>			
EPH	mg/L		
Mineral Oil	mg/L		

\*Excluding a comprehensive suite of herbicides and pesticides which were measured on one occasion during the baseline

Note 1: Field parameters measured: pH, EC, DO, redox potential, temperature, turbidity

Note 2: Total phosphorous, MRP (molybdate reactive phosphorous) and orthophosphate

Average and maximum concentrations of parameters for the Pollanroe Burn and Owenreagh River are provided in Table 4-9. Similar data for the Curraghinalt Burn and Owenkillew River are provided in Table 4-10. The parameters considered in the tables are those selected from a screening assessment undertaken as part of the derivation of site discharge criteria (see Annex B). The screening process was based on selecting parameters which had the potential to be elevated by the Project and which had appropriate national or international standards and guidelines for surface waters.

The Surface Water Baseline Report provides a detailed exploration and summary of relevant water quality standards and guidelines for the study area. The key standard and guideline values considered in this assessment are provided in Table 4-11.

The key legislation used was:

- SR 315; Statutory Rules of Northern Ireland (SRNI), 2015. Water Framework Directive (Classification, Priority Substances and Shellfish Waters) Regulations (Northern Ireland) 2015 SR 351.
- WSR; The Water Supply (Water Quality) (Amendment) Regulations (NI) 2009 and 2010 Schedule 1 – prescribed concentrations and values and Schedule 2 – indicator parameters.

Standards for copper, manganese, nickel and zinc refer to bioavailable concentrations of these parameters, which depend on the receiving water chemistry. Calculations of the bioavailable concentrations are provided in Annex B, with site-specific Environmental Quality Standards (EQS) calculated using the PNEC (Probable No Effect Concentration) calculation method.

This legislation was supported by the following, for two parameters that were not covered in the other legislation, but were considered important for the Project (nitrate and TSS):

- European Union agri-environmental indicator for nitrate ([http://ec.europa.eu/eurostat/statistics-explained/index.php/Agri-environmental\\_indicator\\_-\\_nitrate\\_pollution\\_of\\_water](http://ec.europa.eu/eurostat/statistics-explained/index.php/Agri-environmental_indicator_-_nitrate_pollution_of_water))
- Freshwater Fish Directive. This legislation has been revoked (2013), but it contained a standard for total suspended solid (TSS) concentrations that was not taken forward to other primary legislation. In the light of no other standards for TSS and given the likely importance of this parameter, the standard value from the Freshwater Fish Directive was used.

Boron, molybdenum and uranium were also identified as having the potential for elevated concentrations at the mine site (produced by mining activities). The most appropriate standards for these parameters were identified as those published by the Canadian Council of Ministers of the Environment (CCME); Water Quality Guidelines for the Protection of Aquatic Life. Available at <http://st-ts.ccme.ca/en/index.html>, based on values from October 2016.

EPH and mineral oil were measured during baseline studies, but there are no standards for these parameters. These parameters will be important for the operational mine and construction period, and an appropriate, practical standard for these parameters, encompassing all hydrocarbons is 'Visible oil and grease', with a qualitative standard of 'no trace'.

The standards review also identified secondary, non-statutory water quality guidelines. Freshwater Pearl Mussels (FPM) are an important concern in the Owenkillew and Owenreagh Rivers and appropriate guidelines and parameters are outlined in Table 4-12.

The results show that the surface waters within the study area are of good quality. The acidity of natural waters ranged from slightly over pH 5 to pH 8 with lowest pH values recorded in the Owenkillew tributaries close to the Curraghinalt ore body i.e. the Curraghinalt and Gleanealy Burns. Electrical conductivity, a reflection of dissolved ions in the water, was significantly below the WSR standard in all samples. The major ion signatures of the waters were typically calcium plus bicarbonate ( $\text{Ca} + \text{HCO}_3$ ) type with some of the Owenkillew tributaries and samples downstream of the Owenreagh confluence trending towards a sodium/potassium plus chloride ( $\text{Na/K} + \text{Cl}$ ) signature.

Total Suspended Solids (TSS) is generally low i.e. below the limit of detection, with occasional elevated values compared with the FPM-defined project guideline value of 10 mg/l. During heavy rainfall and flooding the TSS concentrations are observed to increase with values of up to 459 mg/l recorded during fast-flowing conditions when watercourses are visibly discoloured.

Nutrients (i.e. nitrogen and phosphorous parameters) exceed the most stringent FPM criteria in many baseline samples and the BOD guideline is also exceeded on occasions.

Total cyanide concentrations were below drinking water standards whilst free cyanide, for which a project guideline value of 1  $\mu\text{g/l}$  is used based on the EQS criteria, was measured at or below this limit on just over one third of the samples. The remaining samples ranged from 2 to a maximum of less than 5  $\mu\text{g/l}$ .

Metals were occasionally elevated above Project Guideline Values in the baseline, in particular, cadmium, copper, iron, mercury, manganese, selenium and zinc. Surface watercourses in the vicinity of the Curraghinalt orebody i.e. the Curraghinalt and Gleanealy Burns, typically contained the highest concentrations for the metals cited above.

Most parameters do not show any consistent seasonal trend or variation across the study area.

**Table 4-9: Baseline Water Quality in the Owenreagh River and Pollanroe Burn**

Parameter	Unit	Owenreagh		Pollanroe Burn	
		SW09, SW10, SW11, SWN6		SWN5, SWN8	
		Average	Max	Average	Max
<b>Physical</b>					
pH	-	6.90	7.74	6.8	7.4
BOD	mg/L	1.44	4.0	2.3	4.0
Temperature	°C		13.8	12.2	14.5
TSS	mg/L	5.0	15.0	7.0	51
<b>Nutrients/Salts</b>					
Total Ammonia	mg/L as N	0.040	0.093	0.058	0.085
Nitrate	mg/L as N	0.19	0.41	0.12	0.16
Nitrite	mg/L as N	<i>0.0030</i>	<i>0.0030</i>	<i>0.0030</i>	0.0030
Chloride	mg/L	12.9	22.6	8.53	10.6
Fluoride	mg/L	0.15	0.15	<i>0.15</i>	<i>0.15</i>
Sulphate	mg/L	1.05	4.41	0.73	3.49
<b>Cyanide</b>					
Cyanide Free	mg/L	0.0016	0.0030	<i>0.00050</i>	0.0020
Cyanide Total	mg/L	0.0028	0.0050	0.0044	0.0080
<b>Hydrocarbons</b>					
EPH	mg/L	<i>0.0050</i>	<i>0.0050</i>	<i>0.0050</i>	<i>0.0050</i>
Mineral Oil	mg/L	<i>0.0050</i>	<i>0.0050</i>	<i>0.0050</i>	0.021
<b>Metals (Dissolved)</b>					
Aluminium	mg/L	0.057	0.11	0.11	0.16
Antimony	mg/L	<i>0.0010</i>	0.0040	<i>0.0010</i>	0.0010
Arsenic	mg/L	<i>0.00045</i>	0.0021	<i>0.00045</i>	0.0013
Boron	mg/L	0.0025	0.0080	0.0062	0.0090
Cadmium	mg/L	0.000030	0.00016	<i>0.000015</i>	<i>0.000015</i>
Chromium (III)	mg/L	<i>0.0010</i>	0.0030	0.0020	0.0030
Chromium (VI)	mg/L	<i>0.0010</i>	<i>0.0010</i>	<i>0.0010</i>	0.0030
Total Chromium	mg/L	0.00051	0.0028	0.00046	0.0011
Copper	mg/L	<i>0.0015</i>	<i>0.0015</i>	<i>0.0015</i>	<i>0.0015</i>
Iron	mg/L	0.66	1.04	1.12	1.53
Lead	mg/L	0.00040	0.0029	<i>0.00020</i>	0.00020
Manganese	mg/L	0.054	0.088	0.138	0.32
Mercury	mg/L	<i>0.0000050</i>	0.000030	<i>0.0000050</i>	0.0000050
Molybdenum	mg/L	<i>0.00010</i>	0.00040	<i>0.00010</i>	0.00010
Nickel	mg/L	0.00026	0.0012	0.00037	0.00070
Selenium	mg/L	0.00060	0.00060	0.0018	0.0052
Silver	mg/L	<i>0.0025</i>	<i>0.0025</i>	<i>0.0025</i>	<i>0.0025</i>
Sodium	mg/L	7.9	10.5	5.56	6.8
Uranium	mg/L	<i>0.0025</i>	0.0048	<i>0.0025</i>	0.0025
Zinc	mg/L	0.0029	0.0072	0.0098	0.033

*Italics are below detection limit, shown as half detection limit*

**Table 4-10: Baseline Water Quality in the Owenkillew River and Curraghinalt Burn**

Parameter	Unit	Owenkillew River		Curraghinalt Burn	
		SW05, SW06, SW07, SW08		SW02, SW04	
		Average	Max	Average	Max
<b>Physical</b>					
pH	-	6.9	7.6	6.9	8.0
BOD	mg/L	1.7	5	1.3	3.0
Temperature	°C	9.8	14	9.1	12.7
TSS	mg/L	5	18	10.9	40.0
<b>Nutrients/Salts</b>					
Total Ammonia	mg/L as N	0.057	0.15	0.24	1.7
Nitrate	mg/L as N	0.14	0.32	0.72	6.6
Nitrite	mg/L as N	<i>0.003</i>	<i>0.014</i>	<i>0.037</i>	0.32
Chloride	mg/L	11	24	10.5	25.4
Fluoride	mg/L	<i>0.15</i>	<i>0.15</i>	<i>0.15</i>	<i>0.15</i>
Sulphate	mg/L	0.68	3.6	2.4	17.4
<b>Cyanide</b>					
Cyanide Free	mg/L	0.0019	0.010	0.0016	0.004
Cyanide Total	mg/L	0.0049	0.049	0.0037	0.006
<b>Hydrocarbons</b>					
EPH	mg/L	<i>0.005</i>	<i>0.005</i>	<i>0.005</i>	<i>0.005</i>
Mineral Oil	mg/L	<i>0.005</i>	<i>0.005</i>	<i>0.005</i>	<i>0.005</i>
<b>Metals (Dissolved)</b>					
Aluminium	mg/L	0.083	0.18	0.082	0.18
Antimony	mg/L	<i>0.001</i>	0.003	<i>0.001</i>	0.003
Arsenic	mg/L	<i>0.00045</i>	0.0029	0.0010	0.0042
Boron	mg/L	<i>0.001</i>	0.006	<i>0.001</i>	0.007
Cadmium	mg/L	<i>0.000015</i>	0.00013	0.000058	0.00025
Chromium (III)	mg/L	<i>0.001</i>	<i>0.001</i>	<i>0.001</i>	<i>0.001</i>
Chromium (VI)	mg/L	<i>0.001</i>	<i>0.001</i>	<i>0.001</i>	<i>0.001</i>
Total Chromium	mg/L	<i>0.0001</i>	0.0005	0.0001	0.0002
Copper	mg/L	<i>0.0015</i>	0.005	<i>0.0015</i>	<i>0.0015</i>
Iron	mg/L	1.0	1.7	1.7	3.5
Lead	mg/L	0.00055	0.0039	0.00040	0.0019
Manganese	mg/L	0.061	0.12	0.16	0.72
Mercury	mg/L	<i>0.000005</i>	0.00017	<i>0.000037</i>	0.00052
Molybdenum	mg/L	<i>0.0001</i>	0.0003	0.00057	0.0052
Nickel	mg/L	0.00050	0.0020	0.00070	0.0031
Selenium	mg/L	<i>0.0006</i>	<i>0.0006</i>	<i>0.0006</i>	<i>0.0006</i>
Silver	mg/L	<i>0.0025</i>	<i>0.0025</i>	<i>0.0025</i>	<i>0.0025</i>
Sodium	mg/L	6.3	10	6.4	11.1
Uranium	mg/L	<i>0.0025</i>	0.018	<i>0.0025</i>	<i>0.0025</i>
Zinc	mg/L	0.0041	0.0099	0.0058	0.010

*Italics are below detection limit, shown as half detection limit*

**Table 4-11: Environmental Standards**

Parameter	Unit	Environmental Standards					
		SR 351		WSR	EU Agri-environmental indicator	Freshwater Fish Directive	CCME
		Annual Mean	Other				
<b>Physical</b>							
pH	-		6.6 - 9.0 (absolute range)				
BOD	mg/L		3 (90%ile)				
Temperature	°C		20 (max)				
TSS	mg/L					25	
<b>Nutrients/Salts</b>							
Total Ammonia	mg/L N		0.2 (90%ile)	<sup>a</sup> 0.39			
Nitrate	mg/L N			11.3	<sup>b</sup> 5.6		
Nitrite	mg/L N			0.22			
Chloride	mg/L			250			
Fluoride	mg/L			1.5			
Sulphate	mg/L			250			
<b>Cyanide</b>							
Cyanide Free	mg/L	0.001	0.005 (max)				
Cyanide Total	mg/L			0.05			
<b>Metals (Dissolved)</b>							
Aluminium	mg/L			0.2			
Antimony	mg/L			0.005			
Arsenic	mg/L	0.05		0.01			
Boron	mg/L						1.5
Cadmium	mg/L	0.00008	0.45 (max)	0.005			
Chromium (III)	mg/L	0.0047	0.032 (max)				
Chromium (VI)	mg/L	0.0034					
Total Chromium	mg/L	0.0081		0.05			
Copper	mg/L	<sup>c</sup> 0.017 (Owenreagh) <sup>c</sup> 0.015 (Owenkillew)		2			
Iron	mg/L	1		0.2			
Lead	mg/L	0.0072		0.01			
Manganese	mg/L	<sup>c</sup> 0.2 (Owenreagh) <sup>c</sup> 0.12 (Owenkillew)		0.05			
Mercury	mg/L		0.00007 (max)	0.001			
Molybdenum	mg/L						0.073
Nickel	mg/L	<sup>c</sup> 0.01 (Owenreagh) <sup>c</sup> 0.013 (Owenkillew)	0.034 (max)	0.02			
Selenium	mg/L			0.01			
Sodium	mg/L			200			
Silver	mg/L	0.0005	0.001 (max)				
Uranium	mg/L						0.015
Zinc	mg/L	<sup>c</sup> 0.021 (Owenreagh) <sup>c</sup> 0.023 (Owenkillew)					

<sup>a</sup> WSR reference standard is 0.5 mg/L ammonia as NH<sub>4</sub>. Value of 0.39 mg/L presented in table is ammonia as N

<sup>b</sup> Standard is 25 mg/L nitrate. Value of 5.6 mg/L presented in table is nitrate as N

<sup>c</sup> Site Specific EQS from PNEC calculation, in Annex B

**Table 4-12: FPM Guideline Values**

Parameter	Unit	FPM guidance
<b><i>Physical Parameters</i></b>		
pH	-	6.2 - 7.5
BOD	mg/L	1 - 1.4
TSS	mg/L	10
<b><i>Anions and Nutrients</i></b>		
Total Ammonia	mg/L N	0.01 - 0.005 (median)
Nitrate	mg/L N	0.125 - 0.5 (median)
<sup>a</sup> Orthophosphate	mg/L P	0.005 (median)

*a Orthophosphate was scoped out of assessment as there were no identified sources of orthophosphate within the mining operations*

## 5 OVERVIEW OF SOURCES AND RECEPTORS COVERED IN ASSESSMENT

To provide background to the surface water impact assessment, this section describes the sources and receptors of potential surface water impacts.

### 5.1 Sources

Sources of potential surface water impact vary by project phase and originate from:

- the proposed infrastructure site, and access road;
- existing surface infrastructure site; and
- underground mine (via changes to groundwater).

Changes to groundwater levels and quality from underground dewatering and mine waste storage activities are described in the groundwater impact assessment. The results of the groundwater assessment have been considered as sources of impact for the surface water impact assessment so the effects of the project on surface watercourses surrounding the project are considered in an integrated manner.

A summary of sources from the project components described above, and their interactions with receiving watercourses, are presented in Table 5-1. The sources are described separately for surface water flow and surface water quality.

For surface water flow, the sources of impact from the proposed infrastructure site are follows:

- Disturbance of ground and surface water runoff during construction activities.
- Collection of surface water runoff from within the site during operation in the West Pond and East Ponds.
- Diversion and collection of clean (non-contact) surface water from the north of the site to the Clean Water Pond (Figure 3-3).
- Diversion and collection of clean (non-contact) surface water from the west of the site to the West Pond (Figure 3-3).
- Diversion of clean (non-contact) surface water from the east of the site around the eastern and southern perimeter via the East Ditch Diversion to Pollanroe Burn upstream of the outfall (Figure 3-3).
- Pumping of groundwater from the underground mine to the West Pond on surface during operation for use within the process, or treatment and discharge to the Pollanroe Burn.
- Discharge to the Pollanroe Burn via the outfall, comprising treated contact water, overflow from the Clean Water Pond and treated sewage.
- Discharge to the Pollanroe Burn of water from the DSF under drain, comprising natural groundwater and any seepage associated with defects in the DSF basal liner.
- Disturbance of ground and surface water runoff from construction of the mine access road.
- Disturbance of ground due to construction of peat storage and peat habitat enhancement area.
- Surface water runoff during closure and rehabilitation of the site, including reclamation of the DSF, to the Pollanroe Burn.

For surface water flows from the existing surface infrastructure site and underground mine, the impact assessment considers the following potential impact sources.

- Pumping of groundwater from underground mine workings (dewatering) to the existing adit during construction and to the proposed infrastructure site during operations, resulting in changes to existing adit flows and flows in watercourses.
- Discharge to the Curraghinalt Burn of treated surface runoff and flows from the existing adit.
- Cessation of dewatering activities at the end of operations resulting in a rebound in natural groundwater levels and changes in baseflows to streams and flows to the existing adit.

For surface water quality, the sources of impact from the proposed infrastructure site and existing surface infrastructure site, and potential pollutants associated with each source, are presented in Table 5-1. The table also presents the treatment measures in place with the project design that have been taken into consideration by the surface water assessment.

At both the proposed infrastructure site and existing surface infrastructure site, water management facilities have been designed to accommodate the numerous sources of clean and contact water that result from the project at a site-wide level. For water quantity and water quality, the surface water impact assessment, therefore, considers the combined effect of multiple impact sources on receiving watercourses, rather than considering each source separately.

## 5.2 Emergencies and failures

Emergency events and failures of water management infrastructure present possible sources of impacts to surface water flow and surface water quality. As described in the project description, water management ponds at the proposed infrastructure site are:

- Designed to retain the 24-hour 1 in 1,000 year storm event without overflowing (with only discharges from the mine being through the treatment plant);
- Constructed below surrounding ground level and excavated into bedrock, therefore no water is stored using a man-made retaining structure; and
- Designed with appropriate spillways or other control structures so events in excess of the design condition can be routed through the ponds without a risk of uncontrolled overtopping and erosion.

During extreme rainfall events, as water levels in the ponds rise towards the spillway, measures will be implemented to minimise flows able to enter the ponds, including;

- Shut down of mine dewatering and processing plant to reduce flows to water management ponds;
- Diversion of runoff from areas of the site that do not contact mine wastes (i.e., undeveloped areas of the site, roads, car parking and offices away from process plant) from water management ponds.
- Diversion of natural runoff from the West Diversion Ditch away from the proposed infrastructure site to the Pollanroe Burn.

There is also the potential for additional flood storage in the upper east, lower east and west ponds if they are maintained at lower operating levels.

At the existing infrastructure site, no changes are proposed to storm water management concepts based on calculations undertaken by Environ (2013) and approved through the consent of the current operations. The settlement pond at the site has been designed to retain runoff from the site for a 1 in 100 year, 1-hour event followed by two consecutive 1 in 50 year, 15-minute storms (as agreed with NIEA).

During operations, there will be no discharge from the adit to the existing infrastructure site, with all water from the underground mine pumped to the water management ponds at the proposed infrastructure site.

With the storm water design measures in place, the risk of a failure of a water impoundment structure or overtopping of the ponds is considered low. However, the assessment considers extreme climatic events and the impacts of releases of contact water that could occur under these conditions or during emergency events.

During drought conditions, production at the mine will be able to be supported by groundwater pumped from the underground mine and water stored in the Clean Water Pond. In the event that more water is required it would be possible to truck water to the site, but given the rate of groundwater inflow to the underground workings there is expected to be a source of water on site to allow production to continue during drought conditions.

A minimum compensation flow from the mine site area to the Pollanroe Burn is also proposed, either from excess water in treatment or from the Clean Water Pond.

**Table 5-1: Sources of potential water pollution**

Project component	Source	Phase	Sub-sources	Potential pollutants	Management measures in the project design		Releases to the environment	
					Water holding facility	Treatment in the project design	When	Receiving watercourse
Proposed infrastructure site	Disturbance of ground surface	C	Runoff from site	<ul style="list-style-type: none"> <li>Suspended solids</li> <li>Hydrocarbons</li> <li>Construction materials</li> <li>Mobilised metals (from waste rock in DSF)</li> </ul>	West pond Lined pond at portal site	Mobile sediment tanks Mobile filter presses Reverse Osmosis Plant (from Month 4-5 of construction)	Rainfall event	Pollanroe Burn
	Site discharge via outfall	O	Clean water pond overflow	<ul style="list-style-type: none"> <li>None (runoff from catchment upstream of the site and treated water from WTP)</li> </ul>	Clean water pond	None required	Rainfall event or as required to maintain compensation flow in burn	Pollanroe Burn
			Runoff from site	<ul style="list-style-type: none"> <li>Suspended solids</li> </ul>	East ponds	Reverse Osmosis water treatment plant	Throughout the operational phase, but varying seasonally according to plant make up water requirements	Pollanroe Burn
			Runoff from DSF	<ul style="list-style-type: none"> <li>Suspended solids</li> </ul>	West pond and east ponds			
			Seepage from the DSF	<ul style="list-style-type: none"> <li>Mobilised metals</li> <li>Nitrate and ammonia (explosive residues)</li> </ul>	West pond and east ponds			
			Water from dewatering the mine workings	<ul style="list-style-type: none"> <li>Mobilised metals</li> <li>Nitrate and ammonia (explosive residues)</li> </ul>	West pond			
			Return water from the paste plant	<ul style="list-style-type: none"> <li>Mobilised metals</li> </ul>	Direct to treatment plant			
			Sewage	<ul style="list-style-type: none"> <li>Sewage treatment plant</li> </ul>	None	Sewage treatment plant	Throughout the operational phase	Pollanroe Burn
	Rehabilitated site	Cl	Seepage from the DSF	<ul style="list-style-type: none"> <li>Mobilised metals</li> </ul>	West and east ponds	Passive water treatment system	Continuous	Pollanroe Burn
Uncontrolled release due to failure of water management infrastructure	O	Overtopping of water holding ponds	<ul style="list-style-type: none"> <li>Processing reagents</li> <li>Mobilised metals</li> <li>Suspended solids</li> </ul>	None	None	Extreme rainfall event (more than 1 in 1000 year 24 storm)	Pollanroe Burn	
Access road to proposed infrastructure site	Disturbance of ground surface	C	Runoff from site	<ul style="list-style-type: none"> <li>Suspended solids</li> </ul>	Standard sustainable drainage systems	Silt traps	Rainfall event	Pollanroe Burn

Project component	Source	Phase	Sub-sources	Potential pollutants	Management measures in the project design		Releases to the environment	
					Water holding facility	Treatment in the project design	When	Receiving watercourse
Peat storage and habitat enhancement area	Disturbance of ground and deposition of peat	C, O	Runoff from exposed ground	<ul style="list-style-type: none"> <li>Suspended solids</li> </ul>	Standard sustainable drainage systems	Silt traps, silt fences	Rainfall event	Unnamed Watercourse
Existing surface infrastructure site	Site discharge via outfall	C	Adit flows	<ul style="list-style-type: none"> <li>Suspended solids</li> <li>Nitrate and ammonia (explosive residues)</li> <li>Mobilised metals</li> </ul>	Settlement pond	Reverse Osmosis water treatment plant	Throughout construction but varying according to mine development activities	Curraghinalt Burn
		C, O	Runoff from site	<ul style="list-style-type: none"> <li>Suspended solids</li> <li>Hydrocarbons</li> <li>Mobilised metals</li> <li>Nitrate and ammonia (explosive residues)</li> </ul>			Rainfall event	
		Cl	Adit flows once groundwater levels rebound	<ul style="list-style-type: none"> <li>Mobilised metals</li> </ul>	None	Passive water treatment system	Continuous varying seasonally and according to rainfall	
	O	Overtopping of water holding pond	<ul style="list-style-type: none"> <li>Suspended solids,</li> <li>Mobilised metals,</li> <li>Nitrate and ammonia (explosive residues)</li> </ul>	None	None	Extreme rainfall event (more than 1 in 1000 year 24 storm)		
Underground mine	Rebound of groundwater following cessation of dewatering	Cl	Water contacting paste backfill, exposed waste rock and mine walls	<ul style="list-style-type: none"> <li>Mobilised metals</li> </ul>	None	None required	Continuous varying seasonally and according to rainfall	Curraghinalt Burn Attagh Burn Owenkillew River

Phase: C = construction, O = operation and Cl = closure and post-closure.

## 6 SCOPING OF PROJECT IMPACTS

Based on the baseline studies, engineering design work and consultations with regulators, potential project impacts on surface water quantity and quality have been identified and are discussed in this section. The section identifies the potential impacts that are carried forward for more detailed analysis.

### 6.1 Surface Water Quantity

The surface water hydrology impact assessment will consider the effect of the Project on the hydrological parameters described in Section 4.3;

- Annual runoff and flow pathways
- Monthly flow conditions
- Low flow conditions
- Flood flow conditions

Methods for calculating these parameters were derived as part of the Surface Water Baseline Report with relevant baseline values presented in Section 4.3.

An initial scoping assessment has been undertaken considering the potential impact of various components of the development on each of the hydrological parameters noted above. The scoping assessment is summarised in Table 6-1.

#### 6.1.1 Impact of construction activities on streamflows

Construction has the potential to increase surface water runoff from disturbed ground. This can impact all of the four hydrological parameters, with runoff rates likely to be higher from areas of disturbed ground compared to natural surfaces. Impacts can occur in any stream downslope of construction activities.

Runoff from disturbed areas will be controlled and regulated, with water attenuated before discharge to streams. The impact assessment will focus on identifying where construction activities have the potential to impact runoff rates. Details and sizing of runoff control measures during construction will be provided during the permitting process through iterations to the CEMP and detailed engineering drawings.

There are a number of standard approaches to controlling construction runoff and these will be highlighted in the impact assessment, but the assessment will not undertake design of the structures or provided detailed calculations of changes in runoff rates.

#### 6.1.2 Assessment of changes to flow conditions resulting from project infrastructure

##### ***Proposed infrastructure site***

The proposed infrastructure site contains all the main infrastructure components of the project, including water management ponds, ore processing facilities with associated hardstanding areas and the DSF. The site also includes peat storage and habitat enhancement areas to the west of the DSF and in the catchment of Unnamed Watercourse.

Water management will be a key component of the mine operations. Water falling within the footprint of the proposed infrastructure site will need to be retained and treated before discharge. The capture, treatment and discharge of runoff from the site, has the potential to

impact streamflows in the small watercourses downstream of the proposed infrastructure site (Pollanroe Burn and Unnamed Watercourse, and minor tributaries of these watercourses), as well as the Owenreagh River and, to a lesser extent, the Owenkillew River.

A quantitative assessment will be undertaken of the impact of the normal operations of the mine on each of the four hydrological parameters. The assessment will also look at the risk of overtopping of water management infrastructure, although these will be minimised through:

- the provision of freeboard within storage ponds, so that they are able to contain the 1 in 1,000 year 24-hour storm without spilling,
- emergency water management to reduce flows to the ponds during extreme events including
- Shut down of mine dewatering and processing plant to reduce flows to water management ponds; and
- Diversion of runoff from areas of the site that do not contact mine wastes (i.e., undeveloped areas of the site, roads, car parking and offices away from process plant) from water management ponds
- Diversion of natural runoff from the West Diversion Ditch away from the proposed infrastructure site to the Pollanroe Burn.; and
- appropriately designed water management structures.

Construction impacts are considered under a separate heading (see Section 6.1.1) but water management impacts associated with the proposed infrastructure site during operations and closure will be assessed in detail.

#### ***Existing Surface Infrastructure Site***

The existing surface infrastructure site has a small footprint with limited flows from the adit being treated and discharged to the Curraghinalt Burn. However, the impact of runoff from this site area, combined with adit discharge flows, will be considered in terms of impacts on the Curraghinalt Burn and Owenkillew River.

Construction impacts are considered under a separate heading (see Section 6.1.1), but water management impacts of the existing surface infrastructure site during operations and closure will be assessed in detail.

### **6.1.3 Assessment of changes to flow conditions resulting from development of the underground mine**

Dewatering of the underground mine will progressively lower the local groundwater table with the potential for impacting baseflow contributions to adjacent watercourses. Changes in baseflow have been calculated through detailed groundwater modelling (refer to the Groundwater Impact Assessment Report) and will be used to calculate changes in local streamflow conditions.

Impacts to baseflow contributions to local watercourses will be most significant during low flow conditions when baseflow can become a significant contributor to the total flow in the watercourse. Based on an initial assessment, a reduction in baseflow contribution is not predicted to impact flood flows, annual total flows or monthly flows, so these impacts have been scoped out to allow the assessment to focus on impacts under low flow conditions.

Changes to local groundwater levels will have impacts during operations and through the closure period. There are not expected to be significant impacts during construction, so these impacts are scoped out of the assessment.

#### **6.1.4 Assessment of impact of access road to main mine site on streamflows**

The access road could impact streamflows through increased runoff from the road surface and restricting flood flows at stream crossings. These impacts will be mitigated through the provision of appropriately sized crossings and surface water management measures.

Impacts will predominantly impact high flow conditions, with a risk of runoff rates from road surfaces increasing flood flows. Changes are likely to be minor or beneficial during other flow conditions and the effects during non-flood periods are scoped out.

There will be impacts during construction, operations and closure.

**Table 6-1: Initial Scoping of Effects Related to Surface Water Quantity and Flows**

Project Component	Potential Impact	Potential for Effect on Hydrological Parameter				Assessed in Detail or Scoped Out
		Annual runoff and flow pathways	Monthly flows	Low flows	Flood Flows	
<i>Construction</i>						
Construction of mine site infrastructure	Increase in flows due to disturbed ground and changes in catchments and flow pathways	√	√	√	√	Construction effects expected to be minor and managed by CEMP. At end of construction effects expected to be similar to changes during operations. Effects assessed qualitatively.
Construction of access road to mine site	Increase in runoff due to disturbed ground. Impact on flood flows at crossings	√	√	√	√	Construction effects expected to be minor and managed by CEMP. At end of construction effects expected to be similar to changes during operations. Effects assessed qualitatively.
Development of underground mine	Potential for decrease in baseflows to rivers adjacent to mine site due to reduced baseflow contribution from groundwater			√		Impacts are predicted to be negligible during construction and these effects are scoped out.
<i>Mine Operations</i>						
Dewatering of underground workings	Potential for decrease in baseflows to rivers adjacent to mine site due to reduced baseflow contribution from groundwater			√		Quantitative assessment of low flow conditions in local watercourses, based on standard flow calculations using outputs from groundwater model (refer to Groundwater Impact Assessment study). Effects on other flow conditions will be negligible and have been scoped out.
Normal operation of proposed infrastructure site	Changes to flow pathways, monthly flows, low flow and flood flows due to operation of the Project, including management of water from peat storage and habitat enhancement area.	√	√	√	√	Mine site water balance model will be used to predict changes in flows from baseline.
Normal operation of existing surface infrastructure site	Changes to flows in watercourses downstream of existing surface infrastructure site. Potential to impact monthly flows and low flows only as footprint is small and likely no impact on flow pathways and flood flows		√	√		Change to baseline conditions based on assessment of potential flows from existing surface infrastructure site

Project Component	Potential Impact	Potential for Effect on Hydrological Parameter				Assessed in Detail or Scoped Out
		Annual runoff and flow pathways	Monthly flows	Low flows	Flood Flows	
Access road to mine site from the south	Changes to flow pathways and impact on flood flows at crossings	√			√	Qualitative assessment based on assumption that surface water management management will be put in place (e.g. swales and ditches) and crossings will be designed to appropriate standards
Overtopping of water management infrastructure at proposed infrastructure site	Potential for release of untreated water to Pollanroe Burn and Owenreagh River. The main impact will be to augment flood flows in the downstream watercourses, as failures would be expected during flood conditions				√	Assessment of potential for spills a from water impoundment structures. Structures are designed to lie below natural ground levels so water is not retained by man-made structures, so no risk of failure of structure. The impact will be managed though appropriate design and contingency measures, but impacts will be modelled where information is available.
Failure or overtopping of water management infrastructure at existing surface infrastructure site	Potential release of water to Curraghinalt Burn. However, volumes of water stored for treatment are small with negligible impact predicted on downstream flows				√	No significant water storage, so scoped out of assessment.
Drought conditions resulting in reduction in flows from water treatment plant	Reduced flows from the mine site, resulting in Pollanroe Burn flowing dry below the mine site			√		
<b>Closure</b>						
Rebound of groundwater table	Continued impact on baseflow to surface watercourses until groundwater table has returned to pre-development level		√	√		Quantitative assessment based on standard flow calculations using outputs from groundwater modelling.
Reclamation of proposed infrastructure site	Potential changes in runoff from site compared to baseline conditions	√	√	√	√	Qualitative assessment based on areas assessment of runoff rates from reclaimed areas
Reclamation of access roads	Potential changes in runoff from site compared to baseline conditions	√			√	Qualitative assessment based on areas assessment of runoff rates from reclaimed areas

## 6.2 Surface Water Quality

The surface water quality impact assessment will consider the effect of the Curraghinalt Project on water quality within watercourses potentially impacted by mining activities. The assessment will focus on the suite of parameters described in Section 4.4. The calculations consider all parameters which have national or international guidelines and standards and which were identified as being potentially elevated by mining activities.

The assessment will quantify the changes in water quality in the receiving waters downstream of the project activities at both the proposed and existing infrastructure sites. Predicted water quality will be compared to environmental standards and guidelines, summarised in Table 4-11.

However, the assessment will not assign significance to any changes in water quality. The assessment of significance will be undertaken in the appropriate sections of the Environmental Statement that consider the impact of water quality on stream ecology and biology.

An initial scoping assessment has been undertaken considering the potential impact of various components of the development on surface water quality. The scoping assessment is summarised in Table 6-2.

### 6.2.1 Assessment of impact of construction activities on surface water quality

The most significant impacts of construction with respect to surface water quality are likely to be related to releases of sediment into receiving waters (as well as spillages of concrete, fuel oil etc.). These impacts will not be quantified, but will be addressed through reference to the project's outline CEMP, which detail the standard sediment control and spill management measures that will be installed during construction. The assessment will be qualitative.

### 6.2.2 Assessment of changes to surface water quality resulting from mining activities at the infrastructure sites

Mining activities can result in an increase in concentrations in water stored or released from the two infrastructure sites due to;

- Chemicals added to ore during processing, including cyanide
- Contamination of groundwater entering underground mine workings through contact with exposed rock and backfilled tailings. This underground water is then pumped to the surface as part of the mine dewatering
- Runoff over the DSF interacting with exposed rock and dissolving metals and explosives residues from the rock
- Earthworks activities and movement of waste material on site resulting in increases in sediment in runoff from the site
- Runoff over peat storage and peat habitat enhancement areas, resulting in increases in sediment in runoff from the site
- Toilet and shower facilities

As outlined in Section 3.3, all contact water at the mine will be treated prior to discharge. Treated discharges from the existing surface infrastructure site have the potential to impact water quality in the Curraghinalt Burn and Owenkillew River, while discharges from the proposed infrastructure site can impact water quality in the Pollanroe Burn and Owenreagh Rivers (and then the Owenkillew River downstream of its confluence with the Owenreagh

River). Runoff from the peat storage and peat habitat enhancement areas in the catchment of the Unnamed Watercourse will require attenuation to reduce suspended sediment releases until the peat has matured in situ.

The potential for elevated surface water quality in surface watercourses downstream of the project is an identified project risk. The impacts of changes to surface water quality on receiving waters are modelled quantitatively and considered in detail.

### **6.2.3 Assessment of changes to surface water quality resulting from dewatering of the underground mine**

Dewatered underground water will be pumped to the surface and stored in the West Pond before treatment. Underground water is likely to have elevated concentrations of water quality parameters due to its interaction with exposed rock within the underground mine. Underground water will be retained and managed on site.

### **6.2.4 Assessment of impact of access road to main mine site on stream water quality**

Runoff from roads can be contaminated by sediment and hydrocarbons produced by vehicles. The access road is relatively short and will be designed to Northern Ireland national standards. Water quality management for roads as part of overall water management measures are well understood and regulated, therefore impacts are predicted to be low and are considered qualitatively.

The risk of spills of chemicals coming to, or leaving the infrastructure sites, are also considered.

**Table 6-2: Initial Scoping of Effects Related to Surface Water Quality**

Mine Component	Potential Impact	Assessed in Detail or Scoped Out
<i>Construction</i>		
Construction of mine site infrastructure at proposed infrastructure site	Potential releases of sediment to receiving environment; potential spillages (concrete, fuel oil etc) and ensuing contamination of receiving environment	Qualitative assessment with reference to CEMP and standard mitigation measures
Construction of access road to proposed infrastructure site	As above	As above
Construction at existing surface infrastructure site	No increase in footprint, or significant construction proposed; replacement of existing treatment plant with upgraded treatment plant is proposed.	As above
<i>Mine Operations</i>		
<p>Operation of proposed infrastructure site, waste management facilities and associated water management infrastructure. This will include impacts of potential sources of contaminated water i.e.;</p> <ul style="list-style-type: none"> <li>• Dewatering of underground workings</li> <li>• Management of water used in Process Plant (including addition of chemicals in Process Plant)</li> <li>• Runoff over DSF</li> <li>• Runoff over other mine infrastructure (e.g., roads and buildings)</li> <li>• Sewage</li> </ul>	Adverse impact on baseline water quality including exceedance of Environmental Standards and Guidelines.	Detailed dilution calculations are undertaken to assess downstream effects (after treatment) and to develop site discharge criteria to reduce downstream impacts to levels acceptable to regulators.

Mine Component	Potential Impact	Assessed in Detail or Scoped Out
Operation of existing surface infrastructure site	Adverse impact on baseline water quality including exceedance of environmental standards and guidelines.	Detailed dilution calculations are undertaken to assess downstream effects (after treatment) and to develop site discharge criteria to reduce downstream impacts to levels acceptable to regulators.
Access road between proposed infrastructure site area and tunnel, crossing peat	Potential release of sediment and other contaminants associated with traffic	Water quality management measures for roads are well understood and regulated, therefore impacts are predicted to be low and are considered qualitatively.
Failure or overtopping of water management infrastructure	Potential sudden release of untreated contact water into receiving waters	Assessment is provided in terms of potential dilution in receiving environment.
Peat storage and peat habitat enhancement areas	Runoff from peat resulting in elevated suspended solids concentrations	Water quality management measures for the peat storage and enhancement areas will be based on standard SUDS measures that are understood and regulated, therefore impacts are predicted to be low and are considered qualitatively.
<i>Closure</i>		
Discharges from closed proposed infrastructure site	Adverse impact on baseline water quality including exceedance of environmental standards and guidelines.	Water management measures for closure will be developed as part of the Closure Plan for the site. Dilution calculations are undertaken to assess downstream effects
Discharges from closed existing infrastructure site	Adverse impact on baseline water quality including exceedance of environmental standards and guidelines.	Water management measures for closure will be developed as part of the Closure Plan for the site. Dilution calculations are undertaken to assess downstream effects
Impact of groundwater baseflow water quality on local surface watercourses	Changes to baseline water quality	Water management measures for closure will be developed as part of the Closure Plan for the site. Dilution calculations are undertaken to assess downstream effects

## **7 IMPACT ANALYSIS METHODOLOGY**

Details of the methods used in the surface water impact assessment are outlined in this section.

### **7.1 Introduction**

The study area for the surface water impact assessment is shown in Figure 7-1. It includes the small watercourses (i.e., Pollanroe Burn, Unnamed Watercourse, Curraghinalt Burn and Attagh Burn) potentially impacted by mining activities as well as the Owenreagh and Owenkillev Rivers. The study area continues to a point downstream of the confluence of the Owenkillev and Owenreagh Rivers. Beyond this point the impacts on flows and water quality are considered negligible.

The relative size of the Project infrastructure sites and river catchments downstream of the Project were outlined in Section 4.3 and Table 4-2, comparing the Project catchments to the Rivers Strule, Mourne and Foyle. If the impacts of the Project on flow downstream of the confluence of the Owenkillev and Owenreagh Rivers are negligible, they will be substantially smaller in the Rivers, Strule, Mourne and Foyle, downstream of the site.

Project criteria used for defining sensitivity of study watercourses is presented in Table 7-1.

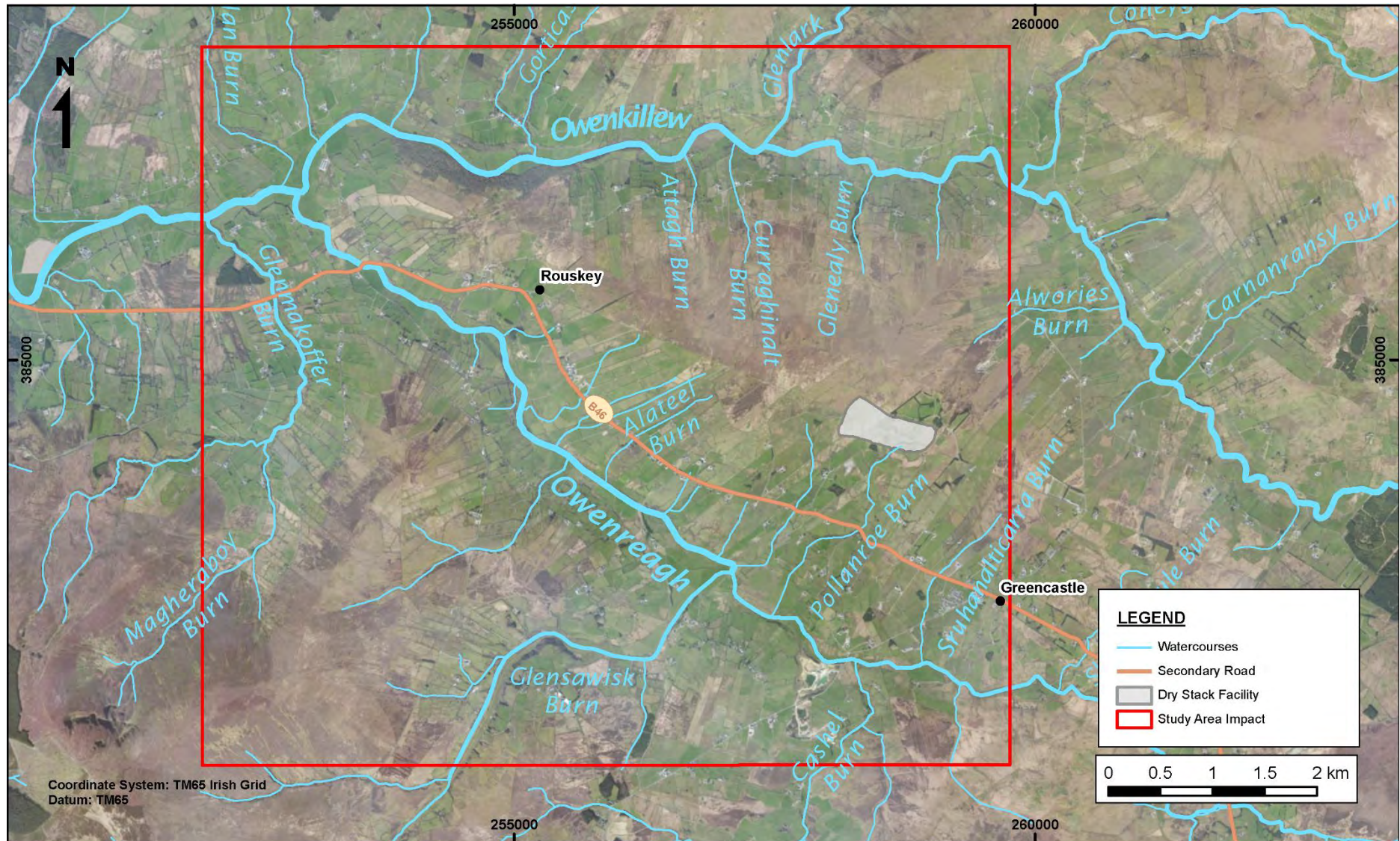


Figure 7-1: Surface water quantity and quality study area