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Construction Monitoring Report 7 FINAL.docx

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Carraig Gheal Wind Farm and West Loch Awe Timber Haul Route (WLATHR) – Construction Water Quality Monitoring Report 7 – (17th May 2012 until 21st June 2012).

This report provides a summary and interpretation of the results from the seventh water quality monitoring period from 17th May to the 21st June 2012 during the construction phase of the Carraig Gheal Wind Farm and West Loch Awe Timber Haul Route (WLATHR) located to the south east of Oban. It is the seventh in a series of water monitoring reports presenting the results of water quality and precipitation records from the Carraig Gheal wind farm and WLATHR. The report includes the SKM Enviros site visit on the 20th and 21st June 2012.

The monitoring reported upon includes water sampling at a selection of monitoring points, field and laboratory analysis of water quality, visual inspection of the watercourses and data from the rain gauge on site.

1. Background

The background to the site is contained within the first of this series of reports. In essence, the purpose of these water monitoring reports is to provide evidence of continual monitoring throughout the construction phase of the project to ensure that the aquatic environment is protected. Construction monitoring has continued in accordance with planning conditions. All works were designed to be undertaken in accordance with the Construction Water Monitoring Plan (CWMP) dated June 2011.

2. Monitoring Programme and Procedures

The monitoring programme and procedures follow the Construction Water Monitoring Plan (CWMP) for the project and are described in the first of this series of reports.

2.1 Monitoring Locations

The CWMP identifies a range of monitoring locations with differing frequencies of sampling, analysis and durations of monitoring. There are three tiers of monitoring locations:

- Ecological Clerk of Works Monitoring Points (EMPs);
- Quarterly Construction Monitoring Points (QCMPs); and
- A Control Monitoring Point (CNMP).

Monitoring locations were selected at points on the watercourses downstream from where runoff from site infrastructure would enter the watercourses. The EMPs are temporary locations for daily monitoring of individual short lived construction activities occurring up gradient in that catchment. They provide a record of point specific water quality at these locations. Any exceedances recorded at the EMPs trigger the immediate implementation of further investigation and mitigation measures as necessary. The indicative EMP monitoring locations for the WLATHR are listed on Figures 1 to 3. Exact locations are selected in the field by the ECOW and Figures 1 to 3 will be regularly updated as these locations are set.

A total of 25 QCMPs (QCMP1 to QCMP25) were selected and are shown on Figures 1 to 3. These monitoring locations provide site wide water quality information downstream of the EMPs for more diffuse catchment construction activities. The QCMP locations are monitored quarterly by SKM Enviros during their monthly site visits. Priority is given each month to those with up gradient construction activities. However if trigger values are exceeded in EMPs upstream of the QCMPs, the ECOW will monitor QCMPs as necessary until readings return to within the normal range.

The CNMP (CNMP1) is located within a neighbouring catchment unaffected by the development and acts as a background water quality indicator throughout the construction phase. The location is also monitored quarterly by SKM Enviros.

2.2 Baseline Water Quality

Prior to construction on site, samples were collected and analysed to determine baseline water quality. The ranges of baseline values for each determinant are presented for comparison in Tables 1, 2, 3 and 5 in the results section below. By comparing the samples collected during the construction phase with the baseline data it can be determined if there has been any significant effect on the water quality of the watercourses surrounding the site. Due to the nature of the WQMP some locations may continue to be monitored prior to construction activities taking place within the catchment. This additional data will be used to update the

baseline range as appropriate. The baseline report used for comparison within this report is called 'Baseline Monitoring Report, V3' prepared in February 2011.

3. Water Quality Assessment and Guidelines

A number of Environmental Quality Standards (EQS) exist for surface and groundwater in the UK. Three of these have been used in this assessment, namely the Water Framework Directive (Directive 2000/60/EC) (WFD), the Freshwater Fish Directive (Directive 2006/44/EC, Annex 1), the UK Drinking Water Standards (DWS) guideline value and EQS as reported on the Environment Agency chemical standards database[1]. The EQS reported by the Environment agency relate to statutory and non-statutory EQS for freshwater and the protection of aquatic life which apply the United Kingdom as a whole.

The Freshwater Fish Directive provides water quality standards for areas of water which support salmonid or cyprinid fish species. In 2013 the Freshwater Fish Directive will be repealed and replaced by standards developed under the WFD (UK Technical Advisory Group on the WFD 2008 a) and b). Standards which have already been set under the Water Framework Directive have been used in this assessment.

For determinands where no standards have yet been set under the WFD, the Freshwater Fish Directive standards for salmonid waters are referenced.

Where EQS reported by the EA have been used, this has been stated. The drivers for the EQS reported on the EA's chemical standards database include statutory values derived from the Freshwater Fish Directive and DWS, but also non statutory values from drivers including the protection of aquatic life and protection of surface waters.

The DWS are often more rigorous than environmental water quality standards but provide a useful indicator of water quality. Water quality is particularly important in the catchments where the two PWS are located. PWS 1 is a surface water supply for 18 properties which takes from the Allt Garbh in catchment 10. The nearest water quality monitoring point is QCMP4 which is located immediately up gradient of PWS 1. PWS 2 is a surface water take for 111 properties from the River Avich and is located in catchment 6. QCMP15 and EMP25 are both up-gradient of PWS 2.

[1] Available online at http://evidence.environment-agency.gov.uk/ChemicalStandards/report.aspx?cid=109 Last accessed 2nd May 2012

4. Construction Activities in the Period

Based on ECoW notes and observations made by SKM Enviros during the monitoring visit on the 20th and 21st June 2012, the following construction activities are known to have occurred during the seventh monitoring period;

- Sub-catchment 3: Works include WALTHR excluding chainage ch24000 to ch26000, turbine A1, A4, A5, A6, A7, A8, A10, A11, A12, and A17, borrow pit 2 and tracks to turbines;
- Sub-catchment 5: WLATHR;
- Sub-catchment 6: WLATHR and water crossing 20/21;
- Sub-catchment 7: WLATHR;
- Sub-catchment 8: WLATHR;
- Sub-catchment 9: WLATHR and water crossings; and
- Sub-catchment 10: WLATHR and water crossing C5.

No construction activities are known to have occurred in the seventh monitoring period in sub-catchments 1, 2, 4, 11, 12, 13 and 14.

5. Rainfall

The rainfall reported here is for the seventh construction monitoring period from the 17th May 2012 to the 21st June 2012. Precipitation data is presented in Figure 4.

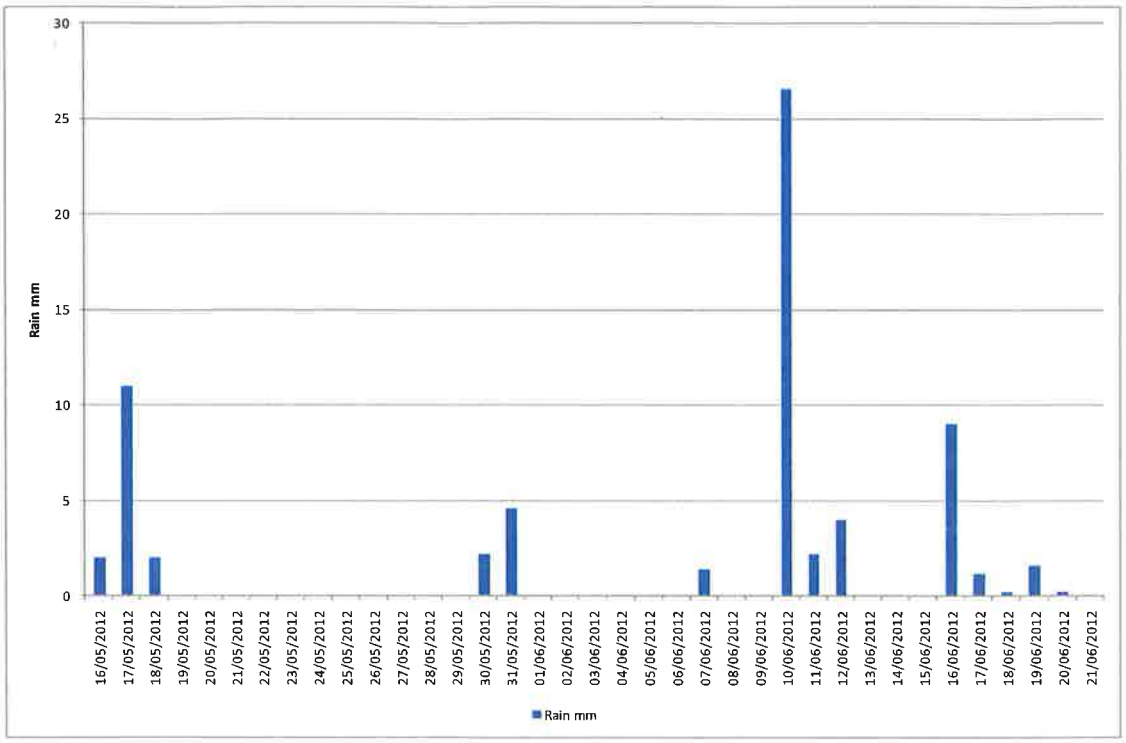
Overall, a total of 68.2mm precipitation was recorded by the onsite rain gauge during the seventh monitoring period. No figures are available for June's rainfall from the Meteorological Office.

The highest volume of rain within a 24 hour period fell on the 10th June and 26.6mm rain were recorded. This incident was relatively short lived with no days of rain leading up to the event and just 2.2mm recorded on the 11th June.

A prolonged rainfall event occurred over 5 consecutive days at the start of the seventh monitoring period. A total of 24.8mm was recorded between the 14th and 17th May. Peak rainfall fell on the 17th May (11mm).

A total of 12mm was recorded on consecutive days of rain between the 16th and 20th June 2012, with peak rainfall occurring the 16th June (9mm).

Figure 4 Rainfall Data



The meteorological office recorded a total of 92mm rain in western Scotland in May and 188mm in June 2012. Much of this rain fell in late June and so is not covered by this monitoring report; nevertheless, the rainfall data collected at Carraig Gheal wind farm does indicate the site received less than the regional total during the seventh monitoring period.

6. Surface Water Quality Monitoring Results

6.1 Structure of Results Reporting

As a consequence of the length of the WLATHR there are 3 main surface water catchments which can be sub-divided further into 14 surface water sub-catchments identified as in hydraulic continuity to the site. When added to the multiple construction activities the amount of data to process is very substantial and it is considered appropriate to look at the data grouped into surface water catchments. This allows review for each surface water sub-catchment as a whole, and for any problem areas or activities to be identified and

catchment/sub-catchment specific recommendations made. A detailed description of each sub-catchment can be found in the CWMP. They are graphically shown on Figures 1 to 3.

A summary of the results of field hydrochemistry monitoring of pH, electrical conductivity and turbidity is presented in Tables 1-3. Monitoring locations visited during construction monitoring period 6 were; QCMP 4, 6, 8, 11, 12, 13, 15, 16, 18, 19, 21 and 24. EMP locations visited were 1, 2, 3, 4, 5, 7, 8, 10, 11, 12, 13, 14, 17, 21, 22, 23, 24, 25, 26, 27, 31, 39, 41, 43, 55 and 58.The data reported in Tables 1-3 is a combination of ECoW and SKM Enviros data.

6.2 Field Hydrochemistry Monitoring

Field hydrochemistry monitoring was carried out by ECoW in accordance with CWMP, weather and access permitting. EMP's in catchments with construction activities were monitored daily or weekly, depending on the results of the field data and visual observations. Other monitoring locations were sampled as control points when trigger levels in daily or weekly monitoring locations were recorded and where the source of any exceedance could not be easily identified.

A summary of the results of field hydrochemistry monitoring of pH, electrical conductivity and turbidity during the seventh construction monitoring period are presented in Tables 1 - 3.

Table 1: Field pH during the seventh construction monitoring period

Sub-catchment	Monitoring Locations Visited	Works Within Catchment During Monitoring Period	pH			
			Min	Max	Number of Exceedances	
					Baseline 5.16 – 8.25	WFD[2] 5.2 - 9
1	QCMP 23	No Works	7.91	7.91	0	0
2	QCMP 21	No Works	7.07	8.35	2	0
3	EMP 38, 39, 41, 43, 44, 55 & QCMP 19, 20	WLATHR and wind farm	6.51	7.98	0	0
4		No Works				-
5	EMP 27 & 31	WLATHR	6.44	8.02	0	0
6	EMP 25	WLATHR and water crossings	6.87	8.23	0	0
7	EMP 22, 23 & 24	WLATHR	5.88	7.65	0	0
8	EMP 21	WLATHR	6.84	7.58	0	0
9	EMP 7, 8, 10, 11, 13, 14, 17 & QCMP 5, 7, 9	WLATHR and water crossings	7.18	7.97	0	0
10	QCMP4 & EMP 5	WLATHR and water crossings	6.94	8.41	2	0
11	EMP 4	No works	7.97	8.04	0	0
12	EMP 3	No works	8.14	8.14	0	0
13	EMP 2	No works	8.31	8.31	1	0
14	QCMP 1	No works	8.04	8.04	0	0
Control	CNMP 1	Control catchment	7.78	7.78	0	0
Overall range			5.88	8.41	5	0

[2] Water Framework Directive (WFD), The River Basin Districts Typology, Standards and Groundwater threshold values (Water Framework Directive) (England and Wales) Directions 2010, *www.defra.gov.uk/environment/quality/water/wfd/.../2010directions.pdf*

Table 2: Field Electrical Conductivity during the seventh construction monitoring period

Catchment	Monitoring Locations Visited	Works Within Catchment During Monitoring Period	Electrical Conductivity (µS/cm)			
			Min	Max	Number of Exceedances	
					Baseline 26 – 224	UK DWS[3] 2500
1	QCMP 23	No Works	203	203	0	0
2	QCMP 21	No Works	75	214	0	0
3	EMP 38, 39, 41, 43, 44, 55 & QCMP 19, 20	WLATHR and wind farm	35	177	0	0
4		No Works				
5	EMP 27 & 31	WLATHR	58	121	0	0
6	EMP 25	WLATHR and water crossings	33	72	0	0
7	EMP 22, 23 & 24	WLATHR	46	156	0	0
8	EMP 21	WLATHR	49	91	0	0
9	EMP 7, 8, 10, 11, 13, 14, 17 & QCMP 5, 7, 9	WLATHR and water crossings	40	178	0	0
10	QCMP4 & EMP 5	WLATHR and water crossings	65	176	0	0
11	EMP 4	No works	95	116	0	0
12	EMP 3	No works	105	105	0	0
13	EMP 2	No works	144	144	0	0
14	QCMP 1	No works	277	277	1	0
Control	CNMP 1	Control catchment	119	119	0	0
Overall range			33	277	1	0

[3] UK Drinking Water Standards guideline value for Electrical Conductivity 2500µS/cm

Table 3: Field Turbidity during the seventh construction monitoring period

Catchment	Monitoring Locations Visited	Works Within Catchment During Monitoring Period	Turbidity (NTU)			
			Min	Max	Number of Exceedances	
					Baseline 0 – 2.5	Trigger Value 9
1	QCMP 23	No Works	0.00	0.00	0	0
2	QCMP 21	No Works	0.00	1.27	0	0
3	EMP 38, 39, 41, 43, 44, 55 & QCMP 19, 20	WLATHR and wind farm	0.00	30.64	5	2
4		No Works				
5	EMP 27 & 31	WLATHR	0.00	11.63	2	1
6	EMP 25	WLATHR and water crossings	0.00	0.00	0	0
7	EMP 22, 23 & 24	WLATHR	0.00	2.67	0	0
8	EMP 21	WLATHR	0.00	0.00	0	0
9	EMP 7, 8, 10, 11, 13, 14, 17 & QCMP 5, 7, 9	WLATHR and water crossings	0.00	0.00	0	0
10	QCMP4 & EMP 5	WLATHR and water crossings	0.00	0.00	0	0
11	EMP 4	No works	0.00	2.06	0	0
12	EMP 3	No works	0.00	0.00	0	0
13	EMP 2	No works	0.00	0.00	0	0
14	QCMP 1	No works	0.00	0.00	0	0
Control	CNMP 1	Control catchment	0.00	0.00	0	0
Overall range			0.00	30.64	7	3

6.3 Turbidity Loggers

In addition to the SKM Enviros and ECOW field observations; there are two field based turbidity loggers which constantly take turbidity readings.

The loggers were installed in October 2011 before the construction period began. The logger situated at QCMP 19 is down gradient of the majority of the Carraig Gheal Wind Farm infrastructure in Catchment 3, while the logger situated at CNMP 1 is located within the control catchment of the Cam Allt River, outside the influence of the Wind Farm and the WLATHR.

The turbidity data can be accessed remotely and throughout the seventh monitoring period the turbidity values recorded at CNMP1 and QCMP19 between the 17th May 2012 and the 21st June 2012 were all within the baseline range. In Construction Monitoring Report 6, SKM Enviros suggested that it was likely that the turbidity logger at QCMP 19 was not recording turbidity data accurately.

On 20th June 2012 SKM conducted a field test of the logger by putting it in a container of strongly silted water. The handheld turbidity logger measured 680NTU and the automatic turbidity logger registered a peak of 2.4NTU. This confirms that the logger at QCMP19 is not working properly.

There are two turbidity loggers at QCMP19 and CNMP1. Neither has ever recorded a reading greater than 2.5NTU. An alarm is sent out for readings in excess of 9NTU to be received by the recipients within the logging interval of the instrument, i.e. 15mins.but this has never been triggered. There have also been problems with any turbidity recordings and the timescale on which they are reported by the system. As the system should be capable of reporting accurate data over the full range of turbidity field measurements, but is not, it is considered therefore that neither have ever recorded turbidity levels correctly.

This issue has been reported to Greenpower and the supplier RS Hydro who are investigating

6.4 Laboratory Hydrochemistry Monitoring

Samples for laboratory analysis were collected by both SKM Enviros and the ECoW during the seventh construction monitoring period. All water sample bottles were provided by the laboratory, Scientific Analysis Laboratories Ltd (SAL), and selected for the relevant analysis suite being undertaken. After careful collection of the samples at each monitoring location, all the bottles were stored in cool boxes until collection by courier. The courier has now been changed and earlier difficulties over collection have been resolved. Due toa misunderstanding

field measurements were not taken on samples sent for laboratory analysis, this has now been corrected.

During the seventh monitoring period intermittent discharges of hydraulic oil (Hydra 46) from pumps and associated hoses / connections occurred into watercourses on the Carraig Gheal construction site. including the Allt Garbh (which forms the source for PWS 1, shown on Figure 1).

As a result of this incident there was additional laboratory monitoring in the seventh monitoring period.

Table 4: Laboratory Samples collected during the seventh construction monitoring period

Date	Sample location	Location	Sampler	Reason for Sampling
06/06/2012	QCMP20	Allt Garbh	ECoW	Hydraulic oil spill to PWS
06/06/2012	EMP41	Allt Garbh	ECoW	Hydraulic oil spill to PWS
08/06/2012	Upstream PWS 1	Allt Garbh	ECoW	Hydraulic oil spill to PWS
08/06/2012	EMP5	Allt Garbh	ECoW	Hydraulic oil spill to PWS
08/06/2012	Upstream C5	Allt Garbh	ECoW	Hydraulic oil spill to PWS
08/06/2012	PWS 1 take	Allt Garbh	ECoW	Hydraulic oil spill to PWS
08/06/2012	PWS1 downstream	Allt Garbh	ECoW	Hydraulic oil spill to PWS
07/06/2012	Downstream C5	Allt Garbh	ECoW	Hydraulic oil spill to PWS
20/06/2012	QCMP21	Berchan River	ECoW	Water abstraction
20/06/2012	PWS 2	River Avich	ECoW	Upstream of PWS 2
21/06/2012	QCMP 5	River Liever	SKM	Upstream works minimal at BPs and track
21/06/2012	QCMP 9	River Liever	SKM	Upstream works at BP9 and track progression at ch 8000.
21/06/2012	QCMP 4	Allt Garbh	SKM	Oil spill to watercourse

A summary of the results for these quarterly lab analyses across the site is provided in Table 5. The data sheets for these analyses by each monitoring point, including levels of detection, are provided in Appendix 1.

Table 5: Laboratory results during the seventh Water Quality Monitoring Round

Determinant	FFD	WFD Standard (upland)				Baseline Range V3		7th Monitoring Round	
		High	Good	Mod	Poor	Min	Max	Min	Max
pH	6-9	6.1-9	5.2-6	4.7-5.1	4.2-4.6	5.4	9	7.5	8.1
Conductivity (µS/cm)	2500 (@20°C)~					41	300	86	**330**
Total suspended solids (mg/l)	25					<10	24	<10	**32**
Total alkalinity as CaCO3 (mg/l)						11	77	20	**134**
Chloride (mg/l)	250*~					4.2	51	6	11
Ammoniacal Nitrogen as N (mg/l)	1.0~	0.2	0.3	0.75	1.1	<0.05	<0.05	<0.05	**0.06**
Nitrite as NO2 (mg/l)	≤0.01					<0.1	<0.1	<0.1	<0.1
Nitrate as NO3 (mg/l)	50					<0.1	0.6	<0.1	**25**
Phosphate (Ortho as PO4) (mg/l)	0.2	0.02	0.04	0.15	0.5	<0.15	0.76	<0.2	<0.2
Sulphate (mg/l)	250~					0.3	5.2	1.5	5.0
Calcium (mg/l)						2.2	23	8.9	**35**
Potassium (mg/l)						<0.2	1.1	0.3	1.1
Magnesium (mg/l)						0.7	4.6	1.7	**5.1**
Sodium (mg/l)	200~					4	22	6.8	**44.0**
Iron (mg/l)	1.0	1	-	-	-	0.05	1.3	0.1	0.73
TPH (C10-C40)(mg/l)						<0.01	0.09	<0.01	0.02
TPH (C6-C10)(µg/l)						<10	<10	<10	<10
Benzene (µg/l)						<1	<1	<1	<1
Toluene (µg/l)		74	-	-	-	<1	<1	<1	<1
Ethyl benzene (µg/l)						<1	<1	<1	<1
m- and p-Xylene(µg/l)						<1	<1	<1	<1
o-Xylene(µg/l)						<1	<1	<1	<1
Methyl tert-butyl ether (µg/l)						<1	<1	<1	<1

Where bold is exceedance
* Value is freshwater EQS
~Value is DWS

7. Discussion of Results

The aim of this discussion is, by comparing the samples collected during the construction phase with the baseline data, rainfall, construction activities and the relevant water quality guideline values i, to determine if there has been any significant effect on the water quality of the watercourses surrounding the site.

7.1 pH

In total there were 4 exceedances of pH baseline in field samples collected during the seventh monitoring period. There were two exceedances of the baseline range (5.16 to 8.25) in sub-catchment 2, and two further exceedances in sub-catchment 10. However, none of these readings breached the WFD standards (5 to 9). Maximum recorded pH in the seventh construction monitoring period was 8.41 (EMP 5 on the 28th May). ECoW field notes indicate that this sample was collected prior to construction works starting on water crossing C5.

Laboratory analysis of pH recorded pH values within the baseline range and within the range for 'high' quality upland water, as defined by WFD standards.

7.2 Electrical Conductivity

A laboratory sample from EMP41 (sub-catchment 3) on the 6th June had an electrical conductivity (EC) of 330µS/cm, this marginally exceeds the baseline maximum of 300 µS/cm but is well within the maximum allowable concentration (MAC) as defined by the WFD (2500 µS/cm). This sample was also found to have elevated concentrations of a number of solutes (alkalinity, ammoniacal nitrogen, magnesium, sodium and nitrate) and it is likely that these solutes are the source of the elevated conductivity levels. The source of these solutes is discussed in more detail below.

The electrical conductivity of the rest of the field and laboratory samples was within their respective baseline ranges.

7.3 Turbidity and Suspended Solids

There were 7 recorded exceedances of the baseline turbidity (2.5NTU) and 4 exceedances of the trigger level (9NTU) during the seventh construction monitoring period. There was an

exceedance of the suspended solids baseline (25mg/l). All of these exceedances occurred in sub-catchments 3, 5 or 10.

There were no recorded exceedances of turbidity or suspended solids in sub-catchment 2, 3, 6, 7, 8, 9, 11, 12, 13 and 14.

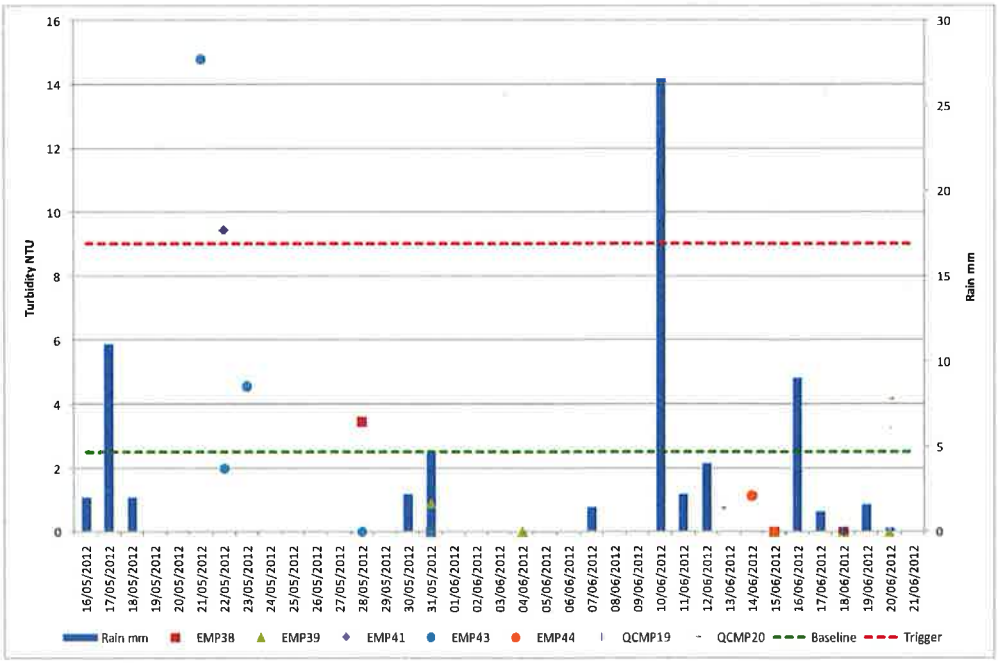
There were no works in sub-catchment 4 so no field or laboratory samples were collected for analysis.

7.3.1 Turbidity in Sub-catchment 3

Catchment 3 drains the Allt Gleann na h-Airigh and associated tributaries. The Allt Gleann na h-Airigh flows into the Abhainn Fionain which discharges into Loch Awe south of Inverinan. Loch Awe is designated by SEPA as Salmonid waters. Catchment 3 contains significant construction works, during the seventh monitoring period this included construction of wind farm access track, water crossings C41 and C42, turbines and some excavation of borrow pit 2.

During the seventh monitoring period in catchment 3, there were 5 exceedances of baseline turbidity and 2 exceedances of the turbidity trigger level (see graph 1).

Figure 5 1 Turbidity in sub-catchment 3



Field turbidity was elevated above the trigger level of 9NTU at EMP41 and EMP43, both of these locations are downgradient of significant wind farm construction activities. Figure 5 shows that sediment was released into the Allt Gleann na h-Airigh over a period of 4 days, Upon incident investigation, the source of the sediment was the track construction towards turbine 11 and 12 and flow within the Allt was low.

The elevated turbidity at EMP41 was specifically attributed to a sediment release coming form the construction of the access track to turbine 6.

Turbidity was elevated above the baseline in a sample from EMP 38. ECoW notes attribute this release to sediment mobilisation following tree removal in preparation for construction of water crossing C32.

7.3.2 Turbidity in Sub-catchment 5

Catchment 5 is located to the north of Loch Avich, and is effectively the surface water catchment of Allt Ghlinn which discharges into Loch Avich. Loch Avich is designated by SEPA as Salmonid waters. Construction activities within the catchment included WLATHR upgrade (RC 18000 to RC 22100) and the construction of new WLATHR sections. It was noted that by SKM Enviros that there has been significant work on upgrading mititgation measures in sub-catchment 5. This has resulted in a reduced number of sediment releases during the seventh monitoring period. In total, there were only 2 exceedances, 1 of the baseline and 1 of the trigger level.

The maximum recorded turbidity level was 11.63NTU at EMP31 on the 12th June. ECoW notes indicate that there were no works upgradient of this location however the reading was taken after heavy rain which had occurred the night before. Although this concentration exceeds the trigger level, it is not considered to be a significant release.

There was a minor exceedance of the baseline of 2.5NTU at EMP27 on the 1st June. A reading of 3.93NTU was recorded and this exceedance was attributed to ongoing WLATHR upgrade upstream.

There has been an ongoing problem with silt entering the watercourse upstream between WLATHR ch.21000 and ch.25000, despite there being a high level of mitigation in place. Runoff generation has been attributed to rainfall directly onto the road, percolating through and collecting silt before seeping out into watercourses so sedimentation is occurring even when there is no construction occurring. Continual review of the performance of mitigation measures including straw bales, silt fences and check dams is required. Compared to previous construction monitoring periods, there has been a significant improvement on the number of

exceedances detected. This is likely to be due to a combination of factors including lower rainfall.

7.3.3 Turbidity in Sub-catchment 10

Sub-catchment 10 is located towards the southern end of Loch Awe. The sub-catchment is relatively small and contains the Allt Garbh and tributaries which flow into Loch Awe below Torran Farm. The Allt Garbh is a particularly sensitive watercourse because it is the source for a PWS to Torran. Loch Awe is also a sensitive aquatic receptor and is a designated freshwater fish habitat. During the seventh monitoring period, sections of the WLATHR and water crossing C5 were under construction. On the 6th June there was a spill of hydraulic mineral oil into the Allt Garbh during the construction of water crossing C5. This is discussed in more detail in section 7.6. The samples discussed here were collected in the days after the spill.

A sample sent for laboratory analysis collected from EMP 5 (on Allt Garbh) on the 8th June returned a suspended solids reading of 32mg/l. This exceeds the freshwater fish and drinking water standards of 25mg/l. No field data or notes were recorded when the sample was taken so no comparison can be made with turbidity. There were no works ongoing upgradient of the sampling point and samples collected on previous days contained suspended solids below the method detection limit. The source of the sediment is likely to be natural runoff. The rainfall record show there was rainfall on the day prior to the sample being collected.

7.4 Nitrogenous Compounds and Phosphate

Nitrates were elevated above the baseline range in samples from sub-catchment 2, 3, 6, 10 and 12.

Of these, nitrates were only marginally above the baseline maximum (0.6mg/l) in samples from sub-catchments 2 (1.9mg/l) and 6 (2.0mg/l) collected on the 20th June, and from sub-catchment 10 and 12 (0.7mg/l) collected on the 6th June. For each sample suspended solids was below the method detection limit suggesting that the elevated nitrate was not accompanied by a release of sediment. Field parameters were only recorded for one sample (sub-catchment 2) and these were all within their respective baseline ranges. The evidence suggests that in these samples, the elevated nitrate concentrations were not caused by sediment releases from construction activities. However, without field monitoring data and notes no further assessment of the likely source can be made.

Nitrates in samples from sub-catchment 3 far exceeded the baseline maximum of 0.6mg/l. Nitrate was 18mg/l in a sample from QCMP20 and 25mg/l in a sample from EMP41. The sample from EMP41 also contained marginally elevated ammoniacal nitrogen concentrations

(0.06mg/l). QCMP20 and EMP41 are downstream of the Carraig Gheal Wind Farm and a discussion with the ECoW has confirmed that these samples were collected following a reported release of sediment to watercourses and is therefore likely to relate to sediment release issues identified in section 7.3.1. Unfortunately, no field sampling was undertaken when the lab samples were collected. It is recommended that all laboratory sampling is accompanied with field monitoring and note taking so that the context under which the samples were taken can be established.

For all other samples, ammoniacal nitrogen, nitrates and nitrites were all within the baseline range.

For all laboratory samples collected during the seventh monitoring period phosphate concentrations were below the method detection limit (<0.2mg/l).

7.5 Metals

Concentrations of iron, chloride, sulphate and potassium were all within their respective baseline ranges in laboratory samples collected during the seventh monitoring period.

Concentrations of calcium, sodium and magnesium exceeded the baseline maximum in samples from sub-catchment 3. These samples were collected from QCMP20 and EMP41, the same locations which contained elevated nitrates. It is likely that the source of the elevated metals will be the same sediment releases from the wind farm. The results are summarised in table 6.

Table 6 Metals concentrations in sub-catchment 3

Metal	Calcium	Magnesium	Sodium
Baseline maximum (mg/l)	23	4.6	22
QCMP 20	23	5	38
EMP41	26	5.1	44

The recorded concentrations are only slightly higher than the baseline maximum. There are no relevant water quality standards for magnesium or calcium but recorded sodium concentrations are well within the freshwater fish standard for sodium of 250mg/l. As a result, SKM Enviros consider these exceedances to be minor.

Calcium concentrations marginally exceeded the baseline standard of 23mg/l in samples from sub-catchment 2, 6 and 10. The maximum concentration recorded in sub-catchment 10 was 25mg/l and this was not considered to be significant exceedance with respect to drinking water quality.

The samples from sub-catchment 2 and 6 are the same samples which contained slightly elevated nitrates as discussed in section 7.4. The calcium concentrations in sub-catchment 2 (35mg/l) and 6 (34mg/l) are unlikely to be as a result of sediment releases from construction activities.

7.6 Petroleum Hydrocarbons Semi-volatile organic hydrocarbons

During the seventh construction monitoring period spillage of hydraulic oil (Hydra 46) occurred into the Allt Garbh (sub-catchment 10). The Allt Garbh forms the source for a private water supply at Torran (marked as PWS 1 on figure 1) which supplies 10 properties. The Allt Garbh also discharges into Loch Awe which is a protected water body under the Freshwater Fish Act. The discharge occurred due to leakage from the hydraulic pump and pipes of mobile plant located within the Allt Garbh during the construction phase of water crossing C5.

When Greenpower identified the contractor spillage, the incident response plan and reporting procedures outlined in the CWMP section 6.2 were implemented, and the private water supply intake was disconnected shortly after the oil spill. It is understood that the contractor has taken steps to instate an alternative water supply for the affected properties. A number of samples were collected for laboratory analysis on the day of the event and for the days afterwards. The water supply has since been reinstated. The contractor has also re-trained staff on the use of the hydraulic pumps near waterways to reduce the risk of oil spills and leakages from the pumps.

Hydra 46 Materials Safety Data Sheet (MSDS) states that Hydra 46 is a not a petroleum hydrocarbon so it would not show up in a standard TPH analysis. The Hydra 46 MSDS states that it is composed of 'hindered akylphenols' and is a type of semi-volatile organic hydrocarbon. It is non-toxic to humans upon ingestion but it is 'slightly' toxic to aquatic organisms. Hydra 46 can form a film on the waters' surface which potentially restricts oxygen exchange in the water and can affect Biological Oxygen Demand (BOD) and Chemical Oxygen Demand in the water (COD). Chemical changes to the water such as these can also adversely impact aquatic flora and fauna and cause visual and taste issues for potable water users.

The analytical results show no exceedances of baseline water quality standards in the Allt Garbh following the spill incident for those parameters investigated which included TPH (C10-C40), TPH (C6-C10) and BTEX compounds. However this result may be misleading because the laboratory did not analyse specifically for Hydra 46. Further analyses should add SVOC with TIC (semi volatile organic compounds with tentatively identified compounds) and possibly BOD and COD to identify whether there has been an impact.

8. Conclusions and Recommendations

There was comparatively (to regional values) little rain recorded on site during the seventh monitoring period. This, together with an increase in mitigation measures, is reflected in the reduction in number and severity of sediment release events when compared to issues discussed in previous monitoring periods.

There have however been a number of trigger level exceedances of sediment and in some cases these are accompanied by high nitrate and ammoniacal nitrogen.

Despite the work on the drainage and sediment control structures, a number of issues remain regarding the efficacy and appropriateness of sediment control structures in some locations. This can be seen particularly in sub-catchment 3 where wind farm construction is ongoing. A number of water quality issues were identified in samples collected from this sub-catchment. These issues and recommendations for improvements are listed below;

- More check dams in areas with steep topography.
- Check dams installed along with track side drains as soon as practically possible when constructing new sections of track (preferably in advance of stripping) and not left until after construction for their installation.
- Fine grained material or hay bales/geotextile which will filter sediment from water need to be combined with larger stones to keep them in place..
- Properly install silt fences
- Avoid pumping of water direct to watercourses

Hydra 46 oil has entered the Allt Garbh in sub-catchment 10 which forms the source for a PWS supplying 18 properties and flows into a designated Freshwater Fish area (Loch Awe). The oil entered the Allt Garbh because equipment was in the watercourse during the construction of the water crossing C5. Further work is required at this location as the piers on either side of the river are under construction and there is a long stretch of steep track approaching the crossing location from the south. There is therefore a continuing high risk of pollution of this water supply; it is therefore strongly recommended that the current River Avich protection plan is extended to include all watercourses including the Allt Garbh and the plan is implemented as soon as possible.

It is recommended that mineral oil is tested for in samples sent for laboratory analysis for SVOC with TIC, BOD and COD. This will improve the understanding of the impact that spills of fuel/oil have on the aquatic environment so that a more robust assessment of impact can be made in these monitoring reports.

Watercourse crossings on site remain generally poor, with the exception of the bridge at crossing 38. An open arched culvert that does not disturb the bed, does not impede fish passage and maintains some of the river bank for mammal passage is recommended. The open arched culvert design would also mean that mobile plant would not need to be in watercourses for extended periods of time and this would significantly reduce the risk of oils and other contaminants entering the watercourse.

Yours sincerely

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