

ELECTRICITY ACT 1989

TOWN AND COUNTRY PLANNING (SCOTLAND) ACT 1997

The DPEA Code of Practice for s. 36 Inquiries

INQUIRY STATEMENT

for DR RACHEL CONNOR AND MR TIM HARRISON

Third Party Objectors

In relation to Matter 4, the issue of DRINKING WATER SUPPLIES

In the public examination of an application for consent under the Electricity Act, s.36 for the Third Extension to the Whitelee Windfarm.

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1 THE DISCOVERY OF PRIVATE WATER SUPPLY CONTAMINATION

- 1 I am Rachel Connor M.B., Ch.B. F.R.C.R. I am a Consultant Radiologist, having qualified in Medicine from the University of Liverpool in 1979. I was an Honorary Senior Lecturer in the Faculty of Medicine at Glasgow University until my retirement in 2012. I am not a geohydrologist, but I have prepared this document with the help of Senior Geohydrologists, Dr S. Carroll and Dr B. O'Dochartaigh from the British Geological Survey, Professor A. Dayan, professor in Environmental Toxicology and Ms. Janice Haines Senior Accreditation Manager for UKAS.
- 2 I live with my family in rural East Ayrshire, next to the Eaglesham Moor and on the lower slopes of the Whitelee plateau.
- 3 We have lived here, see *Figure 1*, since 1991, previously content in our small community and rural surroundings and unaware at any time up until 2013 that we had any problems related to the quality of our private water supply. I make this statement on behalf of myself and Mr Tim Harrison, Cauldstanes, an IT specialist who has formatted this document and prepared the index.
- 4 The Application
- 5 In early 2012, Community Windpower Ltd submitted an application to East Ayrshire Council (EAC) for a 15 x 130m turbine windfarm at Sneddon Law. This windfarm was planned adjacent to and said to be 'nestling' within the boundary of the existing Whitelee Windfarm Extension, which already overwhelmed us.



Figure 1 - East Collarie with Whitelee in the background

- 6 Whitelee windfarm (WLWF), the largest on shore windfarm in the UK, comprising 215 turbines, has been built in three stages. The original development of WLWF, 140 x 110m turbines, commenced construction in 2006 and was operational by 2009. The two extensions to WLWF, Whitelee Extension 1 (WL1) and Whitelee Extension 2, (WL2) commenced construction in 2010 and were operational by 2013.
- 7 Because of the impact of Whitelee windfarm, Sneddon Law windfarm attracted fierce local opposition, bringing giant turbines even closer to us than the existing 140 metre WL Extension turbines illustrated in Fig 1. Turbines were planned within approximately 1 km of our homes which had already been badly impacted by the proximity of WLWF. Local residents were concerned not just about the overwhelming visual impact, noise and the devaluation of their properties, but the potential impact on their private water supplies (PWS).
- 8 In the same way that these concerns regarding the impact of windfarm development on PWS had been raised in written objections to the Scottish Governments' Energy Consents and Deployment Unit (ECDU) prior to the consent of WL1 and 2, (EAC) these concerns were raised with, but disregarded by, the consenting authority, in this case, East Ayrshire Council, prior to permission for Sneddon Law being finalised in January 2013.
- 9 However, as a result of continued concerns from several local residents about the proximity of WL2 construction work and turbine foundations to the shared water collection tank at Airtnoch farm, supplying water to 10 homes along the Hareshawmuir valley, EAC undertook testing of this large PWS in February 2013, to provide reassurance. This showed bacterial contamination of our water supply. This was a great surprise to us, as we had previously believed our water to be clean, safe and reliable.
- 10 I then discovered that Scottish Power Renewables (SPR) had been obliged to monitor our water supply as a requirement during the construction of Whitelee windfarm from 2006, but I was unable to find those test results at EAC. Thus I decided to investigate this further.
- 11 WLWF History
- 12 The original WLWF is built largely on a Scottish Government designated, statutory Drinking Water Protected Area (DWPA). Whitelee was historically an area of largely unspoilt moss, heather and deep peat, which was partly drained and afforested from 1962-1992. Only 35ha of the natural blanket bog remained. It was deemed 'suitable for development' as it was regarded by the Scottish Government as windy and largely 'unproductive', which of course is what you would wish for a water catchment.

- 13 Much of the windfarm site is land owned by the Scottish Government – or more correctly, by their agencies, Scottish Water (SW) and Forestry Commission Scotland (FCS).
- 14 It was predicted from surveys that the peat would be on average 3m deep, but in fact it was much deeper, between 8m and 9m deep in places. Over 2 million m³ of peat were excavated for the whole development. This meant that instead of turbine foundations being the predicted 3 m deep, foundations into solid ground had to be up to 12m (40 feet) in depth. (Whitelee windfarm guide, *pers.comm*).
- 15 The first part of the site preparation involved clear felling of hundreds of hectares of trees. This began in 2005 ([SW, risk assessment Amlaird water catchment, 2010](#)) and continued into 2013. Approximately 3 million trees were felled; many chipped and spread on the peat along with the tree branches, for brash to support floating roads.
- 16 Six quarries with 85 articulated dump lorries ferried almost 6 million tons of excavated rock around the site for roads and turbine foundations¹. Over 160,000 m³ of concrete were used in turbine foundations and other areas, with a cement manufacturing and rock crushing plant on site.
- 17 This was an industrial project of epic proportions, on difficult boggy ground with vast natural peat deposits, on a Drinking Water Catchment supplying water to 73 private water supplies (Environs, 2006) and two public water reservoirs, Craigendunton and Lochgoin, supplying water to 34,000 homes in North Kilmarnock and the Irvine valley.
- 18 Monitoring
- 19 SPR had been obliged , by means of planning conditions attached to the s.36 consent to monitor several designated ‘at risk’ private water supplies (PWS) surrounding the Whitelee WF site, including Airtnoch / Hareshawmuir valley supply, as part of the consent for the original Whitelee windfarm. The results of the Airtnoch monitoring had not been communicated to the competent authority (EAC) or any other responsible authority, despite knowledge of a severe increase of bacterial contamination of the Airtnoch supply from 2006, at the start of Whitelee windfarm construction. It later became apparent, when the Planning Monitoring Officer reports became available to us in 2015, that Airtnoch was only one of several PWS, reliant upon the Whitelee site as a water source and catchment area, to suffer severe bacterial contamination. Although the PMO reports were available to EAC,

¹ <http://www.eastrenfrewshire.gov.uk/whitelee-development>

East Renfrewshire Council (ERC) and South Lanarkshire Council (SLC) from 2006, the actual water test results were not made known to either the Environmental Health Department or the Planning Department. This dangerous level of bacterial and other contamination involving PWS, and contamination of groundwater (GW) and surface water (SW) were known to SPR prior to submission of a planning application for the first Whitelee WF Extension (WL1) in 2010.

- 20 Therefore, in what now seems an extraordinary omission, both the Atkins PWS risk assessment for WL1 and 2 report [\(Atkins, SPR Whitelee windfarm Extension 1 and 2 PWS Risk Assessment, 2010\)](#) and submission of the Environmental Statement (ES) (SPR, ES WL Ext 1 and 2 - Geology, Soils, Hydrogeology, 2010) for the WL WF Extension to Scottish Ministers, SEPA and the Local Authority as consultees, failed to include, or refer to, the already known contaminated ground or surface waters, or private water supplies on the existing WL WF site.
- 21 For our water supply, it seems also extraordinary that not only was this bacterial contamination with dangerous coliforms (*Figure 2, page 13*) not reported to authorities once over the course of seven years, during which time people were repeatedly unwell, but the cause of contamination was never investigated and no effort was made to find the Airtnoch water source, now seen as likely to be arising from an industrial construction site and power station.
- 22 As a final contribution to what appears to us, the public consumer and windfarm neighbour, at best a complete failure in a public health system and at worse, collusion and negligence, is the discovery that Scottish Water had been contracted by SPR to provide the laboratory facilities for testing samples for the Whitelee PWS. An FOI request to SW to obtain this data has failed on the grounds that commercial confidentiality to SPR outweighs the Public Interest. (SW, FOI refused re disclosing PWS monitoring results at WL WF, 2015).
- 23 The RPS PWS risk assessment (Whitelee PWS Risk Assessment Report , 2003) had categorised the large Airtnoch supply incorrectly as a surface water source/supply and it was on this basis that Airtnoch water was monitored during the WL WF construction. The 2010 Atkins PWS risk assessment related to the WL Extensions had categorised the Airtnoch PWS as being at *medium* risk for pollution, which therefore required monitoring. Atkins (Atkins PWS risk Assessment WL WF Extension Report and Appendix 1. , 2010) was concerned that the nearest turbine foundation was very near the water supply (approximately 350m) and that there might need to be micro-siting of the turbine foundation and protective mitigation around turbine construction to avoid contamination of the water supply. Despite this concern, no cognisance was given in the risk assessment to monitoring results obtained by RPS and the Ecological Clerk of Works (ECOW) for SPR, as reported by

the PMO, already demonstrating severe deterioration of water quality over the course of construction of the original WL WF.

24 So how did bacterial contamination of the Airtnoch supply occur?

25 Contamination

26 Without proper investigation at the time of contamination, or knowledge of either the water source or path of the supply pipe to the holding tank, it is now difficult to be certain.

We do know that both Scottish Water, who were monitoring surface water sites monthly on their land, and SPR at their 20 monitoring sites across the WL WF site, recorded high levels of coliform and presumed E.Coli contamination in test results. This was commented upon by Ironside Farrar, Planning Monitoring Officer (PMO) in reports to Local Councils and Scottish Ministers. At the same time that high spikes of bacterial contamination were occurring in the Airtnoch supply 21/08/07 E.Coli 2100/100ml), there were also high levels of presumptive coliforms and E.Coli reported in those surface waters. (Ironside Farrar Ltd., 2007) , 633, 634.) The presence of E.Coli is an indication of animal or human faecal contamination, as this bacterium is not generally found in temperate soil samples.

27 The distribution pipe from the hundred plus year old, stone Airtnoch holding tank is approximately two feet below ground level. Mr Templeton, owning the land at Airtnoch has told me that during land drainage procedures in years past, the tank inflow is a cast iron pipe at approximately four feet depth. This brittle pipe would be very susceptible to the effects of excavation or heavy machinery. Once the overlying ground is disrupted by either forestry felling or construction activity, if either the supply pipe or actual water source has been compromised, then contaminated surface water containing coliforms from human or animal excrement can pass easily into the supply water. The presence of cryptosporidium in the East Collarie sample from 2013 results is also indicative of surface water contamination (S. Loudon EHO at EAC – *pers.comm*).

28 A geohydrology report of the Whitelee site_(S.Carroll, hydrogeology of the Whitelee wind farm, 2015) has concluded that many of the PWS emanating from the Whitelee plateau are likely to be shallow groundwater springs, potentially arising from 'peat pipes'. This conclusion has been endorsed by a senior geohydrologist from BGS, Dr. Brigid O'Dochartaigh. These shallow groundwater springs will be particularly susceptible to surface water pollution or to soil disruption, such as occurs with any earthworks, road construction, borrow pit construction or turbine foundations, even forestry felling. Two million m³ of peat were excavated on the Whitelee site, and

this alone may have contributed to destroying or contaminating shallow spring supplies.

29 Risk assessment and location of sources

30 Many aspects of this WL1 and 2, Atkins PWS risk assessment were not only flawed but patently incorrect.

31 Crucially, and contrary to recommendations from SEPA (SEPA-guidance-on-assessing-the-impacts-of-development-proposals-on-groundwater-abstractions-and-groundwater-dependent-terrestrial-ecosystems) and BGS (British Geological Survey), Atkins did not identify the water source, a negligent practice that was common also to the RPS (Whitelee PWS Risk Assessment Report, 2003) and Environ PWS risk assessment for the original WLWF (Environs, 2006). With cavalier disregard, both risk assessments used the water collection tank location as a proxy for the water source, even though the nearest WL Extension turbine was uphill and approximately 300m from the water collection tank. RPS, without any evidence, also incorrectly categorised the Airtnoch PWS as a surface water source.

32 In particular, the Atkins risk assessment failed to obtain preconstruction water quality (or quantity) testing for the Airtnoch supply, whilst all other PWS under consideration had baseline water quality testing. Was this in the full knowledge that the water supply had already been badly contaminated by the construction of the existing WLWF?

33 Astonishingly, SEPA made no comment with regard to the practice of using water collection tanks as a proxy for a water source for the Whitelee Extension, even though in 2010, SEPA have stated to me that charting a water source, rather than a collection or water holding tank would be a requirement for an ES (SEPA meeting summary 28.04.2015). In fact, no comment was made by SEPA regarding any aspect of domestic water abstraction for the whole site, for either WL1 or WL2, even though SEPA did object to WL 1 on the grounds of insufficient information having been submitted regarding water culverts (Whitelee Extension Phase 1 - SEPA responses), (Whitelee Extension Phase 2 - SEPA response).

34 For the current proposed WL3, again SEPA has made no comment regarding domestic PWS abstraction at all, even though types of water supply have not been identified for some properties, nor been identified correctly for others and water sources have not been mapped (Whitelee Extension phase 3 - SEPA response).

35 In June/July 2013, as a result of discovering from local authority testing, that our water supply was severely contaminated with coliforms and cryptosporidia, we requested from EAC the results of the monitoring that ought to have been

undertaken by SPR over the course of WL windfarm development. We established that Mr. Chalmers of South Drumbohy had been tasked by SPR to collect water samples at approximately 6 week intervals from 2006-2013 from the dairy tap at Airtnoch farm. Mr Chalmers had repeatedly reassured the then relevant person for the supply (The Private Water supplies (Scotland) Act, 2006), Mr J. Templeton, that the water quality was 'fine'.

36 Monitoring results

37 Over the course of seven years, EAC were never sent any of these water monitoring results, either directly from SPR, or indirectly from SPRs appointed monitoring agents, (PMO) Ironside Farrar. After EAC confirmed that they had never received our water test results (B.Gilchrist, 2013), SPR admitted in writing to a journalist, that they had not made these results available to the competent authority (Mega M.).

38 As a result of continued pressure from residents and from this journalist, in September 2013, EAC finally obtained the water monitoring results for the Airtnoch water supply from SPR for the years from 2006 to 2013.

39 These results (*Figure 2, page 13* and *Figure 3, page 13*) revealed the gross bacterial contamination of this PWS occurring over seven years, with coliform counts peaking at 170,000/100ml (required value = 0). The value required to diagnose a urinary tract infection in a human is 120,000/100ml; this level of bacterial contamination would be equivalent to drinking an untreated urinary tract infection!

40 Over this time period, several local residents and/or their house guests had been repeatedly and intermittently ill, sometimes severely, with gastrointestinal upset of vomiting and diarrhea (Connor R. , 17.phone text message to Dr Niblock , president of Scottish Standing Committee,Royal College of Radiologists from R.Connor, 26 Jan 20012.), (Letters of ill health related to WF construction period, 2015).

41 The approximately 30 – 40 adults and children reliant on this supply had therefore been unaware of the pollution of their water supply for some SEVEN years and had therefore not been given the choice to take precautionary measures such as boiling water or to invest in installing appropriate treatment.

42 SPR have repeatedly denied that they caused any private water contamination, yet during this time increasing concerns were being raised by the PMO in reports sent to SPR (CRE), of increasing coliform contamination of several PWS on the WL WF site, including Airtnoch (Ironside Farrar Ltd, August 2007) [633](#), [634](#).

43 Compliance

- 44 Regardless of whether SPR considered that they had a role in causation, SPR failed to comply with planning conditions for WL Extension (SPR, Issue 02 Condition 6.8 and 6.9 (Phase 1 and 2) Monitoring Plan, 2010) by failing to notify householders that their water was unfit to drink, or provide emergency contact details in the event of water problems, as required in planning condition 6.8 and RPS for WLWF 5.2 (RPS, 2003) in their Pollution Prevention Plan. SPR failed to meet these conditions by failing to notify either EAC or residents directly of adverse monitoring results, as stated in these conditions and mitigation arrangements. SPR failed to acknowledge that serious bacterial contamination occurred not just once, but throughout the entire construction period 2006-2012.
- 45 This letter from a senior manager (Mathers, 18. Mathers, Martin. SPR Response regarding Water Quality. 2013,.) at SPR shows the flagrant disregard of SPR for the public health consequences that might have arisen as a result of their inaction. This corporate ethos is repeated later in a letter to Graeme Pearson MSP from SPRs Chief Corporate Officer (Anderson).
- 46 A detailed and referenced rebuttal to this letter is attached (Connor R.).
- 47 The failure to notify statutory authorities of the serious bacterial contamination of this supply meant that EAC, as the competent authority, were unable to instigate any appropriate mitigation and public health measures.
- 48 Such was the prolonged failure of SPR in their duty of care and in compliance with planning conditions, that the story was eventually published by The Times newspaper. (Mega M. , 2013)

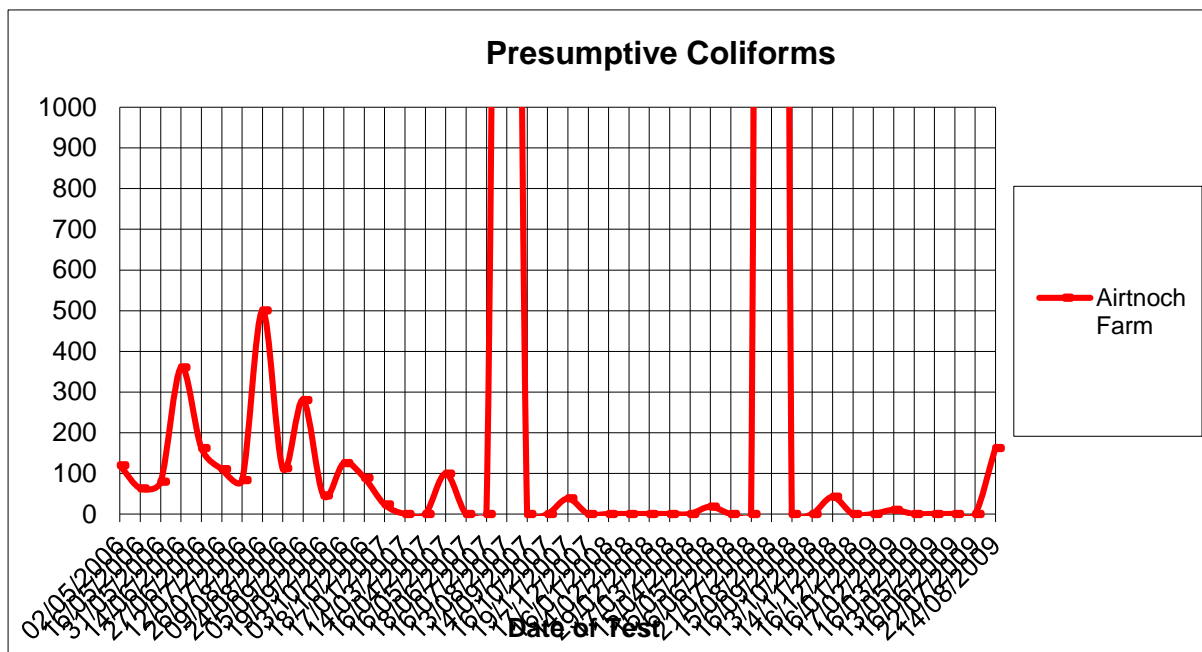


Figure 2 - Airtnoch Farm, Presumptive Coliforms

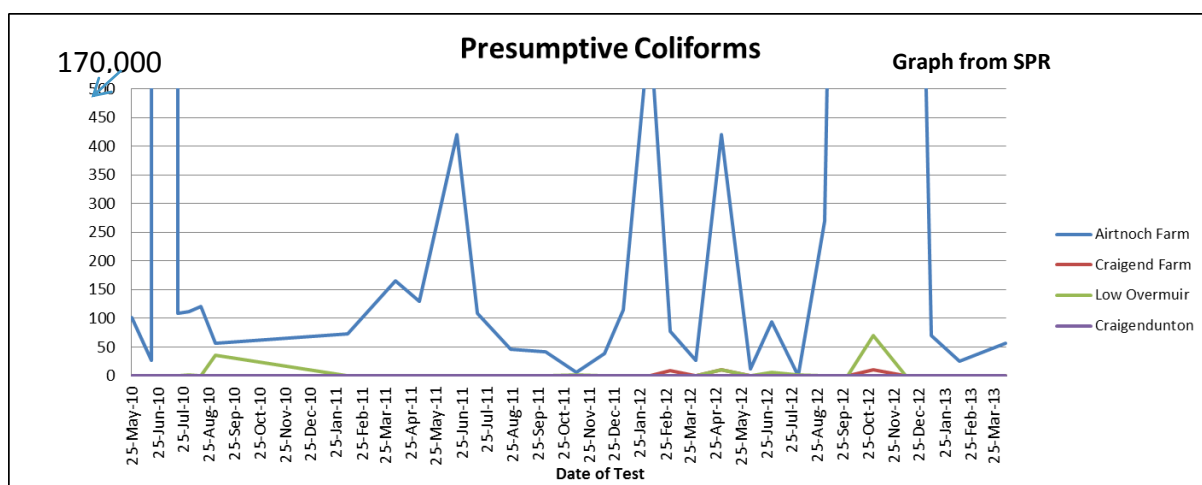


Figure 3 - Presumptive Coliforms - Comparison of 4 farms including Airtnoch

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- 50 Letters to local MSP Mr. Willie Coffey from Scottish Water (SW) and SPR were not only misleading and erroneous in content (to a serving Member of the Scottish Parliament), but SPR failed to accept any responsibility for water contamination. (Coffey, 2013). Within this letter, SPR stated that water contamination could only be regarded as being associated with industrial contamination and associated works if associated with increased water turbidity.

- 51 Data and graphs supplied by SPR (*Figure 4, page 15*) demonstrates that there were indeed spikes of turbidity recorded at PWS [Airtnoch and Low Overmuir], both deemed to be of 'medium risk' for contamination in the risk assessment submitted by Atkins (Atkins, SPR Whitelee windfarm Extension 1 and 2 PWS Risk Assessment, 2010). The highest peaks of turbidity were associated with a peak period of WL Extension construction activity in 2011, with previously the highest spikes in turbidity seen to correlate with WL WF construction in 2007 and 2008. Other PWS were similarly affected by problems of turbidity during the original WL WF construction and the PMO considered that turbidity and increased suspended solids may have contributed to the silting up of the Ardochrig Mor borehole supply (Ironsides Farrar Ltd., 2007) [635](#).
- 52 In a letter to Graeme Pearson MSP, the Corporate Officer for SPR, Mr. Keith Anderson also stated that '*only detecting suspended solids, particulate matter and oil and diesel derivatives are closely indicative of construction activity*' (Anderson).
- 53 *Figure 5, page 15*, demonstrates the increase of suspended solids in the Airtnoch PWS, correlating with the peak of construction activity for WLWF Extensions, contrary to Mr. Anderson's and SPRs assertions that there was no evidence of water contamination. The massive peaks in turbidity for the monitored borehole supply at Low Overmuir should also be noted in 2011. This occurred at a time when the owner was having to change the domestic water treatment filters much more frequently than normal. (All monitoring samples were taken, post treatment, from the kitchen tap). To this date (May 2015), the owner has still not received any monitoring data for this period from SPR or EAC.
- 54 SPR also denied any responsibility for PWS contamination on the basis that no industrial contaminants were measured in water supplies. However, at no time did SPR or its agents include water test parameters which included the measurement of industrial contaminants or minerals in PWS. Absence of industrial contaminants in the water supplies was therefore a self-fulfilling prophecy on the part of SPR and represented completely inadequate surveillance of PWS.

- 55 Perversely, monitoring of both groundwater and surface water for all WLWF phases has required more extensive testing than specified for drinking water (SPR, Issue 02 Condition 6.8 and 6.9 (Phase 1 and 2) Monitoring Plan, 2010).

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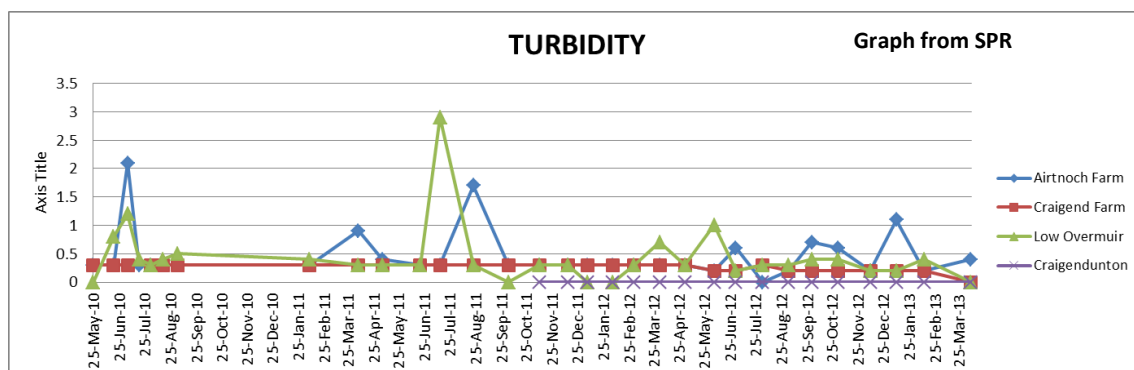


Figure 4 - Turbidity at Private Water Supplies

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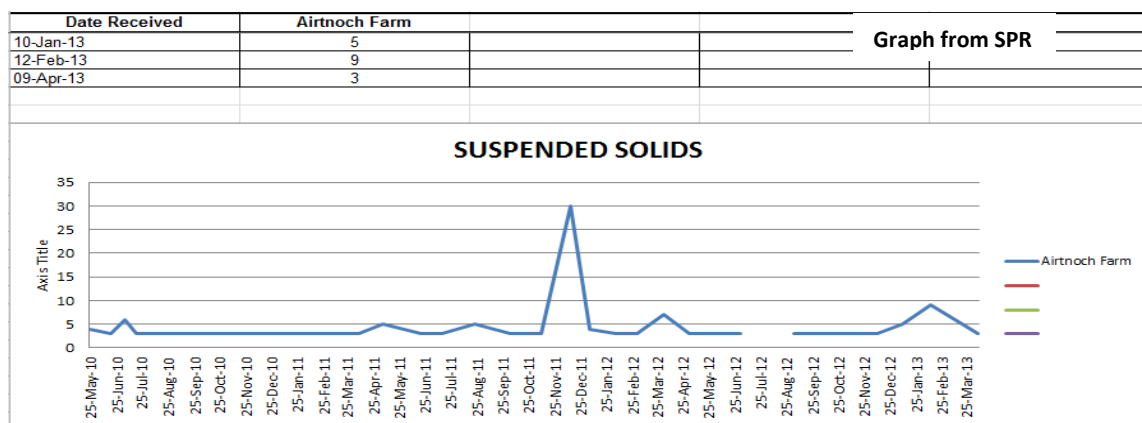


Figure 5 - Suspended Solids at Airtnoch Farm

- 58 Householders on the Airtnoch tank supply cleaned the water collection tank and installed a new tank cover, in line with recommendations from Environmental Health at EAC. However, repeat testing of inflow water to the tank from the unknown spring water source demonstrated continued bacterial contamination [34 coliforms/100ml] (EAC A. t., 2013) coming from the uncharted supply source.
- 59 With help from Graeme Pearson MSP, and following a site visit to examine the layout of the tank and proximity to the nearest turbine, SPR agreed to 'contribute' an unspecified amount towards the costs of finding the Airtnoch water source (Anderson), (Parker). This despite the fact that SPR had not fulfilled their original obligations under planning conditions and as a basic requirement by SEPA, to identify the water source, so that it could be protected.
- 60 Local residents felt unwilling to fund what was likely to be an expensive programme which would have been entirely unnecessary prior to construction of the windfarm.

- 61 In October 2013, I wrote to the Lord Advocate and to the Chief Constable, with the evidence available at that time, to ask whether there was a case to answer, given the glaringly apparent failure in a Duty of Care by SPR (R.Connor letter to Lord Advocate and Ch Constable Oct 2013).
- 62 Disappointingly, the Lord Advocate's Office failed to respond, and after further correspondence, the police decided this did not merit further investigation (Reply to Police - I. Livingstone, water contamination Jan 2014).
- 63 In September 2013, I attended a Renewable Energy conference in Glasgow. Mr. Martin Mathers, Manager for Onshore Renewables for SPR, was one of the speakers. I asked him about the pollution of our water supply and he denied that constructing windfarms would impact on PWS.
- 64 However, he did inform me of an instance where SPR had been obliged to fund and organise alternative mains public water supplies for a community at Cruach Mhor windfarm in Argyll. In the summer of 2014, I managed to track down and get in touch with one of the 17 households whose communal PWS had been so badly affected by the building of SPRs Cruach Mhor windfarm that they had had to move out of their home, along with guests and their new born grandchild, into a hotel over the festive period for two years running (Rodgers, 2014). I was so appalled that not only had the local community prior to planning permission being granted raised the likelihood that building a wind turbine on top of their water supply was likely to cause disruption (by Argyll and Bute Council), but that a developer could allow such serious pollution and disruption of a water supply to continue for so long. I therefore sent a copy of this story to every MP, MSP and Councilor in Scotland. It had become apparent that contamination of our water supply due to windfarm construction was not an isolated incident.
- 65 There were other reports in the press that in 2014 were now surfacing regarding the impact of windfarms not only on private water supplies, but the hydrological environment in general, which included major oil spills from wind turbines².
- 66 Through a journalist at the Sunday Post, I was sent an FOI containing details of all such contamination events recorded by SEPA (SEPA, 2012 SEPA Environmental windfarm Events list, 2012) up until 2012.
- 67 As a result of both press coverage, my 'YouTube' presentation³ and my letter to all the elected Scottish representatives, in October 2014, I finally met with the Planning

² <http://www.sundaypost.com/news-views/scotland/special-investigation-toxic-wind-turbines-1.282890>

Convener, Planning Officials, the lead for Environmental Health and Senior Environmental Health Officers at EAC. Finally, it seemed that at least at a Local Authority level, Officers were prepared to listen to the possibility that windfarm construction might be associated with a deterioration in both the quality and perhaps the quantity of both private and public water supplies.

³ <https://www.youtube.com/watch?v=BQf0hLYXd7o>

2 THE PUBLIC WATER SUPPLY

- 69 Following the revelations that our local PWS had been so badly affected with bacterial contamination during the construction phases of Whitelee Windfarm and its Extensions and knowing that several people had probably ill as a result, I looked further into the impact of WL WF on the *public* water supplies.
- 70 Three public water reservoirs are sited on the Whitelee plateau, namely Lochgoin in East Renfrewshire, which feeds into Craigendunton reservoir supplying East Ayrshire and Dunwan Dam (which no longer supplies public water) to the North East, above Eaglesham. (*Figure 6, page 19*).
- 71 Amlaird Water treatment works (WTW), at Waterside, receives raw water from Craigendunton reservoir, which in turn is fed by a feeder conduit from Lochgoin via a small 'lochan' at the North West end of the reservoir (*Figure 6, page 19*).
- 72 Amlaird supplies public water to over 34,000 customers; probably as many as 50,000 people. The water from Craigendunton has historically been brown and peaty, partly due to the deep peat on the Whitelee plateau, which forms the base of the reservoir and partly to the surface water run off of streams running into the reservoir. Amlaird received substantial reinvestment and rebuilding in 2005, to allow it to treat this water and produce water that met EU, UK and Scottish standards for wholesome and safe public water⁴.

⁴ <http://www.gov.scot/Topics/Environment/Water/17670/9395>

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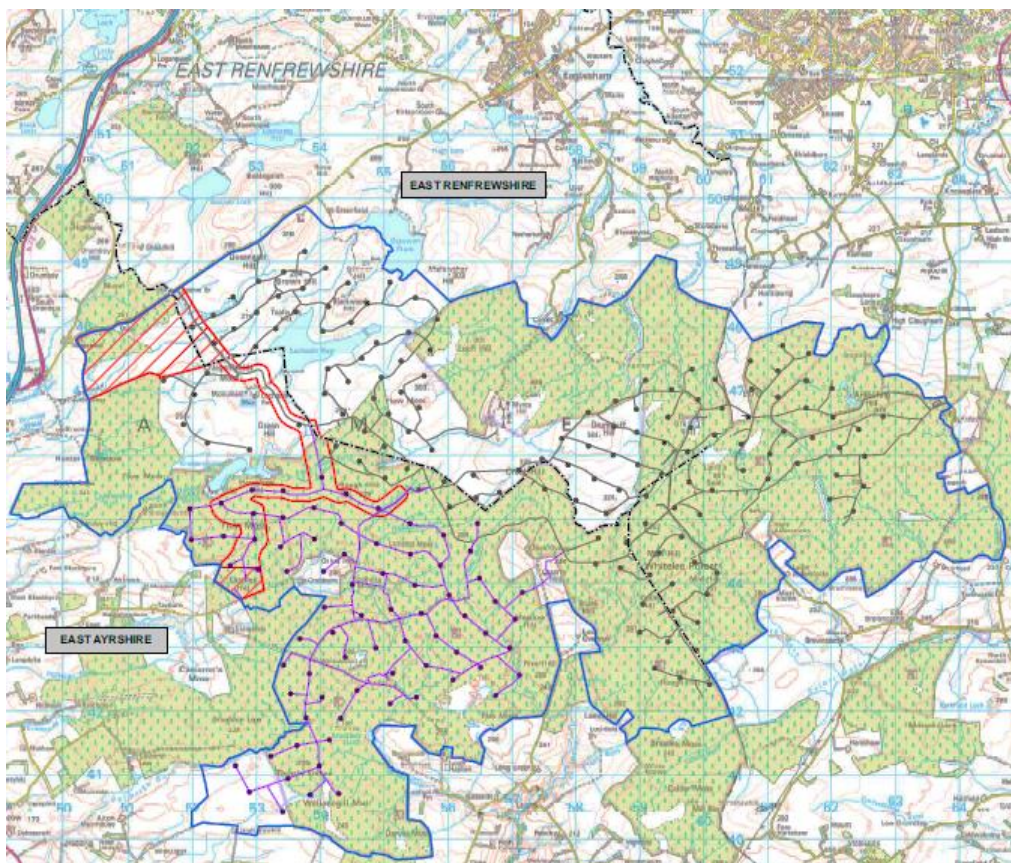


Figure 6 - Whitelee Wind farm showing public water supplies

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Figure 7 - Craigenduntun reservoir including feed from Lochgoin

- 75 With the help of, Graeme Pearson MSP, I managed to obtain graphs of raw water quality for Amlaird WTW from SW from 2003 -2013. The graphs of iron, manganese and colour all showed, at the same time, overwhelming spikes within the raw water feeding in to Amlaird from Craigendunton reservoir and correlating with the major periods of WL WF Extension construction activity. These peaks in 2011 were above what would be expected for normal seasonal variation of colour, iron and manganese (*Figure 8, page 20; Figure 9, page 21; Figure 10, page 21*).
- 76 SW have blamed these higher peaks of colour, iron and manganese in the raw water in 2011 on heavier than average rainfall, but rainfall figures from Saughall (near Darvel at the southern margin of the WL WF) show that rainfall was considerably higher in November 2006 and November 2010 (*Figure 15, page 40*). The rainfall figures we have obtained do not support SW's explanation of the sudden deterioration in raw water quality.

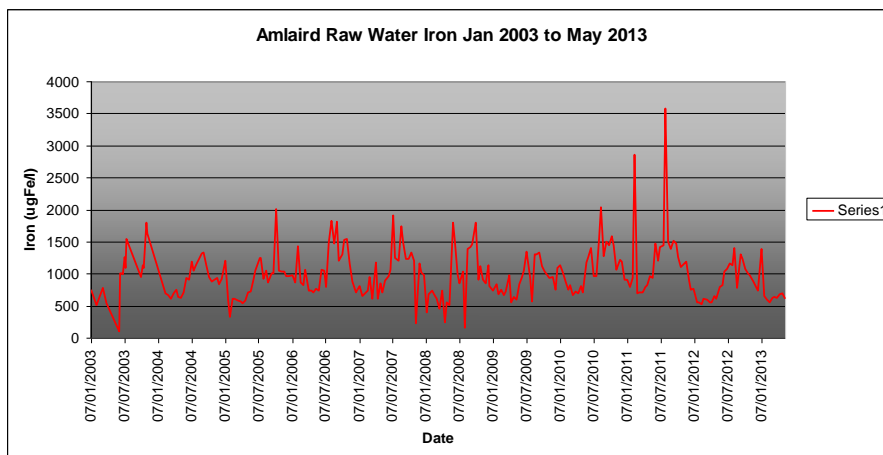
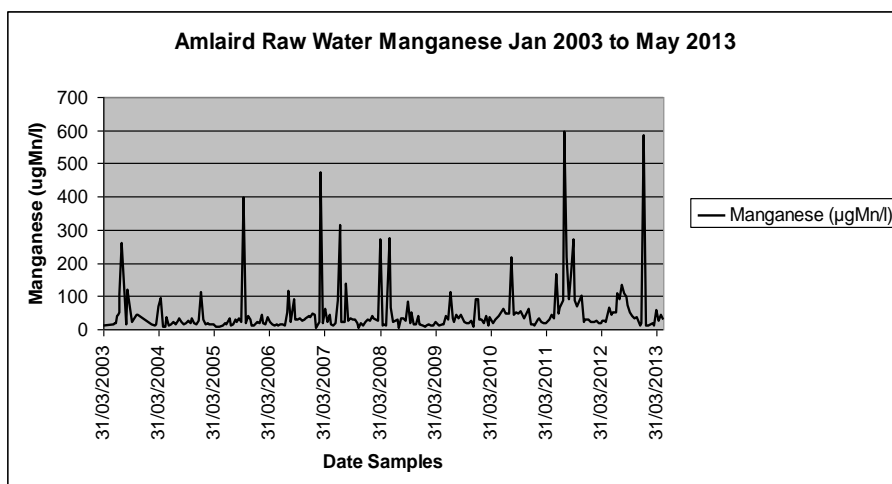
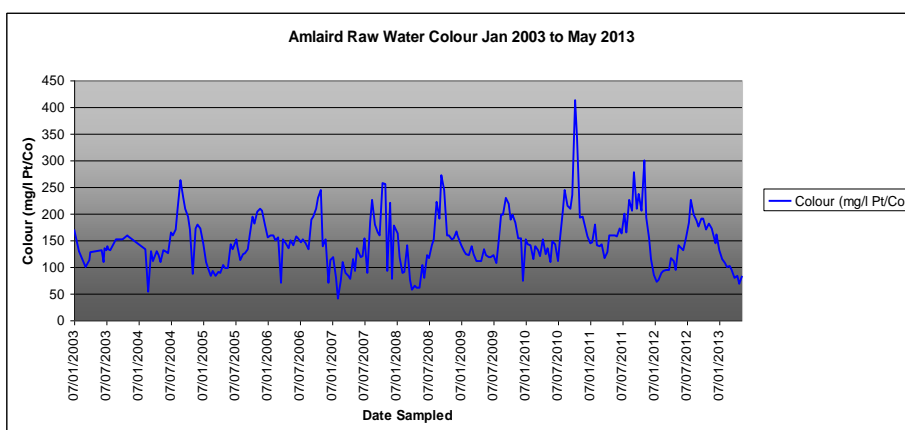


Figure 8 - Amlaird Raw Water Iron 2003 – 2013



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Figure 9 - Amlaird Raw Water Manganese 2003 - 2013



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Figure 10 - Amlaird Raw Water Colour 2003 - 2013

- 81 More data for water test results from Amlaird was alarming (*Figure 11, page 24; Figure 14, page 30*). Not only were there high peaks of bacteria in the feed in raw water (SW, bacteria raw water craigendunton, 2010-13), as had occurred in our PWS at Airtnoch over the same time period, but there were peaks of iron almost six times the regulatory standards, double the allowable levels of manganese and more than double the regulatory standards for allowable levels of chlorine in the treated public drinking water (SW, 2103). Again, these peaks correlated with changes in raw water quality and the construction of WL1 and WL 2 Extensions.
- 82 SW had been involved in monitoring surface water at eight locations in their catchment area involved in the development of WL WF. Although we do not have these results the Planning Monitoring Officer for WL WF (Ironsides Farrar Ltd., 2007), 634, had commented upon the SW monthly monitoring surface water results from 02/03/05 to 02/11/07 which recorded large increases in presumptive coliforms and

increased turbidity at several monitoring locations. SW was clearly aware of changes in the surface waters at the time of the original WF construction.

83 Increased iron, manganese and organic carbon in raw water not only provides a focus for bacteria, but makes it more difficult to remove bacteria from potable water and increases the amount of treatment and disinfection required for raw water to meet regulatory standards for potable water.

84 Therefore, the recommendations by the WHO, the EU, and all competent environmental and water authorities, is that the overriding goal should be to improve and provide as clean and pure incoming water to a treatment plant as is possible, to reduce the demands for treatment and disinfection. Graeme Pearson MSP asked questions in Parliament about the impact of a deterioration in raw water quality on public water quality (SG, S4W-21827parliamentary Qs, 2014), which confirmed the Scottish Government's view of the importance of a clean raw water supply, and change of land use as a cause of the raw water quality (SG, S4W-21826 Parliamentary Qs, 2014).

85 The colour of the raw water intake also peaked at this time in 2011 (*Figure 10, page 21*). Colour is important, because this correlates best with the amount of dissolved organic carbon in the water and the amount of disinfection chemicals that are probably needed to kill the bacteria.

86 Scottish Water had recognised that there was a problem with the deteriorating water quality, even in 2008 during the construction period for WL WF in 2006-2009. Their 2010 risk assessment states,

a. Raw water quality at Amlaird water treatment works (WTW) is generally good. However, raw water colour is consistently high and true colour reached levels of 272 Hazens in 2008, with the works originally designed for a maximum of 244. In 2009-10, apparent colour was generally 230-240 Hazens, but peaked at 400 Hazens following reservoir de-stratification in the autumn. In 2006 there was also a Cryptosporidium breach.

(SW, _risk assessment Amlaird_water catchment , 2010)

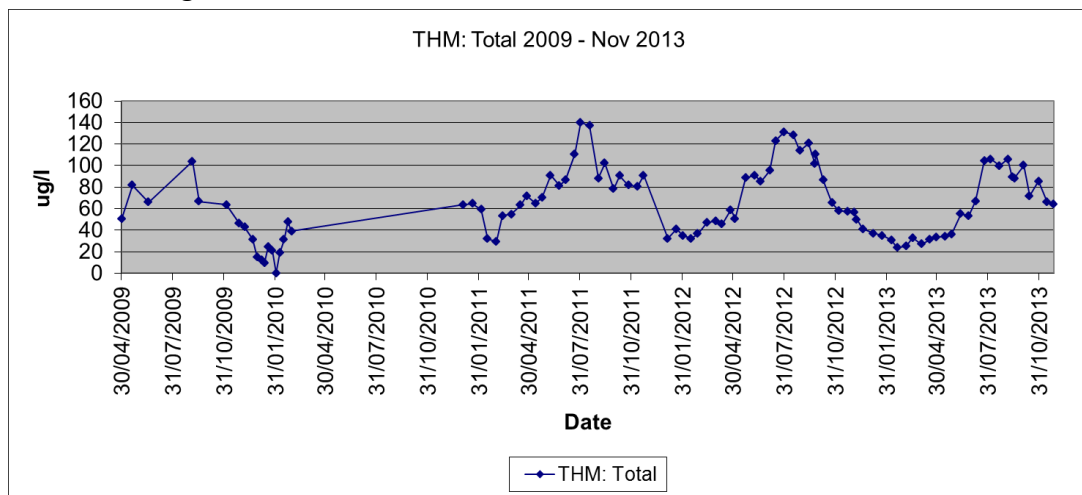
87 Despite this 'cleaning' and improvement to the reservoir, the highest peaks of colour in raw water occurred in 2011.

88 During 2013, SW were successfully prosecuted in Hamilton Sheriff Court by SEPA, for polluting the nearby Craufurdland burn in Waterside in 2011, with excessive discharges of iron and manganese from the Amlaird WTW resulting from treatment

of the raw water. Once again, although there were multiple breaches of environmental pollution regulations, the worst excesses occurred during the peak construction period of the windfarm extension.

- 89 The combination of high levels of chlorine, needed to disinfect the water from the bacterial load, and the high organic content of the raw and treated water meant that there were unacceptably high levels of compounds called Trihalomethanes (THMs) within the public water supply. These concentrations were 40% higher than allowable regulatory limits during this period of windfarm construction (*Figure 11, page 24*). THMs are a large group of compounds, the largest component of which is usually chloroform. There are other more toxic disinfection by products in water which depend on the method of disinfection, for example, sometimes ammonia is added to the water instead of, or in combination with chlorine. Levels of all drinking water disinfection by products are strictly regulated to avoid toxicity when drunk over long periods.
- 90 There are increasing concerns worldwide about THMs in public water, which can be absorbed not just by drinking water, but absorbed through inhalation and via the skin, for example when showering. The absorption and dose related effects are greatest in young children and infants. Trihalomethanes are conservatively recognised by the World Health Authority (WHO) as a possible human carcinogen. The regulatory standard set by the EU and UK regulatory authorities is set at 100ug/L. In N. America, this limit is set 20% lower at 80ug/L, recognising that long term effects of exposure are difficult to quantify in humans and that there are other non-carcinogenic health effects which can also be serious, particularly related to fatty change in the liver.
- 91 The WHO sets health guideline limits for total THM levels of 200ug/L, (WHO, 2011) recognising that developing countries may find these levels more difficult to attain and that developed countries and States (e.g. Member States within the EU) may set

lower health guideline limits.



92 Figure 11 - THM: Total 2009 - 2013

93 There is no regulatory requirement for WTWs to routinely monitor raw water quality coming into treatment works. Many WTWs do this only for operational reasons.

94 THM levels prior to 2009 were not measured by SW routinely at treatment works. THM levels were however, measured as part of compliance monitoring at consumers' taps by the Drinking Water Quality Regulator (DWQR), who are responsible for maintaining records and policing drinking water standards of both public and private water supplies in Scotland.

95 The high levels of THMs in Scottish public water was not new. It had been commented upon in the Scotsman⁵ and was recognised by UK regulatory authorities. It had been written up extensively by Professor Simon Parsons in work commissioned by the DWQR in 2008 (S.Parsons, Study into the disinfection by products by chloramination, potential health implications and techniques for minimisation., 2009)⁶.

96 This study, conducted over approximately nine months, looked at seven unnamed water supplies from a number of different sources in Scotland, including two peat based reservoirs. Whilst the study did not include the time of year when organic carbon tends to be highest, (usually autumn after the first heavy rains), there were still public water supplies with 400% higher than allowable THM levels. Prof.

⁵ <http://www.scotsman.com/news/health/scottish-water-worse-than-english-and-welsh-1-3066947>

⁶ <http://www.gov.scot/Topics/Environment/Water/17670/research/DBPchloramination>

Parsons's study also provided a world literature review of human toxicity and reported cancer associations and reproductive toxicity associated with population based evidence of increased oral ingestion of THMs.

- 97 The cancers typically associated with increased THM levels in humans are colon, bladder and brain cancers. In laboratory animals both Parson's study and WHO water quality guidelines, refer to the animal studies which show, more typically, dose related kidney and liver tumours. Reproductive toxicity is largely related to pregnancy failures and miscarriage.
- 98 In the autumn of 2013, I felt that this information needed to be brought into the public domain. Scotland already has some of the worst cancer incidences in Europe. Although some of that increased incidence is related to social deprivation and genetics, it seems possible that that is not the whole story. Why, for example, does the West of Scotland (with its high reliance on peat based public reservoirs for water) have the highest incidence of bowel cancer in the UK?
- 99 By the summer of 2014, I was increasingly concerned about the impact of windfarm construction on the quality of water for both public and private water supplies at the Whitelee site.
- 100 I had failed earlier in the year to get East Ayrshire Council to take the impacts seriously with respect to water, and the now consented Sneddon Law windfarm. One of our neighbours had four quarries and more than three close turbine bases within the water catchment of his borehole supply. Whilst SEPA had raised concerns about the impact of this windfarm on PWS in their letter to EAC when assessing that planning application, they had not objected. Despite our concerns that CWP Ltd, [Developers of Sneddon Law] had not conducted a formal geohydrology survey and assessed groundwater flows which might impact on borehole supplies, EAC had signed off the Planning Permission for Sneddon Law WF in January 2014. This was similar to the WL Extension planning application, where I had also raised concerns about proximity of the nearest turbine to our water collection tank in an objection to EAC and Scottish Ministers. Along with other PWS on the Whitelee site, we suffered gross bacterial contamination at East Collarie during the windfarm construction period.
- 101 I had failed to secure any press coverage for the public water quality deterioration associated with windfarm construction, so I welcomed the opportunity to address a public audience to bring all this information into the public domain. In June 2014, I addressed an audience of about 30 at the 'Protect our Regional Park' group meeting, who were fighting windfarm developments within the Clyde Muirshiel Regional Park. My talk was well received and raised more questions than answers. Following

feedback and encouragement from that group, I posted the presentation on 'YouTube'⁷. This presentation has had over 1700 viewings to date.

- 102 This video did seem to sensitise the regulatory authorities and perhaps as a result, in September 2014, after trying to communicate with the CEO of SW, Mr. Millican, I met with SW senior Managers: Professor Simon Parsons and Ms. Margaret McGuinness.
- 103 Fortunately, I was able to take a friend who was able to take a shorthand account of that dialogue, as SW did not allow us to record the meeting.
- 104 It seemed to us that from SW's perspective, the meeting was originally set up to placate us and assure us that there was nothing to worry about. However, I had prepared some searching questions which, whilst giving us some valuable information, raised very many more questions about the role of, and communication between and among the various regulatory authorities in the role of managing water quality and the paternalistic approach to informing the public about potential health issues that may arise from water which does not meet regulatory standards.
- 105 A summary of those questions and the answers we obtained that day- which were signed off by SW following our meeting - is attached here (R.Connor, Report of Meeting of Dr Rachel Connor and Mrs Aileen Jackson with Professor Simon Parsons Sept 12 2014, 2014).
- 106 It was apparent to me, as a member of the public, that there seemed to be failures in the way that the regulatory authorities: SEPA, SW, the DWQR, local authorities and the local Consultant in Public Health Medicine communicated and discharged their responsibilities with respect to public and private drinking water safety and quality.
- 107 It was apparent that for the approximately 75,000 people in Scotland without a mains supply of public water, that there was virtually no effective protection of their water supplies from renewable energy developments. Whilst in theory there is protective legislation such as The Private Water Supplies (Scotland) Act 2006, and the EU's Water Framework Directive for more general protection of drinking water catchments and river basins, the reality is that there is *no* regulatory authority able or willing to protect PWS from such development once a windfarm has been consented.

⁷ <https://www.youtube.com/watch?v=BQf0hLYXd7o>

- 108 For example, a large windfarm may have been likely to be consented centrally (following an inquiry) by the Scottish Government, against the wishes of Councils, local communities or individuals likely to be affected; SEPA would then have responsibility for monitoring the water environment of the development, SW would have no responsibility for the water coming into a reservoir, but would have responsibility for the reservoir quality; the local Council would have no responsibility for the water environment, but would have responsibility for protecting existing PWS and for enforcing any Planning Conditions attached to a consent. The ability of the Local Authority to do that would depend on which PWS the *developer* considered to be at risk and on the *developer* conveying monitoring results to the Local Authority. If the *developer* considered a PWS to be at low, or no risk, no monitoring would be conducted at all!
- 109 Whilst PWS were of no concern to SW, at Whitelee, many PWS share the same water catchment area as SW and it is this catchment area which is now host to 60 SPR turbines.
- 110 As a result of that meeting with SW, I requested further information from Scottish Water and I submitted FOI requests to the Ayrshire and Arran Consultant in Public Health Medicine (CPHM). (R.Connor, Letter to CPHM AAHT Dr C Davidson, 2014) (A previous email to the Scottish Government Interim Chief Medical Officer had gone unanswered)
- 111 I particularly wanted to know whether the deteriorating Amlaird public water test results had been notified to the CPHM, and what level of concern would normally be required to notify the public that water supplies were no longer wholesome or met regulatory standards. I wanted to know whether there were any 'red flags' which would automatically convene a review of the failings.
- 112 The comprehensive reply (C.Davidson, 2014) was very revealing. It was apparent that SEPA, SW, DWQR and EAC, as well as the CPHM, had been aware for some time of the deteriorating quality of the raw water input to the treatment works and the subsequent failure of the ability of the treatment works to be able to cope and be able to meet standards for wholesome water.
- 113 The CPHM in her response to me was at pains to use higher WHO guideline values (rather than the more stringent EU or UK values) for THM levels in public water, to support her view that she did not consider that excesses in the water supply constituted a public health risk. This same use of 'double standards', using higher WHO values, has been used in answers by DWQR to the Scottish Parliament regarding THM levels in public water. This is quite extraordinary in my view since

DWQR is responsible for maintaining Scottish Standards, which set a legal definition for 'wholesome' water.

- 114 There were however, contradictions in the CPHM reply to me in that exceedences for THMs occurred for over nine months, far in excess of the allowable short term values by UK authorities.
- 115 She did not consider that the massive excesses in iron and manganese constituted a health risk, even for those particularly susceptible to excess iron in their diet, such as individuals with haemachromatosis who are unable to handle normal dietary iron properly and may require additional medical treatment if their diets contain too much iron. These patients would have been unaware of the need to consider alternative drinking water.
- 116 There was also comment from meetings in 09/09/2011 that the CPHM felt that they had not been promptly notified of quality failings by SW. At this time potable water iron levels were 525 ug/l (07/09/11) (normal standard 200ug/l) THM 137 mcg/l (normal standard 100ug/l) and chlorine 2.17mg/l (21/08/11) (normal standard 1mg/l).
- 117 As a result of our meeting with SW Managers, we also learnt that THMs increase in concentration the *greater* the distance the customer is from the WTW. This is due to the increased time that chlorine has to react with residual organic carbon in the water distribution network. The DWQR will normally require samples to be taken from consumers' taps. The minimum sample frequency is four samples/year, i.e. three monthly testing, on average, for each supply zone from a treatment works.
- 118 So, for example, Amlaird with one supply zone may only have four regulatory samples a year, whereas Bradan WTW in South Ayrshire has three supply zones each of which require a minimum of four samples/year. Sampling for regulatory purposes is random; it is not linked to failures that are known to be occurring at the WTW. It is also unspecified with regard to site; i.e. samples are not taken at the furthest point from the WTW in the distribution network where it would be expected that the THM levels would be highest, the iron and manganese levels would be highest (due to leaching from chronic deposition or old iron pipes) and where chlorine levels would be lowest and therefore potentially, bacterial levels highest.
- 119 In the knowledge that the high THM levels at Amlaird were likely to be underestimates of what was happening at the point of supply to consumers, I requested from Margaret McGuinness at SW, THM levels from customer taps for the Amlaird distribution.

120 *Figure 12, page 29, shows THM levels taken at Galston, approximately 5 miles from the WTW by SW as a result of abnormal results sampled at the level of the WTW (Figure 14, page 30). Figure 13, page 30, shows consumer results taken on specified dates at Galston as a regulatory requirement for the DWQR. Whilst neither set of results alone allow a complete picture of average THM levels for consumers at Galston, it is apparent that levels are considerably higher than at the WTW.*

121 **Over the four years 2010 -2013 Total THMs:**
For the resample results, the maximum 168 and the Mean 128.
For the regulatory sampling, the maximum is 166 with Mean 78
For Amlaird WTW, the maximum is 140, the Mean 69. (All results rounded to nearest whole figure)

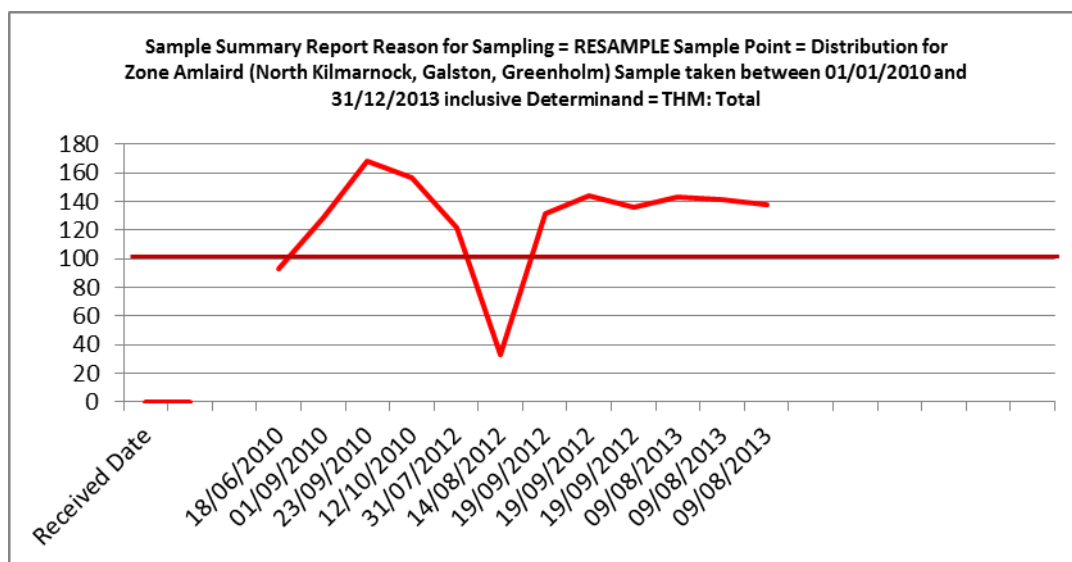


Figure 12 - THM Samples at Galston 2010 - 2013

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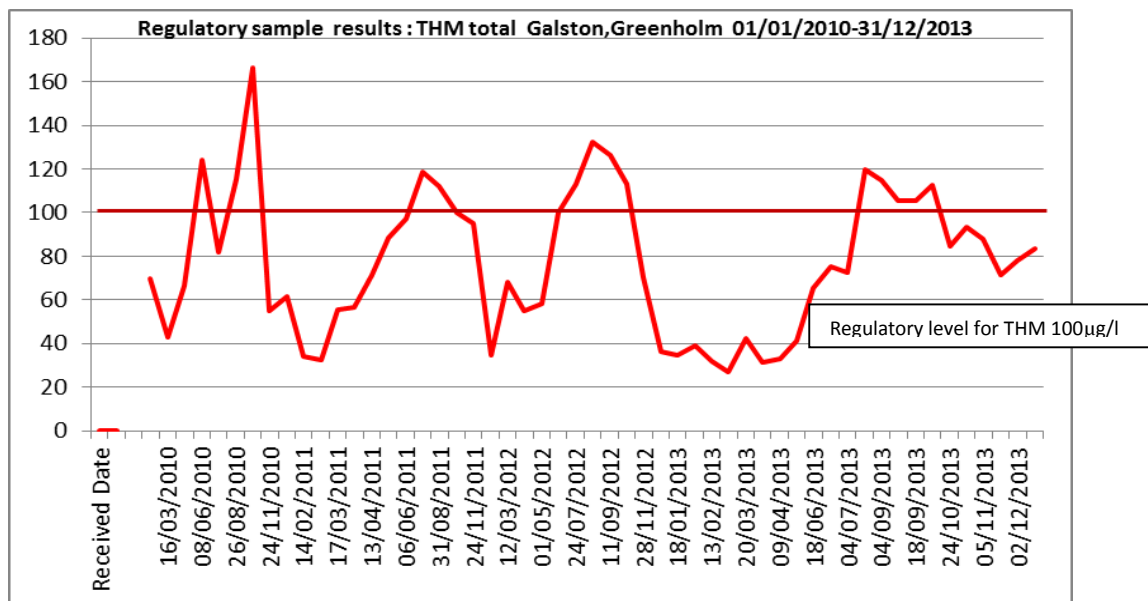


Figure 13 - THM Samples at Consumers 2010 - 2013

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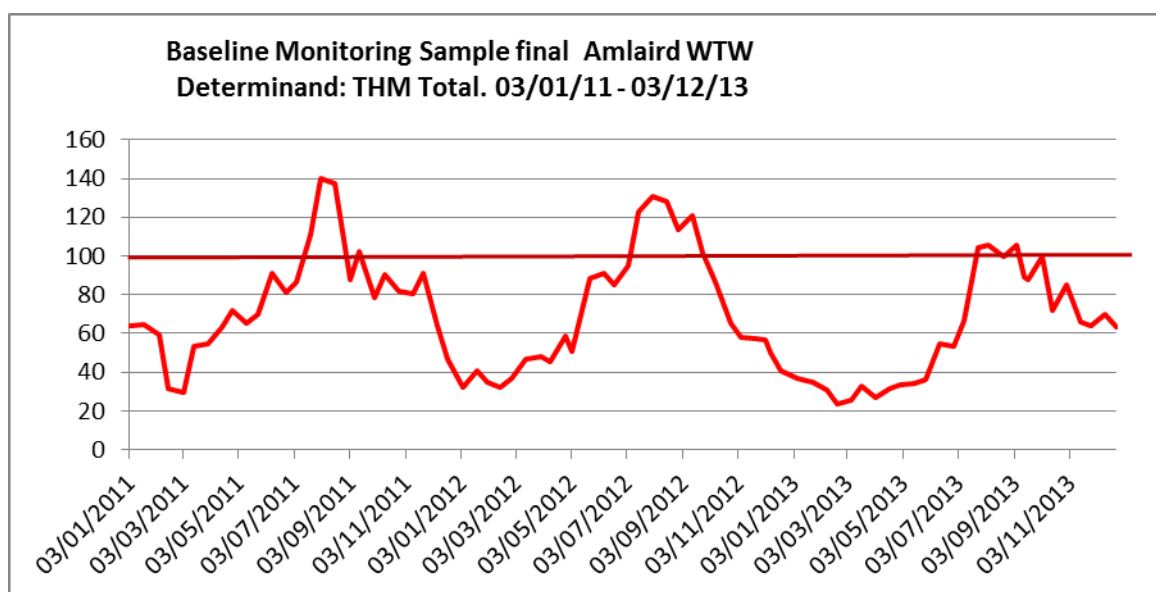


Figure 14 - THM Samples at Amlaird WTW 2010 - 2013

125 Understanding these results and how the population of Galston, as a minimum, had been exposed to THM levels well in excess of current UK guidelines made me surprised that more had not been done to either sample more often at sample points distant in the distribution network from Amlaird, for example at North Kilmarnock or the Irvine Valley, or that the public had not been notified to take reasonably simple measures which might have decreased THM exposure for some, such as increasing household ventilation and boiling drinking water.

- 126 On questioning, the response of the regulatory authorities and the CPHM has been to quote WHO figures of 200ug/l as the reference standard for harm, rather than the regulatory standards in Scotland of 100ug/l. We know that there were complaints from the public about water quality at this time. This is disingenuous to the public who pay for what they expect to be wholesome water.
- 127 If there was a scandal about beef being mislabelled as horse meat, surely this is worse. If the public are under the impression that their water meets the standards for wholesome water and it does not, for prolonged periods of time, then surely as a minimum they should have a right to be told.
- 128 The DWQR are responsible, as the water quality Regulator in Scotland for monitoring compliance of public water with the standards required in the legislative framework. In all of this, it might reasonably be wondered what their role was?
- 129 A request by Cathy Jamieson MP to the House of Commons Library, requesting a search on contamination of water supplies by windfarms, paraphrases comment made by DWQR in their 2013 report:

*DWQR's position on THMs is that the 100 µg/l standard will soon have been in place for 10 years and that full compliance can and must be achieved in Scotland, just as it has been elsewhere in the UK. In fact, the EU Drinking Water Directive requires disinfection by-products to be as low as possible and therefore Scottish Water's efforts must not stop at achieving the standard. The trend in 2012 towards failures due to a lack of plant maintenance, both at larger works and nanofiltration membrane sites, is worrying and **DWQR has received assurances from Scottish Water that the situation has been rectified. One contributory factor at some sites may be a change in the quality of raw water, meaning that a once adequate treatment process is now unable to cope.** The extent of this issue has yet to be fully quantified, but Scottish Water must gain an intimate understanding of the quality of water it has to treat and design, build and optimise treatment processes accordingly' (my accentuation)*

(C.Jamieson, 2014)

- 130 Given the thousands of on shore industrial scale wind turbines in Scotland, Cathy Jamieson's enquiry was also astounding in revealing the lack of credible data and

research that has been obtained regarding the effect of windfarm development on water supplies.

- 131 Whilst there has been a considerable amount of research into the environmental effects on animal and plant life, there is no mention of quantitative or qualitative research of windfarm construction on private water supplies in Scotland, potentially affecting up to 3% (DWQR figures) of the population.
- 132 There is, however, acknowledgement by DWQR that PWS contamination can have a serious impact on the wider public health,

The quality of private water supplies is variable. There are some very good ones that have adequate treatment and are well managed, but others undoubtedly present a risk to health due to the quality of the water. Outbreaks of disease have occurred in Scotland that have been attributed to private water supplies’.

(C.Jamieson, 2014)

- 133 The Scottish Government recognise that contamination of Private Water Supplies is one of the most common causes of serious infectious gastroenteritis (which includes giardiasis as well as E.Coli infections) getting into the more widespread population. Improvement of PWS across Scotland is recognised as a Public Health priority and to this end, grants have been made available from local authorities to householders on PWS to install domestic treatment systems. (The householders affected along the Hareshawmuir road were neither aware that their water was badly contaminated, or that a grant was available during 2006-2013)
- 134 Despite the clear danger to health of a contaminated water supply, SPR seem to have a flagrant disregard for informing responsible authorities and those affected, of water quality results or pollution incidents which are likely to endanger health, whether for private or public water supplies. Despite repeated requests from EAC, SPR have still not released all the PWS monitoring results for WLWF. SW were employed by SPR to provide analysis of PWS supplies during WL WF and Extension construction. Despite the implications for public health, under an EIR request, they have refused to release results to residents of those PWS, citing commercial confidentiality as the overwhelming priority (SW FOI refused re disclosing PWS monitoring results at WL WF, 2015).
- 135 Scottish Water, who host 60 of Scottish Power’s turbines on their land for substantial remuneration from SPR/CRE, had not conducted a risk assessment of the effects of industrial construction on their public water catchment area, a statutory Drinking Water Protected Area, prior to construction of the original Whitelee windfarm.

136 However, a risk assessment (SW, _risk assessment Amlaird_ water catchment , 2010) was conducted in 2010, after Whitelee WF Extensions had been consented by Scottish Ministers. This was in the full knowledge by SW that their surface water monitoring had already shown adverse change related to the WLWF development (Ironsides Farrar Ltd., 2007), 634, 635.

137 This risk assessment stated in a preface statement, (p 3.)

A Scottish Water Incident Report in August 2008 reported that increases in colour coincided with windfarm construction within the Amlaird water supply catchment. The report intimated that windfarm construction may have had an effect on raw water quality, although this was not conclusive.

138 The original Whitelee WF construction schedule is referenced (SPR Whitelee original construction schedule, 2006).

139 Scottish Ministers were informed of the PMO reports for WL WF (see below). Why were the impacts on the hydrological environment not taken seriously and investigated?

2.0 Monitoring Process

2.1 Methodology.

To address the role of Planning Monitoring Officer we have undertaken the following tasks:

- *Reviewed the Environmental Statement*
- *Reviewed the eighty planning conditions specified by the three planning authorities*
- *Reviewed the content of the Section 75 Agreement signed with South Lanarkshire Council, East Renfrewshire Council and East Ayrshire Council.*
- *Review of the sixteen conditions specified by the Scottish Ministers*
- *Review of the content of the Section 96 Agreement between the Councils and CRE Energy Ltd.*
- *Reviewed the construction programme to be prepared by CRE Energy Ltd*

- *This information has been used to prepare a work programme for the Planning Monitoring Officer, which comprises:*
- *A Planning Monitoring Checklist, with a list of items to be checked on site and the frequency of checks.*
- *A protocol and format for reporting to the **three Councils and the Scottish Ministers**, (my accent) interface with CRE Energy Ltd and conduct of site inspections.*

(Ironsides Farrar Ltd, 2006), 463.

140 Why were the growing and documented concerns in the SW 2010 risk assessment impacting on public water quality and the PMO Reports for WL WF considered in relation to additional windfarm construction at Whitelee not raised by SEPA or SW to Ministers before consent for the Whitelee Extension was granted?

141 A letter in reply to Graeme Pearson MSP from SW's CEO Mr. Millican in 2014 therefore seems to be at odds with SW's published conclusions in 2008 and their own surface water monitoring and raw water quality monitoring data,

*Turning to your specify query about windfarms, Scottish Water is often consulted about plans for new windfarm developments. **At no time would we compromise water quality as a result of development in the catchment area of a water supply source.** There is no evidence to suggest that the Whitelee windfarm has affected the public water supply. But changing weather patterns can sometimes impact on a raw water supply.*

(DWQR.SW, 2014)

142 Despite significant previous investment in better water treatment methods and plant for Amlaird WTW in 2005 and as a result of improved water quality standards at that time, Scottish Water and the DWQR acknowledged the more recent chronic problems with this water supply. The public supply from Amlaird was specifically cited as failing key test parameters in the DWQR report 2011 (DWQR, dwqr-annual-report-2011, 2011).

143 In the 2012 DWQR report (p63) (DWQR, dwqr-annual-report-2012) it was increasingly apparent that the DWQR was concerned that despite significant investment by SW in new treatment methods at WTWs, there were increasing

- numbers of public supplies failing regulatory standards for THMs in the North and West of Scotland.
- 144 Could these failures be linked to the increasing number of windfarms being built on DWPA's, such as Whitelee WF?
- 145 By 2013, SW made a decision to bypass water from Craigendunton reservoir altogether, with a plan to supply the approximately 35,000 consumers on the Amlaird supply with water from Glasgow. This would be achieved in 2017.
- 146 Are the general public content with an interval four year period in which their water quality may not reach acceptable standards for wholesome water? Why would this four to five year delay be acceptable to the public paying for and frequently consuming water that does not meet regulatory standards?
- 147 The Environment Minister appears to be comfortable with the reassuring reports from both Scottish Water, the CPHM for Ayrshire and Arran Health Board and the DWQR (A.McLeod, Response from Minister for Environment and Climate Change re WaterQuality dated 9-2-15., 2015). However, she was unable to find the time to understand the perspective from a consumer point of view and refused requests to meet with us.
- 148 In January 2015, SW submitted a consultation response to the proposed Glenouther windfarm (SW, SW Glenouther protection of Drinking water catchment and windfarms, 2015), which is proposed only a short distance from WL3.
- 149 SW's advice and response to CRE/SPR, in planning to site industrial turbines on a public water drinking catchment area, appear to be absent in all three previous consultation responses for the Whitelee windfarm.
- 150 However, the 2001 Legislation referred to in SW's letter regarding the Glenouther WF application, regarding potential impacts to public water supplies by siting turbines in a DWPA , were also in place prior to consent being awarded for all three phases of the Whitelee WF.
- 151 This appears to represent a wholly inconsistent response from SW in terms of protecting public water reservoirs. From a public perspective, one can only assume that the financial incentives from SPR to SW in hosting their turbines on a protected DWPA at the adjacent Whitelee site may have brought other considerations to bear.
- 152 **Summary:**
- 153 In summary, with regard to the proven deterioration of both raw and public water quality that coincided with construction of Whitelee windfarm and its extensions:

- 154 There has been an astonishing public denial by all responsible authorities to acknowledge the contribution of the ‘elephant in the room’; the single largest industrial environmental construction project in Scotland, namely Whitelee windfarm in contributing to the deterioration of raw water quality at public water reservoirs.
- 155 There have been failures of responsibility and regulation by those authorities whose role is to ensure provision of safe and wholesome public water.
- 156 There has been a failure to properly investigate or to acknowledge the cause of the water deterioration
- 157 There was a failure to adequately test consumer supplies most likely to suffer the worst water quality results
- 158 The DWQR did not appear to increase routine water test frequency in the light of ongoing problems
- 159 A failure to communicate at all to the Public that the water supply did not meet standards for ‘wholesome water’ (SG, Water Wholesomeness - Water Supply(Scotland) Act 2001) for prolonged periods over at least three years, which would have allowed consumers the choice to decide whether to use alternative drinking water.

160 **How does this information impact on consideration for the proposed WL3?**

161 In the ES for WL3 it is stated:

The presence of a number of materials used during construction and operation (e.g. fuels, oils, and lime) creates a potential source of pollution. Without pollution avoidance and control measures, incidents could occur and have an adverse effect on both shallow and deep groundwater sourcing private or public water supplies

WL Extn 3 ES Ch 9 71

- 162 Although SW have not lodged an objection to WL3 on the basis that this will not affect the public water supply, SPR have considered that there is a risk of impacting on groundwater quality, which may affect public water supplies. I’m not clear this has been properly considered by SW, particularly in the light of previous contamination events affecting groundwater for WLWF which have not been satisfactorily explained.

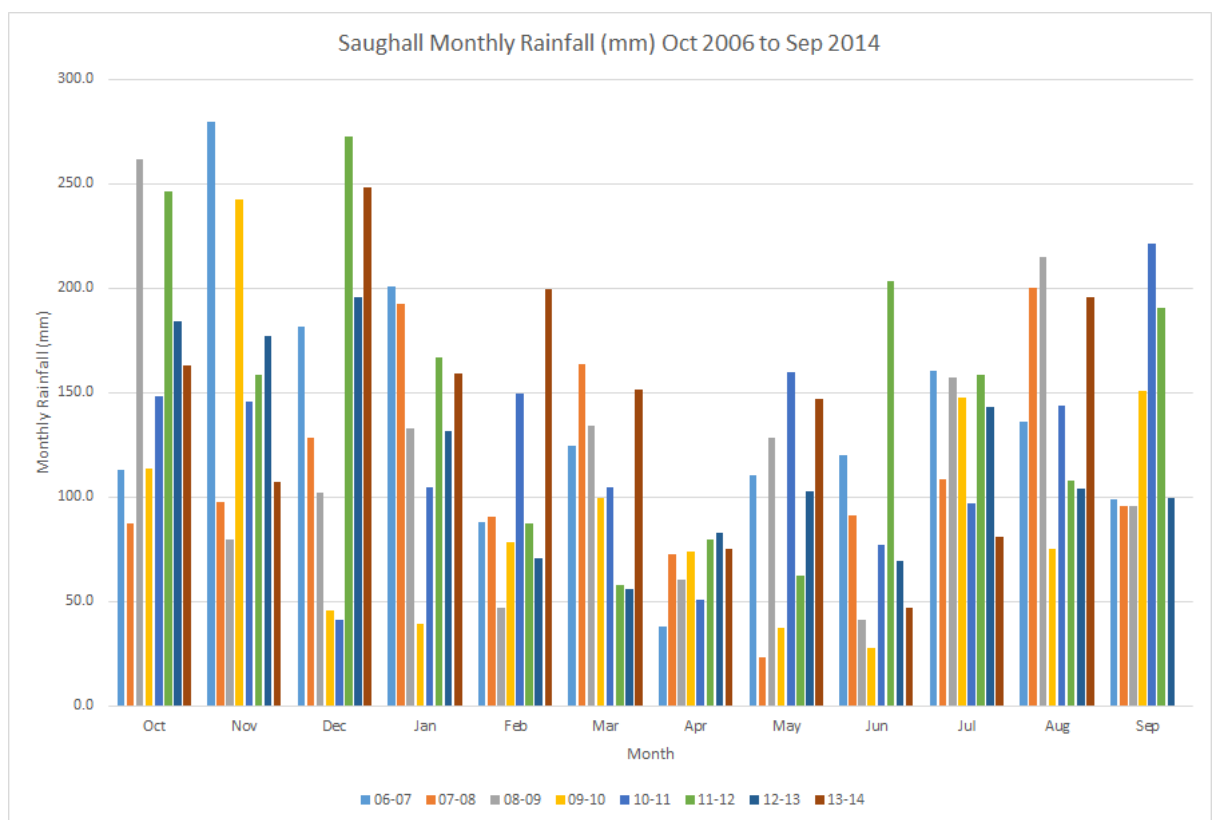
- 163 To date, there is no GW monitoring data available to determine the impact of WL 1 and 2 Extensions on GW.
- 164 SPR failed to inform SW of pollution events on water catchment areas previously, as required under standing orders.
- 165 The information provided in this section would indicate that mitigation measures and regulatory measures employed were unable to protect public water from the adverse effects of previous WL WF construction.
- 166 Therefore, there can be no confidence that there will be no cumulative effect on either public or private water supplies reliant on this site.

3 SURFACE WATER

- 168 The public water reservoirs of Lochgoin and Craigendunton are both largely dependent on surface water supplies. So to understand why the raw water quality in these public water-supply reservoirs had apparently deteriorated, it was important to understand if there had been any change in the surface waters as a result of constructing Whitelee windfarm on a protected drinking water catchment area.
- 169 I was aware from SW's risk assessment (SW, 'risk assessment Amlaird_water catchment', 2010) that problems in raw water quality had been publicly acknowledged from 2008. From the meeting minutes of the Ayrshire & Arran Water Liaison Group meeting (C.Davidson, 2014) SW, SEPA, EAC and DWQR were all aware at various times, during various phases of windfarm construction that there was likely to have been an impact from windfarm construction on raw water quality. Furthermore, the PMO (Ironsides Farrar Ltd., 2007), [634](#), [635](#) and 'Ironsides Farrar Ltd, August 2007', [2102](#), [2103](#), had commented upon the SPR and SW monthly monitoring surface water results from 02/03/05 to 02/11/07 at 8 points within its catchment area, which recorded large increases in presumptive coliforms, some with E.Coli and increased turbidity at several monitoring locations. It seemed that the impact of windfarm construction on the surface and potentially the reservoir water quality was not new to the regulatory authorities, even if it was unknown to members of the public.
- 170 There was discussion during those Ayrshire & Arran Water Liaison Group meetings that some surface water supplies to those reservoirs had been identified which were proving particularly 'troublesome' in terms of poor water quality. This is not what one would have expected simply from a high rainfall picture alone where, on undisturbed land, all supply streams should have been affected more or less equally. Both SW and SPR have been keen in their various responses to me to attribute poor water quality results to heavy rainfall. (Mathers, 18. Mathers, Martin. SPR Response regarding Water Quality. 2013,.) (DWQR.SW, 2014) (R.Connor, Comment to Graeme Pearson MSP re. SW letter of 21.10.14.)
- 171 The use of Bishopton meteorological figures by SPR to prove this point is particularly odd. Bishopton, being a part of Greater Glasgow, is almost 30 miles away on the Clyde estuary, with a very different rainfall pattern to Whitelee. SEPA has a rainfall measuring station at nearby Amlaird WTW and there is a meteorological office (now under the auspices of SEPA) near the southern margin of Whitelee at Saughall, near Darvel. Saughall G.R. NS 259841 636403, is at approximately the same altitude as Whitelee (max 376m). This implies for the period in question that perhaps Bishopton figures were appropriately higher than at Whitelee, in order to evidence unavoidable pollution as being due to an unpredictable Act of God, namely heavy rainfall.

- 172 It could be argued that there is little point in designing and providing mitigation which might be suitable for East Coast of Scotland or English weather, for example. The high rainfall at Whitelee is well known and mitigation specified and tested as being appropriate for this site should have been employed. Average annual rainfall at Saughall between 1975 and 2005 was 1342mm.
- 173 There is documentary evidence in numerous Ironside Farrar Ltd PMO reports 1-8, (461, 2178, 2108, 2121, 2128, 2135, 2144, 2161, covering September 2006 to December 2007 inclusive, (excluding Vol 2 , which is not available) of the inability of mitigation measures on the WLWF site to cope with the high rainfall during construction activities; this repeatedly included: the spine road being partially washed away, tracks collapsing, slurry generated on roads being dumped in borrow pits, borrow pits leaking their bunds, silt laden water entering watercourses, various water courses silting up , peat slippage, and damaged culverts producing dirty water.
- 174 It is an unfortunate indictment that the stated 'best practice' mitigation methods employed at Whitelee windfarm appear to have been unable to cope with the ground and weather conditions. The PMO reports paint a picture not of the effectiveness of mitigation to prevent environmental impact, but rather an environmental disaster.
- 175 There has been much emphasis by SPR, SW and SEPA, to blame problems with change in surface and raw water quality as being due to excessive rainfall.
- 176 At the time of the worst change in reservoir raw water quality for WL Extension construction at Craigendunton, in November 2011, monthly rainfall at Saughall was below 150mm, considerably less than the same period 2006/7 at over 250mm.
- 177 What is apparent, looking at the rainfall figures for 2006-2010 for the Whitelee area (Fig 12), is that the peak rainfall periods did not produce the spikes above what would be expected for seasonal trends of colour in raw water from Craigendunton reservoir (*Figure 10, page 21*). The peak spike in raw water colour occurred in November 2011. The peak rainfall for this period occurred in the winter months of October 2008, November 2010 and December 2011.
- 178 Our rainfall figures compare with information for rainfall data from Saughall within Dr. Murray's Ph.D. thesis (H.Murray, 2012).
- 179 Comparison of 2001-2002 raw water colour for Amlaird is between 50 – 240 mg/l Pt/Co, similar to reservoir raw water values up until 2008. This contrasts with the very large change in reservoir raw water colour for 2011, up to 400 mg/l Pt/Co, coinciding with the peak of earthworks for WLWF Extension (*Figure 10, page 21*).

180 It is important to note the mitigating effect of the natural lochan at the top of Craigendunton reservoir in protecting that reservoir from the hydrological effects of construction and deforestation that occurred with WLWF original with turbines sited close to the margin of Lochgoin. (Figure 6, page 19; Figure 7, page 19). This lochan effectively acts as a sediment trap, protecting the Craigendunton reservoir, (which feeds into Amlaird water treatment works), from the sediment running into Lochgoin from its catchwaters and streams. However, there are some direct feed-in streams to Craigendunton which will not be mitigated in this fashion and WL1 and 2 in particular impacted on land around Craigendunton rather than Lochgoin reservoir. Birk Burn, upstream from Craigendunton is within 1km of the groundwater monitoring well (WP01) where persistent organic chemicals were sampled.



181

Figure 15 - Saughall Monthly Rainfall (mm) 2006 - 2014

182 Fortunately, Whitelee windfarm site and its surface waters have been the subject of detailed academic research and monitoring extending almost continuously over an eight year period, by researchers trying to determine whether the disturbance of millions of tons of carbon storing peat, is likely to produce a worthwhile gain in terms of the carbon saving from siting a windfarm on such a precious carbon storing resource.

- 183 In trying to understand the impacts of WF construction, two peer reviewed studies of surface water changes directly related to the construction activity have been completed_(H.Murray, 2012) (S.Waldron, 2009) and continuing research also provides data for surface waters extending into and beyond the construction period for Whitelee Extension 1 and 2_(A.Phin, 2014). The surface water sampling, largely on a bimonthly basis , has included sampling of runoff on all quadrants of the site and all seasons , corrected for periods of high and low rainfall and river volumes with rainfall data from Amlaird WTW and Saughall Meteorological Office (H.Murray, 2012).
- 184 Surface water samples were taken prior to the major construction periods (although unfortunately not in the complete absence of forestry felling which commenced in 2005),(SW, _risk assessment Amlaird_water catchment , 2010), through construction to the operational phases of the windfarm. The studies aimed to separate the effects which were related to the deforestation required for the windfarm (said to be necessary to reduce air impedance to the turbine blades), to the effects of excavating the turbine foundations and quarries and building the roads.
- 185 The research also looked at which aspects of construction were associated with the release of associated excess carbon, nitrogen and phosphates into the streams and rivers running off the windfarm site. The effects of construction were seen in run off waters within 2km of the site and it took two years after construction ceased, for sampled surface waters to return to baseline values.
- 186 The carbon content of the run-off water is important not just because the whole ethos of renewable energy is to reduce carbon loss into the environment, but because this correlates best with the colour of the water. It is the colour and therefore the dissolved organic carbon content (DOC), which influences the amount of disinfection and treatment raw water will require to become public potable water; to meet the regulatory standards for distribution in the mains supply. The amount of disinfection needed and the amount of residual organic carbon (= colour) in the water supply will influence the levels of THMs in the public water supply.
- 187 Phosphate and nitrates are plant ‘fertilisers’. Release of these chemicals into the water environment of streams and rivers encourages the growth of algae and other aquatic plants, which suck the oxygen from the water, killing off the fish and animal life and creating a ‘dead’ green stream. This is termed *eutrophication*. Peat is very poor at retaining phosphate and so will not tend to mitigate water with high phosphate levels (S.Waldron, 2009)
- 188 Increased run off and levels of phosphates and nitrates in a water course will cause the water’s environmental status to be downgraded by SEPA and is contrary to the

Water Framework Directive (2000), which underpins much of the current Scottish legislation designed to protect drinking water catchment areas and river basins.

- 189 Collectively, Dr. Murray's Ph.D. thesis and poster presentation, Professor Waldron's peer reviewed paper all show well the documented effects of leaching of dissolved organic carbon (DOC) and soluble reactive phosphorus (SRP) from the disturbance of peat and the felling and mulching of forests on the Whitelee site.
- 190 *Figure 16, page 43*, is a poster presentation by A. Phin at the Scottish Renewable UK and SEPA conference in 2014. This demonstrates the change in carbon and soluble reactive phosphates (SRP) at the windfarm aquatic 'site exit', a sampling site on the Hareshawmuir Water (less than 300m from East Collarie) which drains one of the larger surface water catchments from the Whitelee Extension site. WLWF original construction began in September 2006 (SPR Whitelee original construction schedule, 2006) continuing through to the summer of 2009 with forestry operations continuing beyond that.
- 191 The WL Extensions began construction officially in 2010 with associated works continuing into 2013 (SPR Whitelee Extension Construction program, 2010). The figures from this poster show that over the monitoring period, during the peak construction activity for WL Extensions in 2011, water quality for the Hareshawmuir water (catchment 14), with respect to phosphates deteriorated in terms of classification by SEPA and UKTAG 2008 (UK Technical Advisory Group Environmental Standards) from high to moderate quality, contrary to requirements under the Water Framework Directive (2000) .
- 192 This surface water deterioration correlates with the same period in which the raw water quality from Craighendunton reservoir into the water treatment works at Amlaird experienced its worst peaks in colour and carbon content (*Figure 10, page 21*). Whilst the effects of rainfall alone cannot be ignored, rainfall during this period was higher in 2011/12 or 2013/14. It is difficult to ignore an obvious conclusion, which is that it was the combination of rainfall and man-made environmental disturbance through forest felling and construction that produced these adverse impacts. As a consequence of the increased organic carbon and bacteria in the reservoir raw water, this is the same period in which THM's in the public water supply also averaged at their highest levels.

Tables 1 & 2 Mean concentrations of (1) DOC and (2) SRP at the site exit before, during and after Whitelee windfarm extension development

	1) Time period	Annual mean [DOC] ± 95% CI (mg l ⁻¹)	2) Time period	Annual mean [SRP] ± 95% CI (µg l ⁻¹)	SEPA EQS category
before	mean Oct 2006 - Sept 2007*	23.5 ± 5.2	mean Oct 2006 - Sept 2007*	16.8 ± 4.5	High
	mean Oct 2007 - Sept 2008*	27.9 ± 5.9	mean Oct 2007 - Sept 2008*	22.4 ± 5.4	Good
	mean Oct 2008 - Sept 2009*	27.7 ± 4.8	mean Oct 2008 - Sept 2009*	38.6 ± 13	Good
	mean Oct 2009 - Sept 2010*	28.6 ± 4.6	mean Oct 2009 - Sept 2010*	26.6 ± 4.2	Good
during	mean Oct 2010 - Sept 2011	30.7 ± 6.4	mean Oct 2010 - Sept 2011	44.4 ± 13.8	Moderate
	mean Oct 2011 - Sept 2012	31.2 ± 6.7	mean Oct 2011 - Sept 2012	49.5 ± 13.7	Moderate
after	mean Oct 2012 - June 2013	24 ± 4.3	mean Oct 2012 - Sept 2013	36.7 ± 7	Good

*from previous research³ SEPA environmental Quality Standards (EQS) in µg P l⁻¹: moderate (40 – < 150), good (20 – < 40), high (< 20)

193

Figure 16 – From: A.Phin presentation (Scot. Renewable UK & SEPA Conf. 2014)

194 For WLWF (Construction 2006-2009), the water catchment with the highest concentration of dissolved and particulate organic carbon was at catchment 13, Drumtee Water, in 2007-8. The overall phosphate concentrations increased in the Drumtee and Hareshawmuir waters by tenfold from 2007 (H.Murray, 2012). This corresponded with extensive clear felling of forestry, as well as construction of turbine foundations. In summary, these studies concluded that the increase in phosphate run off correlated best with forestry clearing and the mulching or spreading of brash on the disturbed soil and peat. Increase in carbon run off, correlated best with peat disturbance, particularly where there had been previous forest plantations and enhanced land drainage.

195 Unfortunately, because the actual windfarm site itself was a construction site, access was limited to authorised personnel.

196 None of the many streams feeding into any of the public reservoirs, which were much closer to areas of major soil disturbance, turbine foundations or quarrying than for the researcher's published sample sites, were monitored by the university researchers. However, SPR undertook its own monitoring of surface water (*Figure 17, page 44; Figure 18, page 44*), which can be compared directly with the Amlaird Raw water colour on Figure 10, page 21, and shows a similar trend. (SW and SEPA were also involved in monitoring and sampling of surface waters, but these results are "not available").

- 197 SPR's sample locations are again on the Hareshawmuir Water (*Figure 18, page 44*) and importantly, include a feed in stream to Craigendunton reservoir (*Figure 17, page 44*) Monitoring results for water colour for these waters are shown with comparison of the SW graph for raw water colour in the Craigendunton reservoir over the same time period.

198

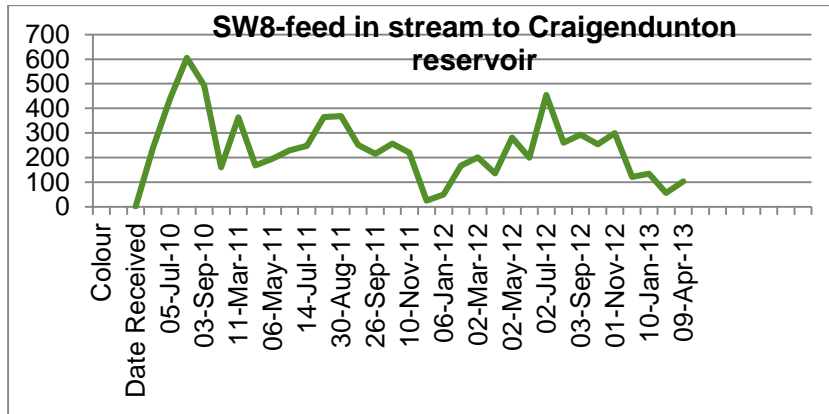


Figure 17 - SW8 feed in stram to Craigendunto reservoir

199

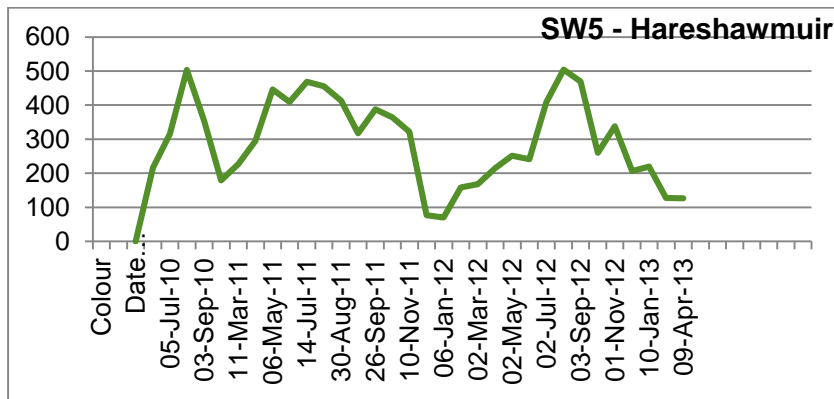
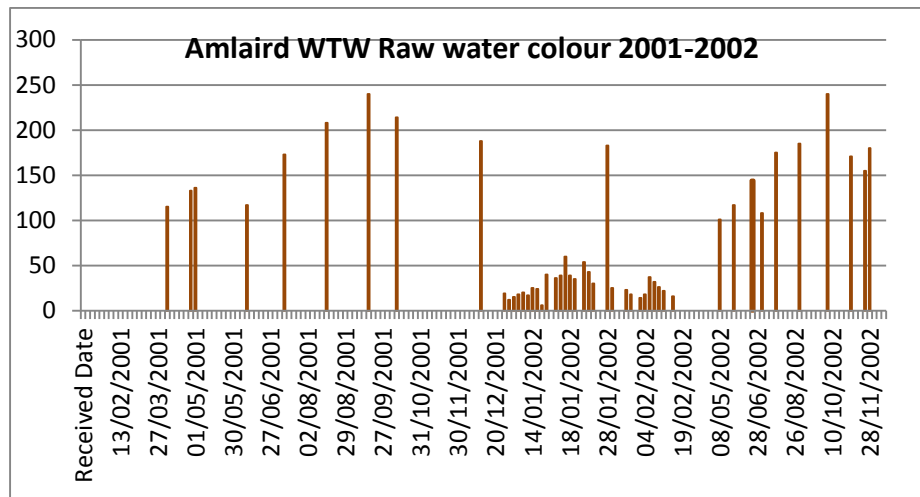


Figure 18 - SW5 Hairshawmuir



200

Figure 19 - Amlaird WTW Raw water colour 2001 - 2002

201 What these SPR graphs show (*Figure 17, page 44; Figure 18, page 44*) is that when compared to expected base colour levels of approximately 100 -250 mg/l Pt/Co, even allowing for seasonal and rainfall variation, there were persistently elevated levels of colour in the surface water run-off into a public reservoir and within Hareshawmuir Water during the WL Extension construction period – as seen in Dr. Phin’s research.

Unfortunately, although the PMO reports which refer to surface water monitoring results conducted by SPR and SW have recently been supplied, it has not been possible to obtain the actual monitoring results for WL WF 2006-2009.

202 The millions of tons of peat excavated in previous WL WF developments have undoubtedly contributed to the previous deterioration in the surface water and groundwater on the WL WF site. Whilst SW have been publicly reluctant to admit that this has impacted on public reservoir water quality, perhaps because 60 commercial turbines are hosted on SW owned water catchment land, in 2013, SW offered 100% grants to landowners for improvements in a few impacted water catchment areas in Scotland (SW, SW grants SLM loch goin craigenduntun, n.d.). One of these grants was for the water catchment around Craigenduntun where the landowner (SW) was to be offered a grant for peat reinstatement. It seems quite extraordinary that the public purse should be funding restoration of peat damage caused by SPR to facilitate SPRs commercial profit from the windfarm.

203 It is difficult to understand how the further excavation of deep peat at the WL3 site can in any way be regarded as contributing towards a repair process.

204 **Why is this relevant to the application for WL Ext 3?**

205 Drumtee Water will be the main draining waterbody for WL 3.

- 206 The proposed WL 3 site has a significant depth of peat, up to 5m from peat probing. (WL3 ES). There will be extensive forestry felling of ± 37 hectares. All but 10 ha is immature forest and will be mulched and left in situ. (the 10 ha of more mature timber being removed from the site).
- 207 From Dr. Murray's work, this mulching is likely to increase phosphate run off.
- 208 These factors, surrounding the tributaries to the Drumtee water will produce significant changes of increased phosphates, total and dissolved organic carbon and increased suspended solids and turbidity if the previous 'best practice' mitigation methods implemented previously are utilized once again, as is foreshadowed in SPR's material.
- 209 The Drumtee Water has already experienced the greatest increases in total carbon and iron related to WL WF original construction. Greenfield, Collory Bog Burn and Howe Burn are headwaters for Drumtee water which feeds into Fenwick Water and eventually Kilmarnock Water.
- 210 Pollution occurred in these headwaters during WLWF construction. The PMO Report 3 Jan/Feb 2007 (Ironside Farrar Ltd, 2007) refers to an 'incident' (details presumably in Report 2, which is not available) involving Collory Bog Burn with residual high Manganese and turbidity and an oil spill. The PMO makes comment in June 2007 of the increased surface water iron in Howe burn and of significantly increased solids within Collory Bog Burn
- 211 The Ayrshire Rivers Trust has recently commented upon the WL3 proposal stating,
- The Kilmarnock Water is an important salmonid river that has recently had barriers to fish migration eased and further improvements are planned. It is not unreasonable to expect salmon may migrate into the upper reaches of the Fenwick Water where water quality is currently of good status.*
- (Ayrshire Rivers Trust Comment to DPEA May 2015)*
- 212 Fish are the 'canaries in the mine' of water quality. They are particularly sensitive to the decrease in oxygenation that can occur as a result of eutrophication and also to effects of chemical contamination. Although the cause has not been established, there have been three major 'fish kills' downstream from the Drumtee water above Kilmarnock since 2008 (*Figure 20, page 47*) (Ayrshire Rivers Trust⁸)

⁸ <http://www.ayrshireriverstrust.org/blog/2015/03/19/fenwick-water-polluted-again>



213

Figure 20 - Ayrshire Rivers Trust - Fenwick Water polluted again

214 Surface waters impacting on Public Reservoir raw water quality and PWS

215 Dr. Steve Carroll, Consultant Geohydrologist, reviewed the geohydrology section of WL Ext ES (S.Carroll, hydrogeology of the Whitelee wind farm, 2015) and the raw water data for Amlaird on our behalf. His views are that raw water quality to the reservoir were influenced by changes in surface water run off resulting from construction activity.

Turbidity, iron and manganese loading and chemical spills were identified as potential sources of pollution during construction by SP (Environmental Statement, 18.10.1). The same document states that procedures were to be put in place that would mitigate the effect of such undesirable events.

The observed increase in turbidity, iron and manganese in raw water intake to the Amlaird water treatment plant over an extended period in 2010-2011 during the expansion phase of construction would, on the face of it, appear to be evidence of deleterious impacts of construction on surface water runoff in line with SP's estimation of a potential hazard in the Environmental Statement.

If this is the case, then the mitigation measures specified by SP and their contractors were inadequate in themselves or insufficiently enforced.

(S.Carroll, hydrogeology of the Whitelee wind farm, 2015)

- 216 For WL3 there is less likely to be impact for surface water pollution to directly contaminate public reservoirs than appears to have occurred for preceding WL windfarm developments and SW have offered no objection to this development.
- 217 However, all of this development will be within a protected drinking water area, protected by law from a decrease in water quality under the Water Framework Directive.
- 218 It is clear that documented decreases in surface water quality for WL WF were linked to detrimental effects on PWS. There remain a substantial number of PWS that are likely to be impacted by a decrease in quality, or contamination of surface water related to the WL3 WF site, such as happened previously.
- 219 SPR are proposing to site a substation, (WL3 ES Fig 4.7) complete with toilet facilities, on a water catchment area with dependent superficial and deep groundwater abstraction, without charting where drinking water abstraction points are sited. SPR also sited a similar operational and storage compound for WL WF Extensions on our drinking water catchment area, without determining the source of our drinking water. Our PWS has had extraordinarily high levels of bacterial contamination. It is considered that this shows complete disregard for existing windfarm neighbours and is a potential health hazard.
- 220 Within WL3 ES, there is acknowledgement of the potential for pollution to affect both public and private water supplies through contamination of groundwater. Craigendunton Reservoir is noted as 80m and Lochgoin as 350m from this development.

WL3 ES Ch 9 71. The presence of a number of materials used during construction and operation (e.g. fuels, oils, and lime) creates a potential source of pollution. Without pollution avoidance and control measures, incidents could occur and have an adverse effect on both shallow and deep groundwater sourcing private or public water supplies.

(WL3 ES 9.8.4.1.)

- 221 We have documented evidence of oil and fuel spills, although many spills were apparently remedied **after** the intervention of the PMO (e.g. PMO Reports March/April 2007, May/June 2007, Sept/Oct 2007, Jan/Feb 2009 Diesel spills

29/06/07, 14/11/08). The PMO also repeatedly reported of fly tipping within borrow pits and 'littering' e.g. of paint cans, around the site. There is documented evidence of other synthetic and toxic chemicals entering the groundwater on the WL WF site. As this was never investigated and a cause of contamination identified for these chemicals, it is not possible to devise a mitigation strategy which would prevent reoccurrences on the proposed WL3 site.

222 **Summary:**

- *There is peer reviewed research documenting adverse effects on surface waters draining from the Whitelee windfarm site related to construction activity. The WL3 ES has provided no change in mitigation methods that will show these adverse changes will not reoccur.*
- *The general effects on surface waters outside the site have been most marked for leaching and increase of phosphate concentration resulting in a downgrading of catchment water quality status, according to SEPA recognized criteria.*
- *This decrease in surface water quality is contrary to requirements outlined in the Water Framework Directive 2000.*
- *The whole WL 3 site is within a DWPA.*
- *Increase in the dissolved organic carbon content occurred in the surface waters related to construction activity and correlated with increase in the DOC seen within raw water for the public reservoir. These surface water changes were also reflected in increases in groundwater organic carbon for WL WF.*
- *The change in reservoir raw water quality resulted in a direct need for increased treatment and increased disinfection of raw water, producing potable water that failed regulatory water quality standards, failing to meet the statutory legislative requirements of the European Drinking Water Directive (Council Directive 98/83/EC)*
- *The WL 3 ES has predicted that there is a potential for pollution in groundwater from this development to affect both public and private water supplies.*
- *Drumtee Water (Catchment 13 in WLWF ES) suffered the largest increases in iron, manganese and colour/DOC during construction of the original WLWF. This same catchment and the private water supplies dependent on this catchment, are again most likely to be affected by WL Extension 3.*
- *Independent geohydrology assessment suggests mitigation in protecting surface water run off during construction of WL Extension from Whitelee was either*

ineffective or insufficiently enforced. SPR intend to use the same 'best practice' mitigation methods to protect the hydrological environment on the WL3 site.

- *It is reasonable to conclude that the methods to be employed at WL3 will not be effective.*

4 GEOLOGY AND GROUNDWATER

4.1 Geology

- 224 After meeting up with Mr. Harrison of Cauldstanes and Mr. Davis of Kingswell in October 2014 and learning that their private water supplies and that of Veyatie had ceased during the time of the construction of the original Whitelee windfarm development, I realised that the geohydrology of the Whitelee site was likely to be a key component of the reason that PWS had been badly affected on both the North West, the South (Low Overmuir) and the West (Airtnoch) of the WL WF site.
- 225 It seemed that whilst some cognisance had been given by SPR to surface water drainage and the potential impacts to public water supplies, little or no thought had been given to groundwater sources, which probably make up the majority of the private water sources dependent on the Whitelee plateau. Some of these sources have been in use for over a hundred years. They have been reliable supplies that provided adequate water supply and quality even in dry summers and they would therefore have probably been fed by springs rising from the ground, replenished by groundwater flow.
- 226 Many of these larger historic supplies (e.g. for Kingswell and Airtnoch) once formed parts of large estates (e.g. Rowallan Castle estate) and had many dependent farms and houses. They had sophisticated distribution networks, in the case of the Airtnoch supply, extending over a mile from the holding tank to serve ten properties.
- 227 Even to someone with no hydrological knowledge, it would seem a bizarre and risky assumption, to assume that a holding or collection tank could be taken as a proxy for a water source. However, this is exactly what all four SPR hydrological consultants ((RPS, 2003), (Environs, 2006), (Atkins, Atkins PWS risk Assessment WL WF Extension Report and Appendix 1. , 2010) and WL ES 3, Ch 9) did for the various phases of Whitelee windfarm ES and risk assessment, including Whitelee 3. This would be the cheapest and easiest assessment for the developer, but would leave the water source and any water piped from a source to a holding tank completely vulnerable to damage and pollution, with no protection from planned mitigation.
- 228 We know from SEPA's brief response (SEPA, Whitelee X3 - SEPA response, 2012) to the Whitelee Extension 3 proposal that PWS and hydrology have not been specifically addressed, despite the history of contamination of groundwater and surface water PWS during previous construction at Whitelee. There has been no request from SEPA for further information from SPR, despite water sources for the nearest properties of Kingswell and Cauldstanes remaining uncharacterised. This is contrary to SEPA's policy on assessing PWS in the vicinity of windfarms (SEPA-

guidance-on-assessing-the-impacts-of-development-proposals-on-groundwater-
abstractions-and-groundwater-dependent-terrestrial-ecosystems, 2014).

229 We obtained an independent Geohydrological review from Dr. Steve Carroll (S.Carroll, Whitelee windfarm hydrogeology summary, 2015) of the Whitelee windfarm site, providing him with information from preceding WLWF Environmental Assessments and preceding PWS risk assessments, to inform our understanding of the current situation and geohydrological risks pertaining to the proposed WL 3.

230 This is a summary taken from Dr. Carroll's report:

- *The geology at the Whitelee windfarm consists largely of bedrock at or near surface on the higher hilltops, overlain by superficial deposits of up to a few metres thick.*
- *The superficial deposits consist of peat on the higher hilltops, which lies on either bedrock or on glacial till (a stiff sandy, gravelly clay or silt). The glacial till covers most of the bedrock areas away from the hilltops. Sand and gravel deposits (alluvium) occur in narrow floodplains in places along most of the streams draining the Whitelee area.*
- *Most of the monitoring wells on the windfarm are installed in the superficial deposits. These show water levels to be very close to the ground surface, indicating that the superficial deposits are mostly saturated. Groundwater is present in these deposits in the pore spaces between the individual mineral grains. Groundwater flow within these deposits is expected to follow the shape of the terrain and to flow from hilltops towards the stream valleys.*
- *The bedrock consists of three layers of the Clyde Plateau Volcanic (CPV) formation, these were basalt lava flows formed by different volcanic eruptions separated in time.*
- *Basaltic lavas are crystalline rocks of low permeability and groundwater for the most part is only present in fractures that cut the rock. Fractures are not always open and evenly spaced throughout the rock and where they are close together and more open, as may happen along fault lines, they can carry larger quantities of groundwater.*
- *Lavas of the CPV formation elsewhere in central Scotland often show zones porous and permeable sedimentary rocks or broken up lava at the junction of flows of different age. These zones could form very localised aquifers and allow more rapid groundwater flows than would occur in fractured basalt that form*

most of the lava flows. These narrow aquifers and potential water channels through fractures are also more difficult to predict from an overall geological map.

- 231 In PWS wells that draw groundwater from the CPV formation (e.g. as at Kingswells or Ardochrigg) most of the water inflow is probably in interlava aquifers, fracture or fault zones.
- 232 Wall-like sheets of igneous rock (dykes) cut the CPV formation lavas, such as described in the Atkins report (Atkins, SPR Whitelee windfarm Extension 1 and 2 PWS Risk Assessment, 2010). These are younger than the basalt lavas and were injected into the CPV formation in such a way that they are likely to have a different fracture orientation and spacing than in the lavas. Any such differences mean that this dyke could have a profound influence on groundwater flow rates and directions for the Cauldstanes and Veyatie boreholes.
- 233 The geology is important, because it controls where groundwater is stored and how it flows from where it infiltrates as rain to where it discharges in springs, streams or water supply wells. The hydrogeologists that we consulted (Dr B. O'Dochartaigh, Dr S. Carroll) are in agreement about the ways in which the groundwater system at Whitelee most probably works. However, the sparseness of well logs or test bore holes across this site means that these hypotheses cannot be confirmed, quantified or mapped.
- 234 Because no boreholes were drilled or groundwater testing requested from the developer by planning or regulatory authorities, even in relation to assessing impacts to groundwater from potentially polluting activities such as quarrying, the importance of potential pollution pathway into shallow groundwater through superficial deposits or to deep groundwater through rock fractures was not adequately assessed for previous Whitelee windfarm proposals.
- 235 Pollution of groundwater is recognised as being particularly serious, not just because there may be untreated domestic water abstraction reliant on groundwater (as here on the Whitelee site), but because in general, groundwater flows are very slow compared to surface water flows and pollution within groundwater aquifers may persist for many years_(Groundwater_and its susceptibility to degradation.) The figure below reproduced from this UN sponsored document indicates the influence of fractured rock and dykes on local groundwater flows and potential for limited abstraction.

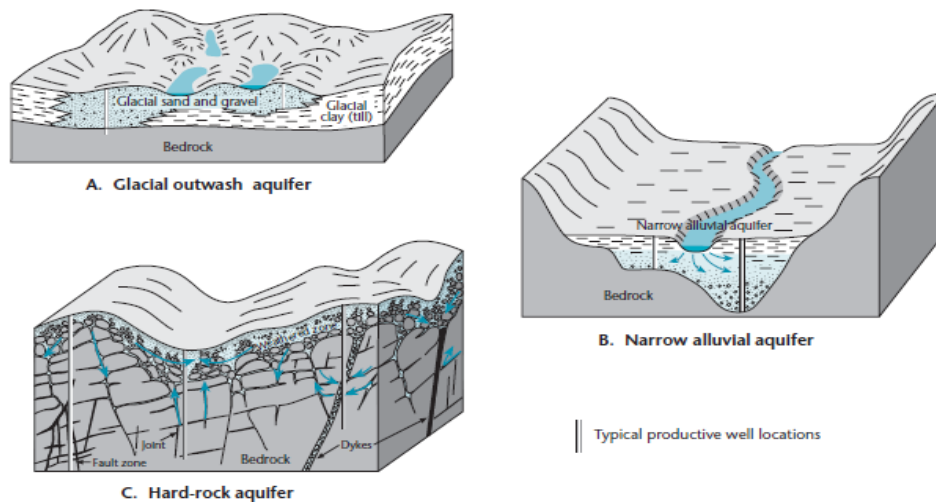


Figure 4a,b,c. Localised groundwater flow systems in minor aquifers (adapted from Freeze and Cherry 1979, Davis and De Wiest, 1966).

236

Figure 21 - Localised groundwater flow systems in minor aquifers

- 237 I also contacted the British Geological Survey (BGS) early in 2015 to request their opinion of the geohydrology of the windfarm area and any potential for groundwater pollution risk in relation to PWS abstraction.
- 238 Dr B. O'Dochartaigh, senior Geohydrologist at the BGS, reviewed Dr Carroll's preliminary geohydrology assessment at Whitelee (Review of S. Carroll's geohydrology Whitelee report, 2015) and largely agreed with his findings and conclusions, except that she thought the bedrock, described as impermeable on published BGS groundwater maps may be more fractured than previously described by SPR. (see above) However, she expressed concern to me that SEPA had not required SPR at Whitelee, or CWP Ltd at the adjacent Sneddon Law site to sink test bore holes to obtain a better understanding of rock characteristics on the local site, to allow quantification of the geohydrology risk, in view of the scarcity of detailed geological information on this site (B.O'Dochartaigh, 2015). BGS has no record of the actual depth of overlying peat, glacial till, alluvium and bedrock structure in various parts of this extensive site. Dr O'Dochartaigh also commented that any domestic abstraction was likely to be within the shallower part of the bedrock (within tens of metres) which would be more susceptible to surface water pollution.
- 239 Both Dr. Carroll and Dr. O'Dochartaigh commented that groundwater conditions in the bedrock are therefore essentially unknown at this time due to the scarcity of boreholes drilled specifically to assess soil and rock successions, structure and groundwater conditions prior to construction activity on the Whitelee site. Dr

O'Dochartaigh described a number of BGS registered shallow boreholes drilled on the North side of Lochgoin in relation to the WL WF site, which had been logged with BGS probably as part of a geotechnical investigation, but which were subject to client confidentiality for SPR. These boreholes were very shallow, less than 5m depth and provided no useful geohydrological information in relation to the WL 3 site.

- 240 Turbine foundations are major ground engineering projects. WL 3 ES (9.5.2.2.) describes clearly how these foundations will allow potential contamination of groundwater by surface water and indeed, this is exactly what happened, despite mitigation, in preceding WL WF developments to the detriment of PWS

9.5.2.2.

69. Excavation of material will be required for the foundations of turbines.

While these excavations are open, without mitigation in place they may present preferential pathways for any pollution incident on the surface to reach the bedrock aquifers (increasing vulnerability of groundwater to general contamination). This in turn, could have an adverse effect on the quality of the groundwater abstracted in nearby private water supplies

70. Borrow pits thus represent locations where the unsaturated zones of the bedrock will be exposed and there will be a higher risk of any potential pollution incident to reach bedrock aquifers. A pollutant may move through the fractures or fissures of the bedrock and could impact downstream on existing private water supplies which are sourced by bedrock aquifers.

WL 3 ES (9.5.2.2.)

- 241 It is understood that with this type of geology, where the structure of layers and fractures is unknown in detail, it can be practically impossible to predict the path, depth and quantity of groundwater with any confidence (Groundwater and its susceptibility to degradation, 2003), Figure 21, page 54. Furthermore, the confined and limited aquifers, high water table and narrow unsaturated zone of soil or peat means this type of geology and ground structure is particularly susceptible to pollution.
- 242 From the shallow borehole monitoring for WL WF, it is apparent that the water table is at, or only just below surface level. Therefore, there is little to no unsaturated surface zone; the water table was at the surface for most of the site and for most of the time that these levels were monitored at boreholes. The one exception to this

was at borehole CP02, (*Figure 28, page 72*), close to the visitor centre, sited within a different ground structure of peat overlying sand and gravel, in comparison to all the other bore holes.

- 243 The 'unsaturated ' soil zone is a critical area in attenuating pollution, or bacterial contamination at the surface from reaching the groundwater /water table, by allowing natural oxidation processes and bacterial action to break down contaminants.

The unsaturated zone is of special importance since it represents the first line of natural defence against groundwater pollution. Therefore, it is essential that it is considered fully in the evaluation of risks to groundwater supplies. Should the unsaturated zone be ignored, such evaluations will be excessively conservative.Ch 4. (Groundwater_and its susceptibility to degradation.)

- 244 This process cannot occur effectively if there is little or no unsaturated zone, as on this site, where the water table is close to the land surface and anoxic groundwater would be expected at shallow depth. This lack of an unsaturated zone may have been a contributory factor in the widespread coliform contamination of surface waters and PWS that occurred during WL WF construction. Again, there was no consideration of this aspect of geohydrology in any of the submitted Whitelee Environmental Impact Statements or responses by statutory consultees.
- 245 SEPA has classified the groundwater sensitivity to pollution as 4d on a severity rating increasing from 1-5) (SEPA, Groundwater vulnerability_methodology for Water Framework Directive, 2004), (SEPA Hydrogeo Response - Sneddon Law - Jan12).
- 246 I asked Dr O'Dochartaigh if BGS could supply a groundwater risk analysis for the domestic bore holes at Cauldstanes in relation to the proposed WL Ext 3 (the nearest water source)) and Muirburn, the nearest abstraction to the Sneddon Law windfarm. Unfortunately, BGS was unable to provide me with an informed groundwater risk assessment from windfarm construction, due to the lack of available data (B.O'Dochartaigh, 2015).
- 247 I am therefore both amazed and disappointed that on a site extending over 30 square miles, SPR had not previously drilled such test boreholes to provide this

information. Equally, I am disappointed that SEPA, charged with protecting groundwater from the effects of development, did not require SPR (or CWP Ltd for Sneddon Law) to provide this information in their site analysis and risk assessment.

- 248 Figure 23 to Figure 27, on pages 62 to 64, are schematic diagrams which explain the underlying geology and likely water flows on this site as they relate to spring or borehole abstraction (and potentially streams feeding into reservoirs). *Figure 27, page 64*, is an outline of the various types of construction activity risk on a windfarm site and how a pollution pathway is created, allowing surface water easy access to groundwater as described in WL3 ES.
- 249 In areas where the bedrock has been exposed, or extracted, for example in the quarries (borrow pits) or where there are deep turbine foundations, any surface water contamination has the potential to pass directly into groundwater.
- 250 We, the public, now understand there is the potential for a direct pollution pathway for contamination from such construction activity to affect not only PWS boreholes, but also PWS spring sources reliant on shallow groundwater.
- 251 Dr. Carroll in his report also describes how groundwater would be expected to discharge into streams in valley bottoms, such as those leaving the Whitelee site. There is no reason that these streams and catchwaters, also supplying the public water reservoirs, could not be similarly affected. Dr. Carroll's comment in section **3. Discussion**, is particularly relevant:

*Alluvium is mapped in BGS publications **extending along the course of the Birk Burn upstream from Craigenduntun Reservoir and lies within 1 km of well WP01, where **persistent organic chemical constituents** have been sampled***. (my accent).

(S.Carroll, hydrogeology of the Whitelee wind farm, 2015)

- 252 These narrow strips of porous alluvium related to watercourses allow easy routes of potential contamination to flow into superficial groundwater.
- 253 It is therefore even more surprising in my view, that the hydrology experts commissioned by SPR to evaluate the risks to water supplies have not, in all three environmental impact assessments for the various phases of Whitelee, either requested more geological information from the drilling of test boreholes, or been able to evaluate the available information to construct a **source – pathway – receptor** model for pollution which includes groundwater.
- 254 This standard pollution risk modelling, which formed the basis for risk assessment in the PWS risk assessments (Atkins, SPR Whitelee windfarm Extension 1 and 2 PWS Risk Assessment, 2010), (Environs, 2006), did not properly consider the possibility of

groundwater pollution, which is extraordinary, given that Whitelee windfarm was the largest environmental construction project in Scotland at the time and that groundwater pollution is recognised by regulatory authorities and trade organisations, such as BGS and CIRIA (Construction Industry, Research and Information Association), to have much more persistent and significant consequences than surface water contamination.

- 255 SEPA have informed me that where old quarries are used as landfill sites, the quarry is 'lined', specifically to avoid contamination of groundwater. At Whitelee, some quarries were constructed without the method statement being approved and we are not aware that these, or other quarries were lined. Quarries were used not only as a repository for the millions of cubic metres of peat and soil excavated on site but for the dumping of silt and slurry from roads and track, contaminated by HGV movements (e.g. (Ironsides Farrar Ltd, 2007) April 2007-556, (Ironsides Farrar Ltd, Aug 2007), 2091. Presumably the filling of quarries with deep unstable peat provides the potential for organic matter to leach into the groundwater for years to come, with the consequent changes in GW. This practice is endorsed by SEPA (SEPA, Whitelee X3 - SEPA response, 2012)
- 256 CIRIA 352 is regarded as a key reference in guiding construction methodology and SPR makes reference to complying with CIRIA recommendations in its construction mitigation methods.(Planning condition 6.4 WL Extensions)
- 257 CIRIA 352 states with regard to avoiding pollution 2.5.3 : *Piling, in particular vibro-replacement piles forms a direct flow pathway down columns of granular material for contaminated water and leachates to potentially move into an underlying aquifer both during and after construction. If the piles break through a naturally impermeable horizon, perched groundwater in a higher horizon may also flow vertically.*
- 258 Whilst at the neighbouring Sneddon Law WF this pile driving technique has been described in the ES, it is unknown whether this type of construction occurred on the WL site. However, 'backfill' of the turbine foundation and around its margins with aggregate will allow a permanent preferential permeable pathway to extend from the surface to groundwater. This is of particular concern given the volume of oil within the Nacelle (approx. 800 litres- [communication with Siemens]) and the need to change this oil as a minimum, every five years.
- 259 The PMO noted concern with regard to potential nacelle oil leaks and the requirements of meeting The Water Environment (Oil Storage) (Scotland) Regulations 2006. SPR was therefore to modify the nacelle to help avoid the oil leaks and would 'consider' biodegradable oil as an alternative, although it is not clear

whether this has been implemented. There is a significant amount of additional oil and other chemicals in transformers and other equipment on site.

- 260 Is the 'storage' and frequent oil change of a minimum of 170,000 litres of oil on a DWPA really an acceptable risk for public and private water supplies? In what way does the operation of the existing WL windfarm comply with The Water Environment (Oil Storage) (Scotland) Regulations 2006? Contrary to SEPA's assertions (e.g. Macritch Hill WF response (Angus Council ref: 15/00047/S36), windfarms are not excluded from complying with these regulations).
- 261 It is recognised that contaminated groundwater may occur at some distance from the pollution site (Small water treatment systemsDWI70_2_137_manual, 2001) 3.3. "Water abstracted from deep wells and boreholes may have originated from catchments several miles away" and (CIRIA 648) "*Construction activities must not affect the reliable yield or quality of any groundwater abstraction or receiving environment*"

4.1.1 Expert Summary

- 262 In his assessment of the existing Whitelee windfarms on private water supplies, geohydrology consultant, Dr Carroll concludes in his report for Whitelee:

The potential for more immediate impact on local private water sources, both from springs and wells (which I suspect are probably completed in the superficial deposits), is greater than that to public water supply reservoirs. The likelihood is that such sources are taking water from near surface flowpaths with short residence times and potentially complex interaction of surface and groundwater flow. I believe that this situation merits a serious attempt on the part of Scottish Power to

properly characterize and understand the nature of those water sources,

establish baseline conditions,

implement a monitoring programme and

define a plan to both mitigate impacts and respond to deviations from acceptable water quality standards. (S.Carroll, hydrogeology of the Whitelee wind farm, 2015)

There seems to be evidence of adverse impacts to surface and groundwater at different times and locations across and adjacent to the windfarm site during the time that construction occurred – the nature of this needs to be quantified and causes understood

The impact to groundwater seems to be pretty local, but this may be partly an effect of the limited monitoring network in such a large area of activity

Impacted groundwater, even if currently in headwaters areas now, may ultimately enter downstream water supplies if no action is taken

Local, private water source users are likely to be more impacted in the short term than municipal users.

There are a lot of unknowns at this point. These need to be addressed. That there is a small probability of affecting a small number of end users does not make this a trivial concern.

(S.Carroll, Whitelee windfarm hydrogeology summary, 2015)

4.1.2 The Whitelee WF 3 ES

263 There is very limited reference to groundwater contamination from construction activities, quarrying and forestry clearance in any of the preceding or existing ES.

264 For example, copied below is the entire section **18.4.4.3** dedicated to 'water quality' from the original WL WF. This doesn't mention water quality at all. Only quantity is mentioned and this is not specified or related to existing borehole abstractions.

265 The ES for Whitelee Extensions or WL Extension 3 contains even less detail.

266 *Groundwater quality*

- *The basalts and other igneous formations in the study area are classified as being Weakly Permeable. This indicates that they are formations of generally low permeability that do not widely contain groundwater in exploitable quantities. However, some formations can locally yield water supplies in sufficient quantities for private/domestic use.*
- *The sedimentary rocks and granular drift deposits in the study area are classified as being Moderately Permeable. This classification is assigned to fractured or*

potentially fractured rocks that do not have a high primary permeability, or other formations of variable permeability. Although these formations will seldom produce large quantities of water for abstraction, they are important for local supplies and in supplying base flow to rivers. The majority of the sedimentary rocks in the area are overlain by low permeability glacial till.

- 267 Groundwater from these formations is currently providing private water supplies at several locations around the perimeter of the wind farm.
- 268 The current WL Extension 3 ES is inadequate in that it does not undertake to understand the capture zone of borehole PWS, to the extent of failing to even chart the nearest vulnerable groundwater borehole PWS at Cauldstanes which is 1km or less from the nearest proposed turbine foundation, *Figure 22, page 62*.
- 269 For those PWS that have been mapped by SPR within the submitted WL Ext 3 ES in Fig 17 (i.e. EK10, EK3 and EK2, and which are within 1km of the site boundary), SEPA provided no comment in their statutory response in 2012 (Whitelee X3 - SEPA response, 2012).
- 270 However, in other S36 windfarm applications, (e.g. Macritch Hill WF adjacent to Backwater reservoir, Angus) SEPA submitted an objection (19.02.2015) on the grounds of private water sources not being identified for two properties which are greater than 1Km from turbine foundations : "We object to this planning application on the grounds of a lack of information relating to private water supplies."
- 271 From 2012, SEPA have required developers to identify potentially 'at risk' private water sources (R.Connor, SEPA meeting summary 28.04.2015, 2015).

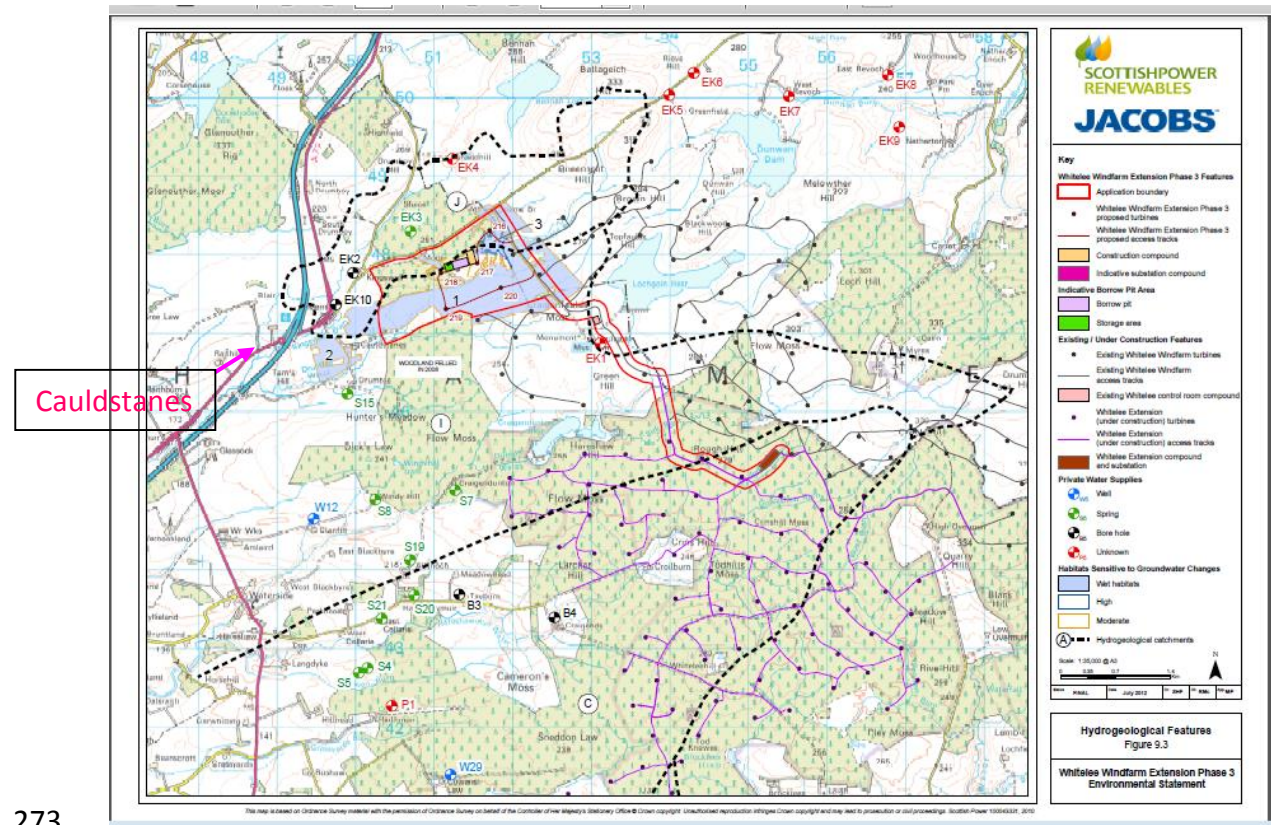


Figure 22 - Jacobs - Hydrogeological Features, figure 9.3

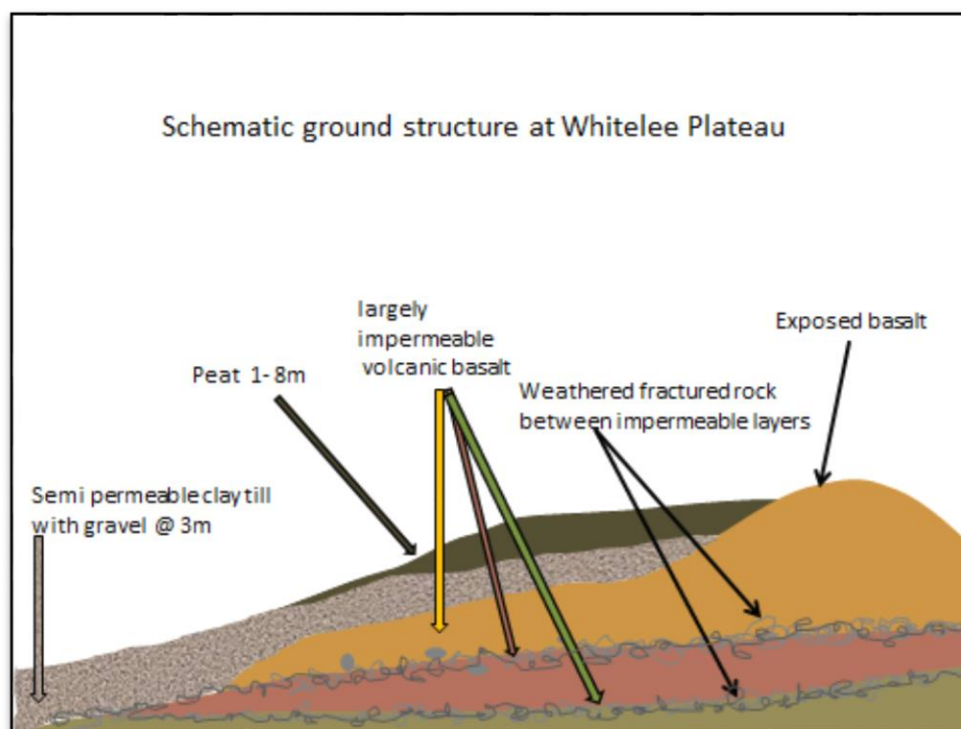
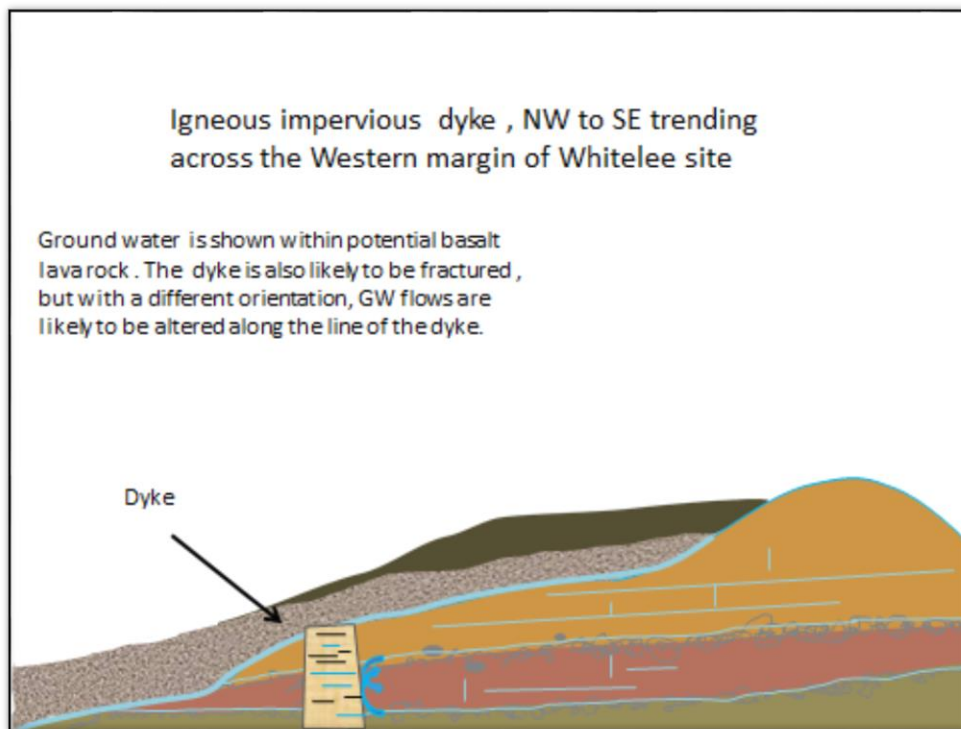
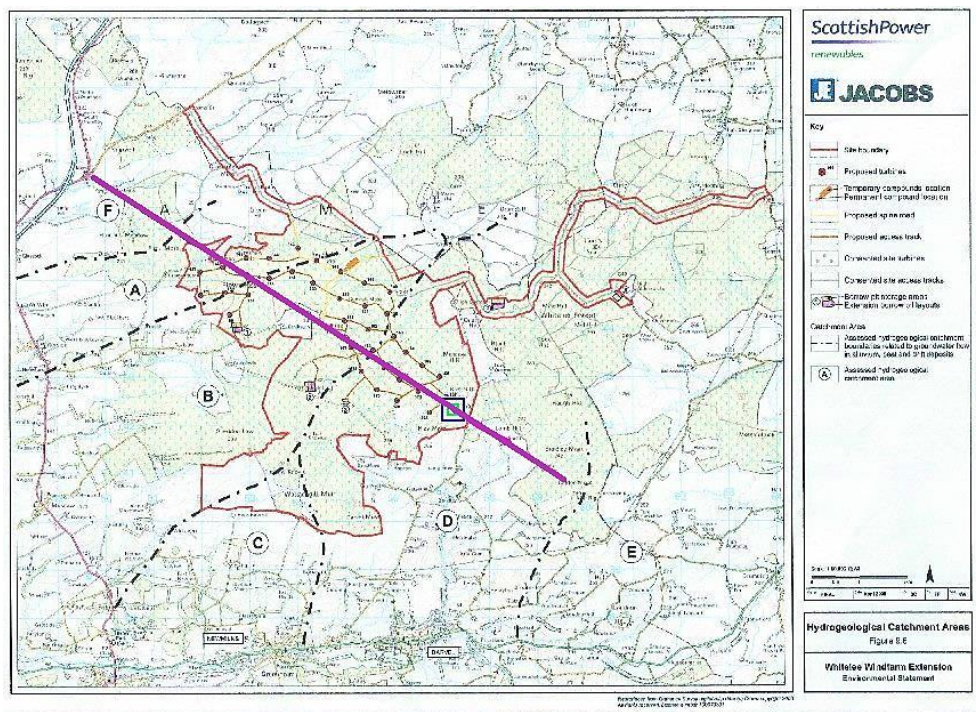


Figure 23 - Schematic ground structure at Whitelee Plateau



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Figure 24 - Igneous impervious dyke, NW to SE trending across western margin of Whitelee



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Figure 25 - Superimposed igneous dyke trending NW to SE across the Whitelee site

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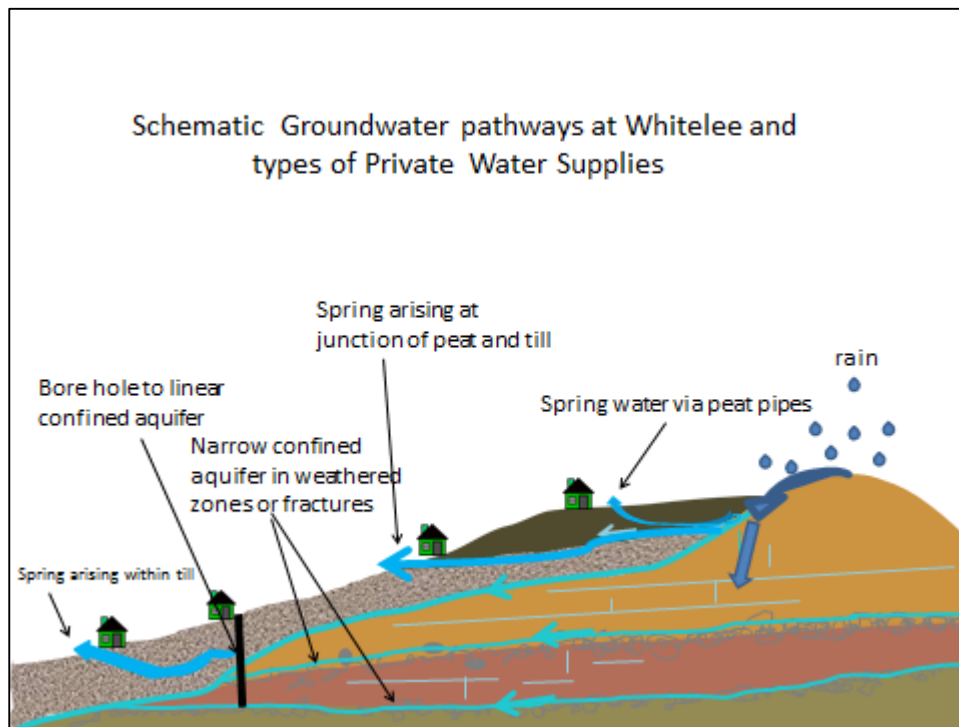


Figure 26 - Schematic Groundwater pathways and types of Private Water Supplies

278

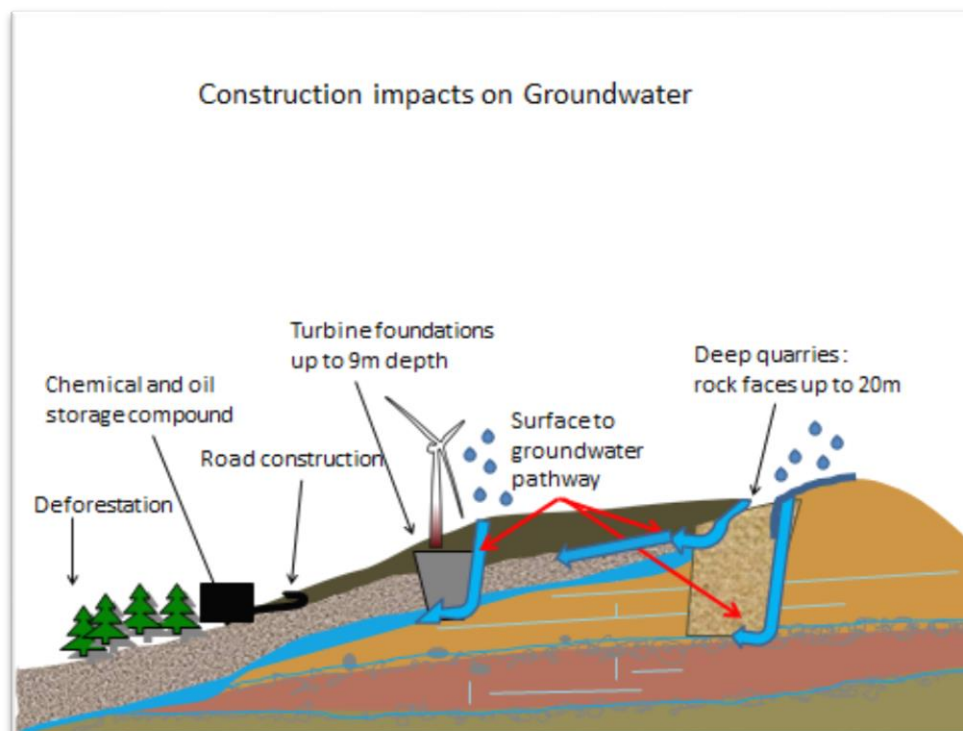


Figure 27 - Construction impacts on Groundwater

In summary

- *The ES's submitted for the various phases of Whitelee windfarms have not investigated geohydrology at an appropriate level of detail, nor have they considered the reliance of private and public water supplies on either groundwater flow to springs and surface streams or direct groundwater abstraction from boreholes.*
- *The required borehole logs required to make an informed, adequate groundwater risk assessment have not been obtained, or have not been made available.*
- *Given the minimal unsaturated zone on most of the WL site, inadequate consideration has been given to ability of the local soil structure to influence the natural degradation of surface pollutants.*
- *The current WL Ext 3 ES has not identified, mapped or provided a geohydrological risk assessment for the nearest PWS abstraction to turbine foundations (Cauldstanes).*
- *SEPA have failed to assess the WL 3 application in accordance with their own policy of requiring developers to identify water sources for PWS that may be at risk.*
- *The ES for WL3 has identified the particular risks of constructing borrow pits and turbine foundations in providing a preferential route for surface water to contaminate groundwater. This contamination of GW was documented as occurring with preceding WL WF developments.*

4.2 Groundwater Contamination.

- 279 In November 2014, Mr Davis of Kingswell obtained from EAC a copy of the Jacobs Groundwater Monitoring Post Construction report 2009, (Jacobs Whitelee Post Construction Report Nov 09) commissioned by SPR as part of planning conditions for WL Original WF. (Construction 2006-2009).
- 280 EAC received this as an electronic document on 07/11/2014 from the Planning Monitoring Officer for WL WF, Ironside Farrar.
- 281 This document summarized the groundwater monitoring results which had been collected during the construction period as well as obtaining post construction groundwater quality indices in September 2009. A copy of the borehole locations is shown in *Figure 28, page 72*. The Jacobs report describes the borehole construction, borehole depth (usually between 6-8m) and core samples which extended just into glacial till and clay. The report describes standard, acceptable methodology for water sample collection, to avoid spurious test measurement results, which involved purging the borehole three times to exclude effects of direct surface water contamination or water stagnation in the borehole affecting test results.

- 282 The groundwater results that were described and tabulated in this report are surprising and deeply concerning.
- 283 Not only did results show grossly elevated levels of synthetic chemicals: phenols, chlorinated phenols, toluene and DEHP (Bis (2 – ethylhexyl)phthalate) within the groundwater of boreholes, but these results were not communicated to EAC or, as far as I can determine, any other statutory body, such as SEPA, when the results became available during the course of monitoring between 2006 - 2009 . These GW monitoring results were available to the PMO and the summary reports were made available to SPR, Scottish Ministers and the Competent authorities.
- 284 If EAC, East Renfrewshire Council (ERC), or South Lanarkshire Council (SLC) as the competent authorities, had known about and understood the implications of the GW test results, PW supplies could have been more rigorously tested and had quality also been affected, could have sanctioned further mitigation measures and alternative water supplies, as was required under the pollution prevention plans.
- 285 However, PWS were never tested for any of the synthetic chemical contaminants and those dependent on groundwater never warned or given a choice to drink alternative water. This was the same scenario as had happened with monitoring and bacterial contamination involving our PWS; but this time with much more serious implications for long term public health. Monitoring had occurred, but again the relevant authorities were not informed of adverse results.
- 286 SEPA and the competent authorities (EAC for WL 1and 2) had the power to delay further construction on site until the cause of the pollution was investigated and mitigating steps taken.
- 287 Why did this not occur when the PMO repeatedly raised concerns about GW throughout the WL WF monitoring period? For example, phenols at borehole WP01 at almost 100 times drinking water standards and Di-n-butylphthalate 12ug/l at CP02 ((Ironside Farrar Ltd, 2008), 2140.
- 288 No action was taken, or could be taken, as the results of this 2009 Jacobs report was unknown to competent authorities, or the public, until 2014, five years after completion of WL original and almost 2 years after completion of the WL WF Extensions.
- 289 Likewise, had they known, SW could have instigated more detailed monitoring of ‘at risk’ public water supplies for chemical contamination of raw and potable water.

4.2.1 Consent of Whitelee windfarm Extensions and impact of the Jacobs Report.

290 I found it difficult to understand that WL1 and 2 could be consented by Scottish Ministers had they known that both surface and groundwater contamination had occurred in relation to the construction or operation of WLWF original.

291 A letter from the Energy Minister Mr. Ewing, to Mr. Elliot Davis at Kingswell, 17 December 2014 stated ,

*Mr Davis states that he believes that SPR submitted flawed ,inaccurate Environmental Statements (ES) for the consented Whitelee wind farm and subsequent extensions. **All environmental information was consulted on** during the application stage and all parties given an opportunity to comment at the time. **All information was taken into account** and conditions attached to the consent in line with advice given by the statutory consultees.’ (emphasis added)*

(Ewing, 2014)

292 Ironside Farrar, as the PMO have stated in their terms of reference ([PMO Report 1 Sept/Oct 2006](#)), 463, that Scottish Ministers would be copied into their reports.

293 In early 2015 I submitted an FOI request, copied below, to the Energy Consents Unit, to determine if they had been aware of the Jacobs 2009 report, which was published 6 weeks before consent was issued for Whitelee Extension 2- not withstanding that the groundwater monitoring results obtained during the construction period, had already shown serious contamination and had been available to SPR, Scottish Ministers and the Competent authorities. (ECU, 2015)

FOI to ECU 01.04.15:

Question: *Whether the Scottish Energy Consents Unit has ever received the Whitelee Wind Farm Jacobs Post Construction report 2009 (Which I enclosed for your convenience). Was this in paper or electronic format?*

Answer: *Officials can find no trace of ever having received the Jacobs Post Construction Groundwater Quality Monitoring Report (Nov 2009) as part of the Environmental Statements or supplementary information received in relation to Whitelee Wind Farm and the subsequent extension applications.*

294 I was extremely disappointed to discover that even the concerns of SPR's consultants, Jacobs Ltd, regarding the adverse impacts on groundwater and the

recommendation that mitigation methods outlined in the original WL WF ES should be reviewed, had not been made available to the ECU or to Scottish Ministers prior to awarding consent for WL2 or taken into consideration when devising planning conditions for further turbines to be sited on public and private water catchment areas.

295 Water pollution is a material planning consideration; why didn't Scottish Ministers inform the ECU of what was already happening on the existing WL WF site?

296 **Why is this past history of consenting WL Extensions relevant to the proposed WL Extension 3?**

297 As part of the planning conditions for WL Extensions 1 and 2, (SPR, Issue 02 Condition 6.8 and 6.9 (Phase 1 and 2) Monitoring Plan, 2010) SPR were required to monitor groundwater quality, as they had done for the original WL WF.

298 Jacobs referred to this in the summary of their report (Jacobs, Jacobs Whitelee Post Construction Report Nov 09, 2009) and made additional recommendations that continued ground water monitoring should occur on the original site, particularly for investigation of the presence of phenols, and that the predictions made in the original ES should be reviewed and future mitigation should be revised in view of the findings.

299 **Why were the recommendations of Jacobs Ltd not implemented for WL WF Extensions?**

300 In their final report (Ironsides Farrar Ltd, 2010) the PMO also recommended further investigation of the veracity of laboratory results with respect to abnormal sample test results. They felt that WF had not generally impacted on GW, but that the findings of focal chemicals in a borehole such as cresols and phenols, could not be explained.

301 Although there is reference throughout the PMO reports of concerns regarding the deteriorating quality of groundwater, EAC were not informed of the groundwater pollution raised in the Jacobs 2009 report during the construction of WL WF until 2014, and to date (10/04/15), EAC have not received any groundwater monitoring results for the WL Extension and I am unable to find any statutory authority with these results.

SPR have not been able, thus far, to provide these results, even after repeated direct requests. In attempting to find these GW monitoring results for WL1 and 2, not the least to determine whether our own water supply and potentially our future health would be jeopardised, I contacted my MSP, Mr. Graeme Pearson in early 2015. He contacted Environment Minister Ms. Aileen McLeod, MSP who was of the opinion

that EAC had these results and suggested I contact EAC Planning Officer Mrs. Jane Little (A. McLeod to G. Pearson . WL WF discharge of conditions 2015-03-25 (1)).

- 302 I subsequently contacted Mrs. Jane Little and she and senior Planning Officer Mr David Wilson reiterated that EAC has never had sight of these results.
- 303 These GW monitoring results are critical to the WL 3 proposal not only in providing a base line for monitoring GW in relation to the now-proposed WF Extension, but to understand whether mitigation used for constructing the WL1 and 2 was any more successful in preventing GW pollution than in WLWF. SPR have referred to these 'successful' mitigations methods as those which will be employed on the proposed WL3 site.
- 304 I also searched the British Geological Survey (BGS) data base, which lists and maps all recorded boreholes (such as those for Whitelee WF original) and there is no record of any boreholes for WL WF Extensions, even though the boreholes for WL WF original were mapped and recorded.
- 305 To date, I have explored every avenue open to me to find these groundwater results. Without understanding the further changes that have occurred in relation to groundwater on both the original site and extension site, the continued impact on dependent water supplies cannot be quantified and the public health risk remains unknown, causing anxiety for every individual dependent on this site for their water.
- 306 Consenting further development of WL3 on this water catchment area would repeat the previously uninformed consent decision, putting public health at risk.

4.2.2 The Jacobs Report – involvement of Statutory authorities.

- 307 SW had standing orders in place with SPR such that they should be notified directly of any contamination event on water catchment land (SW, FOI response 5139426 from SW re. notification by SPR of contamination spills at WL WF, 2015).
- 308 This did not happen, despite abnormal water sampling results showing significant chemical contamination with phenols, toluene and phthalates found in a borehole (WP01) (*Figure 28, page 72*) nearest to the two public water reservoirs from 2007. SW was *not aware* of the Jacobs post construction report 2009 until I forwarded them a copy early in 2015. SEPA also recorded other pollution events on the Whitelee SW catchment area e.g. Four oil drums, some with oil leaks: Env/0839797 (SEPA, SEPA Pollution Incidents Whitelee 2004-2014_FOI, 2014) but again, this was not notified to SW.
- 309 I am not clear whether SW were aware of the multiple oil and fuel spills on the WLWF site, as recorded by the PMO, even though it seems many of those that were

detected were ultimately dealt with satisfactorily.

In their post construction report, Jacobs Ltd were concerned by the appearance, presence and levels of synthetic chemicals in groundwater. The summary conclusions from that report are reproduced here:

Conclusions and recommendations

8.1 *Throughout the monthly monitoring period and from the post construction monitoring, localised increases in the concentration of contaminants have been observed, but cannot be correlated to identifiable site activities or other changes in conditions at the site. It is noted that such peaks and troughs in the concentration of dissolved species are not limited to particular parts of the site and are assumed to represent the intrinsic variability of the sampling and analytical procedures adopted, coupled with any natural variations due to changes in infiltration, percolation through the soil and sub-surface water flow.*

8.2 *Nevertheless, the post construction samples did show continuation of increasing trends of iron and total organic carbon at both WP01 and WP04 and a decreasing trend of pH values across all boreholes. An increasing trend for 3/4-methylphenol was also recorded at WP01. An increase in TPH concentrations was also observed, with higher levels of TPH being recorded at each borehole in this round compared to the previous round.*

8.3 *No record or visible signs of oil contamination were noted during the latest monitoring visit. Boreholes WP01 to WP04 are screened across peat and it is possible that the increased TOC and iron concentrations along with the decreasing pH concentration may be indicative of local increases of peat rich water into these boreholes. With this in mind, it is also possible that the elevated TPH concentrations recorded during the postconstruction monitoring may be due to the high levels of TOC associated with the peatywater (quantified as TPH during the solvent extraction based TPH*

analysis). 3/4-methylphenol was only recorded at WP01. The reason for its presence within this borehole is unknown but has not been attributed to any site activities which have taken place within this vicinity.

8.4 *In the light of the unexplained trends and changes noted above, it is recommended that the available monitoring data and information is assessed against the predictions made in the original Environmental Impact Assessment (EIA) for the windfarm development. The significance of the observed groundwater quality information should be assessed and consideration given to the need for revising existing impact predictions and associated mitigation / precautionary requirements.*

8.5 *It is understood that a second phase of the Whitelee Windfarm is planned for construction and groundwater monitoring will again be undertaken to establish baseline conditions and monitor any construction impacts. It is recommended that during any such Phase 2 groundwater monitoring, bi-annual monitoring of the boreholes within the Phase 1 area is also undertaken and the data reassessed on a yearly basis. During this monitoring it is recommended that phenols at WP01 are specifically targeted and subjected to further assessment and review.*

(Jacobs Whitelee Post Construction Report Nov 09)



312 In January 2015, frustrated by my inability to get answers from relevant authorities
regarding the contamination on the WL Windfarm site, I contacted the National
Press.

314 SPR's response was to attribute the presence and grossly elevated levels of Bis (2 – ethylhexyl)phthalate (DEHP) found in multiple ground water samples at 400 times the recommended 'safe' levels in drinking water, (as recommended in WHO drinking water guidelines (WHO, 2011)), to be probably due to laboratory cross contamination or error.

⁹ http://www.thesundaytimes.co.uk/sto/news/uk_news/scotland/article1516825.ece

316 I sent the Jacobs report to both SW and SEPA in February 2015 and asked them for comment, but also asked them whether they felt these results could be due to 'error'. Both SW and SEPA referred the Jacobs report to their respective scientists for an informed reply.

317 SEPA produced a detailed response (SEPA reply re. Jacobs report 2009 and DEHP 2015), (SEPA meeting summary 28.04.2015) but stated that they regarded contaminant DEHP as probably due to laboratory or sampling error.

The lack of obvious source, in combination with the apparently random detection of DEHP on a very wide scale (boreholes are approx. 2 km apart), gives some support to the statement within the Report that cross contamination within the laboratory maybe the source. Equally the chemical could be detected through sampling practise as the chemical is often found in vacuum pumps which are used for groundwater sampling. The source of the DEHP is considered at this stage to be unclear and may well be as a result of sampling or laboratory cross contamination.

(SEPA reply re. Jacobs report 2009 and DEHP 2015)

318 SEPA, whilst being unable to explain definitively how these synthetic chemicals entered the groundwater, or how laboratory error or sample collection would have produced such high results, concluded that, 'Therefore, there is no conclusive evidence in the report to confirm that a spill incident has occurred.'

319 I found that a puzzling statement:

- If this wasn't a spill incident, were these chemicals deliberately used in the environment?
- How did the chemicals get into groundwater if they weren't spilt?
- If this wasn't an accidental, unreported chemical spill, but diffuse contamination related to a construction process, then there are implications for windfarm construction sites throughout Scotland.
- Surely this warrants further investigation?

320 If the extraordinarily high readings were due to laboratory error, then what was the evidence for this? Had other laboratories had produced such erroneously high

readings in borehole water samples previously, or was this a 'one off' affecting multiple samples over many months on this site?

321 **In essence, what is the point in testing a sample if abnormal results are simply to be attributed to error, with no further investigation or explanation?**

322 I understood it was SEPA's role to investigate environmental contamination and if necessary, to prosecute the polluter according to principle framed in legislation of the Water Framework Directive that 'the polluter pays'?

323 However, as SEPA are unable to explain a 'source' for the chemicals, they do not agree that groundwater contamination has occurred (contrary to the summary within the Jacobs report) and if it did occur, then it is historic and an investigation is now unwarranted (SEPA meeting summary 28.04.2015).

324 This refusal by SEPA to acknowledge that GW contamination had occurred did not explain the presence of other contaminants in groundwater, or the diffuse adverse changes to GW, as evidenced by the GW monitoring results over 2 years.

325 What seems contradictory in SEPA's response to me regarding groundwater contamination is that SEPA also acknowledged that,

Bis (2-ethylhexyl)-phthalate (also known as DEHP) is currently a Priority Substance under Scottish legislation for surface waters; whilst DEHP is considered "non-hazardous" for groundwater, this definition is quite specific and still results in limits on discharges.

and

*'DEHP was in December 2014 included under the EU chemicals regulation REACH (Registration, Evaluation and Authorisation of Chemicals) as a **Substance of Very High Concern (SVHC)**. DEHP is a Priority Hazardous Substance for surface waters under the EU Water Framework Directive (WFD)*

(SEPA reply re. Jacobs report 2009 and DEHP 2015)

326 SEPA, EAC, ERC, SLC and SPR were aware from the submitted ES for WL WF, that untreated groundwater was used as a drinking water source from the Whitelee site. The PWS risk assessments list 73 separate PWS reliant on the Whitelee plateau for their drinking and domestic water supplies. Apart from two listed surface water supplies, the remainder are reliant on groundwater, either from naturally occurring springs, or from boreholes. These are likely to be of the type shown in *Figure 26, page 64*.

- 327 SEPA acknowledge that they don't have proscriptive GW values for DEHP, although there are values for surface water, which was not tested for DEHP at Whitelee.
- 328 SEPA's reply to me, (answer 1) (SEPA reply re. Jacobs report 2009 and DEHP 2015) in regard to groundwater values for DEHP, is to stress environmental values, rather than drinking water standards (DWS). In the knowledge that this groundwater was being used as a drinking water source, this would not seem to me to be a 'precautionary approach', when even the developer's agents, Jacobs Ltd. did use drinking water standards wherever possible and only used environmental standards when DWS were not available! 7.1 (Jacobs Whitelee Post Construction Report Nov 09).
- 329 As groundwater provides the base flow for surface water streams (S.Carroll, hydrogeology of the Whitelee wind farm, 2015), (Groundwater_ and its susceptibility to degradation. , 2003), as well as providing superficial spring and water from wells, it would seem logical that as a minimum, the same values should be adopted. Therefore, as a minimum, WHO drinking water guidelines for safe groundwater chemical levels should be adopted. (WHO, 2011). It is illogical to have recommended maximum acceptable levels of consumption of a potentially dangerous, toxic chemical which varies according to the origin of that water.
- 330 The issue is the 'safe' level of a chemical in water; not where the water has come from.
- 331 SEPA has an obligation to comply with the EU Water Quality Framework Directive, which requires SEPA to develop and action plans to ensure ground water is free of chemical contamination and classified as 'good' by 2015, not to allow deterioration in quality and not to fail to investigate the cause of groundwater contamination or attribute unexpected, unexplained contamination to laboratory error.
- 332 **The unassailable fact in this case is the persistent presence of DEHP in multiple monitoring wells. Regardless of any correlation with site activity or a plausible conceptual model of how it might have been introduced to the environment, it is the responsibility of the monitoring well owner to show that the groundwater is clean and that the previous "false positive" readings can be safely ignored.**
- 333 We know that Whitelee was a restricted access construction site, to which members of the public had no access. Synthetic organic chemicals were not present in base line groundwater tests, thus SPR, holding licences and consent for development were responsible for the site and must take responsibility for any pollution.
- 334 This is described very clearly in construction guidelines.

The law relating to water pollution may appear complex but the principle is simple: it is an offence to cause pollution. And 8.2 It is essential to know the status of surface water and groundwater before construction starts. Mitigation measures should be designed to protect these baseline conditions in the water environment. Baseline data can then be used as a benchmark to determine what effect, if any, construction activities are causing.

(CIRIA, 2006)

- 335 Scottish Water provided, in my view, a more balanced response to the levels of synthetic chemicals found in GW samples at Whitelee. Prof S. Parsons:

Whilst I cannot say if that is the case for all these samples on the list if we had found these concentration (DEHP has low solubility in water 300 - 400 µg/L - the levels reported – 2300 ug/L are well above this level) and pattern of samples shown in the data (significantly higher levels on a single day) in samples we had analysed would have instigated an investigation of the laboratory methods to identify if it was cross contamination.

(S.Parsons, SW. reply re DEHP in GW at Whitelee , 2015)

- 336 The role of Regulatory Authorities in preventing water contamination.

- 337 In my view, it seems that SPR consider that by conducting monitoring according to the planning conditions, they have fulfilled their obligations, even if they have not communicated those results to the relevant authorities or investigated abnormal results.
- 338 I fail to understand why this material planning information was not considered prior to consenting a further large windfarm extension on this site and can only wonder if this might have impacted on consent being awarded.
- 339 The competent and relevant authorities appear to have regard only for whether the monitoring has been conducted and not for considering the results or implications of adverse results or water quality changes.
- 340 It is also apparent that there has been a complete failure by the Local Authorities to ensure that SPR had complied with all the planning conditions and a failure to ensure that all the monitoring required to comply with conditions was actually carried out. The PMO reports for WLWF repeatedly made reference to PWS monitoring results

that were not obtained, to monitoring wells that were not replaced when they were damaged and to SPR wanting to cease monitoring of SW, GW and PWS once earth works had completed, rather than over the lifetime of the construction period.

341 In my opinion, Local Authorities are woefully under resourced to carry out their monitoring and enforcement task effectively, to understand and act on the specialist results and to have the resource to instigate prosecution when developers fail to comply with conditions.

342 Other authorities such as SEPA and SW have the expertise to properly interpret monitoring results for water, but are not involved in the notification of monitoring results. Even when notification arrangements were in place between SPR and SW, to protect public water supplies, they were apparently disregarded without penalty.

343 In my opinion there is a serious disconnect in the effectiveness of the whole regulatory and planning process in respect of water.

344 There is no effective protective mechanism for PWS if the competent local authority is responsible for protecting the water supply, but has no mechanism to insist that a developer find, chart and protect the water source, and is subsequently not responsible for the hydrological environment upon which that water supply depends.

345 The hydrological environment is SEPAs responsibility and yet they have no responsibility for the quality of public drinking water supplies or for PWS and they do not receive any monitoring results.

346 Laboratory Investigation

347 In view of the opinion expressed by SPR, SEPA and SW, that the presence of DEHP in groundwater was related to sampling or laboratory error, I attempted to gain more information from the Laboratory in question, (Scientific Alliance Laboratories- SAL) in East Kilbride which undertook the analysis, to determine whether in the light of such extraordinarily high results for DEHP they considered it possible that results were erroneous.

348 Unfortunately, even after talking to the Managing Director, Mr Wood, they refused to give me any more information than had been published in 'The Times', citing commercial confidentiality. However after researching the published credentials for SAL, I confirmed that the laboratory was accredited to the relevant regulatory standard, ISO 17025, to be able to conduct GW monitoring of the relevant test parameters for Whitelee WF 2006-2009. (R.Wood, 2015)

- 349 Unable to gain any further information from the laboratory now being blamed for erroneous methodology and results, not only in the National press by SPR, but also potentially by SEPA, I contacted UKAS.
- 350 UKAS is the United Kingdom Accreditation Service for Laboratories, which by EU law regulates the quality control procedures at laboratories and certifies competence for laboratories to conduct certain tests. For example, a laboratory may be accredited to measure for tests parameters in groundwater, but not in surface waters or soil samples. Or, it may be accredited to measure for minerals, but not for volatile organic compounds (VOC) such as toluene, or semi volatile organic compounds (SVOC) such as DEHP in groundwater. SAL in East Kilbride was accredited to measure the chemicals specified in the Jacobs post construction report 2009 within groundwater.
- 351 I asked UKAS Senior Accreditation Officer (Ms H) what the regulatory requirements would be in 2006-2009 regarding sample collection and containers and quality control procedures in the lab to minimise the likelihood of 'lab error'.
- 352 I also asked Ms H whether in her opinion, values of up to 3200ug/l of DEHP could be attributed to 'cross contamination' and lab error and what the normal reporting procedure would be of abnormal results from an accredited laboratory to a client . She described the procedure an accredited laboratory would be expected to follow in terms of quality control; I refer to that response: (UKAS Laboratory Accreditation Standards, in 2006-2009 e-mails, 2015)
- 353 In essence, the client, in this case Jacobs Ltd for SPR, would have to inform the Lab what the context of the testing was being used for, e.g. general water environmental monitoring, or drinking water monitoring for the Lab to know which standard values would apply. There is not an obligation on a laboratory to necessarily 'flag up' abnormal results to a client, although many will do this.
- 354 If samples are submitted in inappropriate or damaged containers, such that the result of the sample may be compromised, this is known as a 'deviant' sample and the client is notified so that the sample can , if necessary be repeated.
- 355 We know from the Jacobs report (Jacobs Whitelee Post Construction Report Nov 09) 2.5 methodology, that laboratory supplied bottles were used for water samples and that borehole water was purged three times before water samples were collected. SEPA have suggested the erroneous samples may have been due to contamination by leaching from plastic in the sample pump equipment, including tubing. As the details of sample collection are not described in any of the water quality reports, the potential for this kind of contamination cannot be evaluated, as this was not investigated at the time.

- 356 As a potential source of error, this was described comprehensively in 'Problems Associated with bis(2-ethylhexyl)phthalate Detections in Groundwater Monitoring Wells' published by the Wisconsin Dept. of Natural Resources (Problems Associated with DEHP detection in Groundwater wells, 2002). This report describes how false positives have occurred within the laboratories as a result of leaching from plastic used in collection bottles or tubing during sample collection or in later handling. (Problems Associated with DEHP detection in Groundwater wells). There is detail about how the laboratory should repeat the analysis, with control samples, if a false positive or laboratory contamination is suspected.
- 357 The PMO GW monitoring reports also refer to the high values of DEHP (Ironsides Farrar Ltd, 2008), 2138 , but report that laboratory blanks also contained traces of DEHP. Those results are not available to us. However, the Wisconsin report makes clear that abnormal sample results should not be ascribed to laboratory error, even if sample blanks contain DEHP, without further investigation and there is a clear testing procedure to follow, to exclude sample error in this event.
- 358 I also discussed this further with Ms H (R.Connor, Memo from conversation with Janice Haines. , 2015)
- 359 In summary, Ms H thought it unlikely a laboratory error would result in so many high readings. (I neither identified the laboratory concerned to UKAS, nor the client customer -SPR)
- 360 However, because SPR, SEPA and SW have considered that laboratory error or contamination may have caused a 'false positive' result, I continued to attempt to research further into the likelihood of laboratory error or cross contamination being responsible for such results.
- 361 Because DEHP is ubiquitous in the environment, false positive problems have previously been reported from laboratories when testing groundwater, for example when trying to monitor groundwater near industrial landfills where there might be expected to be contaminants such as DEHP leaching from plastics into groundwater.
- 362 Analytical quality control is part of routine UKAS accreditation (and would have been required in 2006) at the SAL laboratory in East Kilbride which carried out the GW monitoring at Whitelee. To determine what the Wisconsin Dept. of Natural Resources considered to be elevated levels of DEHP, above the U.S. Prescribed limit of 0.6ug/L (which is lower than WHO limits of 0.8ug/L) I searched their records from 1995 to 2015 (Wisconsin DNR GW results for DEHP 1995-2015). Over this 20 year period, the highest level of DEHP in groundwater was 20ug/L. compared with the reported peak Whitelee of 3200ug/L. It is relevant to note that GW monitoring at Whitelee occurred at multiple wells scattered over 30 sq. miles and that on the same

day, results varied from 67 to 3200ug/l. This was not a site previously used for landfill where there might have been underlying soil contamination.

363 It has also been suggested that the false positive high readings for DEHP might have been due to the lining material of boreholes leaching into well water. On the original WL WF site, not only did the collection technique include purging the well three times to avoid such sample error, but the boreholes drilled for Whitelee WF by Land Drill Geotechnics were routinely encased with steel pipe, not PVC. For the earlier borehole drilled in 2002 for CRE /SPR by Ritchies (Boreholes CP02, *Figure 28, page 72*) the type of casing was not stated. Therefore, it seems unlikely that this would have been a contributory factor.

364 Groundwater contamination:

365 This occurred under three broad headings

- Focal, point source chemical contamination
- Diffuse chemical contamination
- Diffuse mineral and organic changes in groundwater

366 Focal point source chemical contaminants.

367 The Jacobs 2009 Post Construction GW quality report (Jacobs Whitelee Post Construction Report Nov 09) identified phenols, chlorinated phenols, toluene and DEHP appearing during the construction monitoring period in borehole WP01, the borehole sited between the two public water reservoirs (*Figure 28, page 72*). Chloroform was also detected in two other boreholes WP02 and WP04.

368 At WP01, the peak level of phenols (120ug/L) was four times the allowable environmental limit of 30ug/L. Phenols and chlorinated phenols are part of a group of substances called cresols. (3 methylphenol and 4 methylphenol are m-cresol and p-cresol respectively

Cresols have a wide variety of uses as solvents, disinfectants, or intermediates in the preparation of numerous products. They are commonly used in the production of fragrances, antioxidants, dyes, pesticides, and resins. In addition, p-cresol is used in the production of lubricating oils, motor fuels, and rubber polymers, while m-cresol is also used in the manufacture of explosives.

(IPCS INTERNATIONAL PROGRAMME ON CHEMICAL SAFETY, 1997)

- 369 WHO does not refer to chlorinated methylphenols or chlorinated cresols for safe drinking water levels.
- 370 Chlorinated phenols are of particular concern for toxicity. They are found in pesticides, herbicides and disinfectants and well as being used as an 'anti clogging' agent in some fuels. Cresol concentrations in surface water (up to 204 ug/L) and ground water (2 mg/L) have been observed adjacent to industrial effluent sites where coal tar and creosote compounds have been handled in large quantities. At WLWF methylphenol (Cresol) was detected up to 180ug/l in borehole WP01, between the two public reservoirs.
- 371 Toluene, found at WP01, is a volatile organic compound, which is often used as a degreaser and as a component of fuels and other organic chemicals. In high concentrations it is a nervous system toxin to humans – as well as other serious effects. However, because of its volatility, its presence in the groundwater to this level at borehole WP01 to 19ug/L in 2008, is unusual. The reason for the presence of toluene in this borehole was not explained. Concentrations of 0.8 µg/litre and 1.9 µg/L have been reported in the Rhine in Germany and Switzerland, respectively (Merian & Zander, 1982) from (WHO, 2011).
- 372 It should be the responsibility of SPR to investigate which chemicals used on the site might have contaminated the GW at this site.
- 373 SEPA's response to the appearance of these synthetic organic chemicals in GW was to minimise the potential impact, rather than draw conclusions which might support the need for investigation on a precautionary basis. (SEPA reply re. Jacobs report 2009 and DEHP 2015)
- 374 Cresols have a specific gravity (SG) of 1.02 to 1.05 g/ml. This means that they're denser than water with a tendency to sink. They are classified by BGS, SEPA and others as Dense Non aqueous Phase Liquid (DNAPL). This characteristic is important with respect to behaviour in groundwater and underlying aquifers because any DNAPL contaminant will tend to sink to the bottom of the aquifer, (*Figure 29, page 82*) like Ribena in a glass of water, and depending on the degradation time, persist in the aquifer potentially for many years. In anoxic groundwater at depth below the water table, cresols in general have a very limited degradation and might be expected to be persistent in the environment: Figure 29 taken from p39 (*Groundwater_ and its susceptibility to degradation. , 2003*)

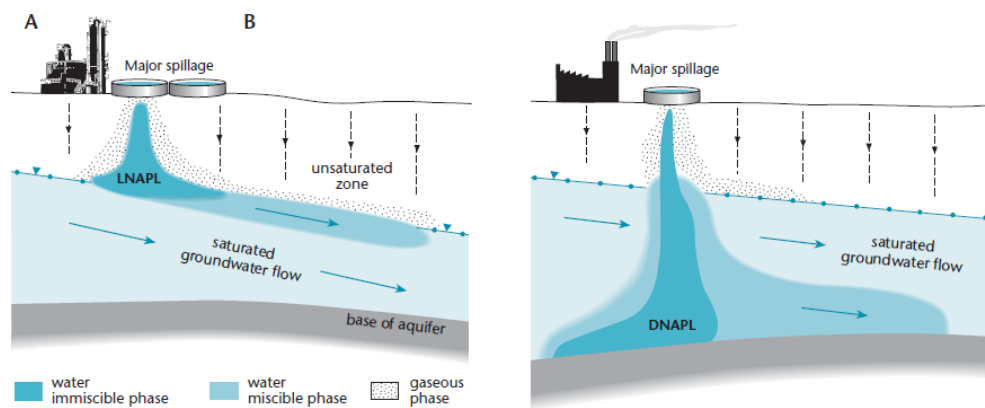


Figure 29 - Surface distribution of Hydrocarbons following major spillage

375

376 The amount and depth of unsaturated soil above the groundwater level is critical in providing a zone of natural breakdown of many naturally occurring, as well as synthetic chemicals, such as those found on the Whitelee site.

377 Whilst information from deep boreholes is lacking from across the site, we know from the shallow borehole logs in the Jacobs report (Jacobs Whitelee Post Construction Report Nov 09) that for most boreholes on the site, the groundwater was within 50 cm of the ground surface level. In areas of blanket peat, groundwater can be effectively at the surface for much of the year. This high water table means that any infiltrating contaminants can enter the groundwater rapidly, while there is virtually no natural capacity to break down those contaminants in the unsaturated zone before they are able to enter groundwater.

378 None of this particular sensitivity in this water catchment area was taken into consideration for any of the environmental statements for previous Whitelee developments, or for the current WL Ext 3.

379 Diffuse source chemical Contaminants.

380 The Jacobs post construction report shows alarming levels of DEHP in all boreholes across the site, up to 3200ug/L. This is 400 times the recommended drinking water quality limit (WHO, 2011).

381 DEHP is recognized particularly as an endocrine and reproductive toxin in humans (Assessing exposure to phthalates – The human biomonitoring approach. Review.), (SEPA reply re. Jacobs report 2009 and DEHP 2015), (WHO, 2011), (DEHP EU Risk assessment report Document).

382 Most of the toxicity data comes from animal studies, which is difficult to reproduce entirely in humans. Nevertheless, phthalates are recognized to cause irreversible

infertility effects particularly in males related to sperm production as well as effects on the foetus in particular with congenital malformation such as undescended testicles as well as other anogenital malformations. In females there are also effects on fertility. In animals there is now a recognized 'phthalate' syndrome to describe these effects. Other endocrine effects on insulin and thyroid hormone production have been recognized. WHO have categorized DEHP as a possible carcinogen based on animal studies.

- 383 The EU has banned the use of DEHP from childrens toys and other items and there are restrictions on other uses related to food products and medical devices.
- 384 DEHP has been unanimously categorised by EU member states as a substance of very high concern (SHVC) because of its endocrine disrupting properties in the environment. (European Chemicals Agency) ECHA/NA/14/56. From 21st February 2015, DEHP production within the EU is only on an authorized basis.(EU REACH committee- REACH is a European Union regulation concerning the Registration, Evaluation, Authorisation and restriction of Chemicals). (SEPA reply re. Jacobs report 2009 and DEHP 2015)
- 385 A summary for human toxicity within the EU risk assessment document states (Page VIII):

Humans Exposed via the environment.

Concerns are for children with regard to testicular effects, fertility and toxicity to kidneys on repeated exposure via food locally near sites processing polymers with DEHP. The scenarios that give concern are generic scenarios based on default emission data.

(DEHP EU Risk assessment report Document, 2008)

- 386 Of note from this risk assessment were human experiments regarding absorbed dose:
- 387 Oral absorbed bioavailability DEHP: Adults- 50%, Children – 100%.
- 388 This means that if DEHP is ingested, in adults 50% of the dose will be absorbed, in children 100% of the dose will be absorbed. Thus the effects on children of drinking water contaminated with DEHP will not only produce more biological effect, but all of the potential dose of DEHP will also be absorbed from the water.
- 389 Concerns regarding DEHP and its effects on human health have been sent by the Royal College of Physicians (UK) to ECHA. (European Chemicals Agency)

- 390 DEHP is recognised as a ubiquitous chemical in the environment. It is and was widely used as a plasticiser in plastics, cabling, pipes, also in hydraulic oils and electrical capacitors and transformers. Some of these uses may be pertinent to activities and products on the Whitelee site.
- 391 There is a requirement under current EU law that the consumer (in this case SPR) can request from the manufacturer of all products, the presence and concentration of DEHP in products or components. Therefore, this information should be available to SPR, to determine a potential contamination source at Whitelee.
- 392 Because of the previously widespread use of DEHP and concern for human and environmental toxicity, there has been widespread analysis of ground and surface water sampling elsewhere. Extracts below from the extensive literature review (DEHP EU Risk assessment report Document) show that no samples were found, even from effluent related to plants producing DEHP or to borehole sites related to landfill with DEHP levels that were close to those levels found at Whitelee.
- 393 Extracts from (DEHP EU Risk assessment report Document, 2008):
- 394 Surface water:
- P118-119 Multiple and repeat sampling of heavily industrialised N. Rhine rivers 1993 and 1998 – 2000 showed DEHP levels 0-3.1ug/l with mean 0.63ug/l. The Rhine and Meuse rivers in the Netherlands, downriver from two production plants sampled over 3 years had 0.1 to 0.4ug/l collectively.
 - P 121 DEHP measured in surface water affected by diffuse pollution from industry and urban areas range from 0-21ug/l.
- 395 Groundwater:
- p 120. A monitoring study performed in the UK on DEHP in private and public water supply boreholes (Kenrick et al 1985) found **DEHP in 7/11 samples . Average concentration 0.07ug/l**
 - p 120 Land treated with treated sewage sludge had GW samples containing 0-510ug/l.
p270. Contaminated groundwater in the Netherlands reported levels 20-45ug/l (WHO 1992)
- 396 DEHP normally has a short half-life in water (14-50 days) largely through biodegradation in oxygenated surface water. In the generally thin unsaturated soil zone at Whitelee, its rate of degradation within anaerobic groundwater below the water table is likely to be much slower.

- 397 DEHP has a SG at approx. 0.986 g/ml, almost equivalent to water. It is poorly soluble in water; it will easily form a colloid and tends to become absorbed onto clay or organic particles.
- 398 Other diffuse Contamination:
- 399 Across all the WL WF monitoring boreholes there was a trend to increasing mineral content in the water.
- 400 During the construction period, there was a marked rise in aluminium. Although aluminium increased at all boreholes, at one borehole it increased to 27000ug/l (Drinking water quality standard (DWQS Scotland 200ug/l). This is over a hundred times the acceptable limits for drinking water.
- 401 This lasted over a year, occurring at borehole WS59A. This borehole is in the water catchment of Carrot Farm and many other PWS.
- 402 These levels of aluminium in groundwater are similar to what might be found in the 'toxic' waters related to old mine workings, except that there are no recorded mine workings in these areas!
- 403 WHO (1997 and 2003) considers that the relationship of Alzheimers disease and excessive aluminium exposure, particularly from drinking water, cannot be disregarded.
- 404 Iron also increased significantly at all boreholes, particularly at WS119, WS59A and of note, WP01. This last borehole is nearest the two public water reservoirs. Generally, there was an increasing trend for iron to increase over the time of monitoring including increase into the post construction period.
- 405 The highest recorded level, at 50mg/L , was 250 times allowable drinking water standards. It should be remembered that most PWS, unlike public water supplies, do not have sophisticated treatment systems. They may have no treatment system at all, or as simple treatment, a filter and UV system designed to remove bacteria and solid sediment, but not excessive minerals.
- 406 Increase in mineral content of groundwater usually occurs with increased acidification and drop in pH of GW. This was also confirmed as occurring at all boreholes and continuing to drop below 6 across the site even into the post construction period. (Jacobs Whitelee Post Construction Report Nov 09, 2009)
- 407 This happens when organic matter (peat) gets into the groundwater and the degradation and oxidation process of organic material makes the groundwater

anaerobic and acidic, releasing metals from their naturally occurring salts in a redox reaction.

408 The presence of increased organic material was also confirmed within groundwater with an increase in total organic carbon (TOC), also extending into the post construction period.

409 **Of note is that there is no base line data for pH or carbon in GW, with monitoring for these substances only starting late in 2007, a year after construction had started.**

410 Also of note is that the borehole with the highest recorded TOC, WS59A, also had the highest recorded aluminium level within the same 3 months, correlating the effect of surface to groundwater contamination. Of interest, this borehole did not have high peaks of TPH at this time, which might have been expected had TPH contamination been related purely to organic matter degradation products.

411 Thus the appearance and increase of aluminium, iron and manganese, eluted from minerals present in the rock structure into groundwater would be consistent with the effect of contamination of groundwater by surface water.

412 Continued organic contamination of GW directly by peat will potentially allow continued impact on GW and this has potential implications for all the PWS reliant on this site, as well as surface water flows relying on groundwater recharge.

413 From PMO reports for May/June (Ironsides Farrar Ltd, 2007), 556, (Ironsides Farrar Ltd, August 2007), 2091, (Ironsides Farrar Ltd, 2007), 607, it is reported that deep peat, slurry and silt was stored in the onsite quarries and that not only were leaks seen from the quarries, but that these quarries allow ready access of surface water to groundwater; including any chemical contaminants.

414 Without further GW monitoring results made available from the WL Extension construction period, it is not possible to determine whether these effects are likely to be significant.
However, these effects should be assessed before consent is granted for WL3 which may potentially cause further GW impacts.

415 Total Petroleum Hydrocarbons (TPH): Increase in TPH was seen in GW across all the monitoring boreholes, as well as in surface water monitoring.

416 TPH can be an indication of contamination with fuel and oil derivatives, but these chemicals can also occur as a result of peat and organic matter degradation.

- 417 The elevated levels found in GW samples, which also increased into the post construction phase would therefore either suggest confirmation of a general contamination of GW by peat laden surface water, or more of more concern, contamination from industrial construction activity. The origins of different hydrocarbons can to some extent be determined by 'fractionation' in the laboratory, which generally occurs with gas chromatography in accredited laboratories. This did occur in sampling analysis for surface waters, but was not done on GW samples. Surface water samples later in the construction process showed an increase in long chain hydrocarbons. These are more likely to be associated with heavier oils found in fuel oil contaminants.
- 418 The PMO Reports documented numerous and widespread oil and fuel spills across the WLWF site, although these were largely dealt with appropriately. However, as a major construction project, with many thousands of HGV movements over a year, it would seem inappropriate to dump road silt and slurry into an onsite quarry.
- 419 The PMO felt that increases in GW TPH concentrations were probably due to peat degradation products.
- 420 Borehole WS59A had very high levels of TPH at the outset of monitoring in July 2007, which subsequently dropped within 2 months more than a hundred fold. SEPA have also attributed this high level to 'natural' organic products, even though TPH levels at all other boreholes were low. There was unfortunately no monitoring of pH or TOC in GW at that time at any borehole which might have supported the case for natural peat degradation products. This borehole was at the edge of a large site of forest felling.
- 421 I find it disappointing that again this was not investigated to determine causation or source.
- 422 Regardless of the cause, it supports the view that the 'best practice' mitigation employed on this site was not effective in preventing such contamination.

423 **Conclusions**

- *There was documented contamination of GW by synthetic chemicals on the WLWF site.*
- *Some of these chemicals have the potential for serious health consequences*
- *Investigations of causation were not performed at the time of detection*
- *There was a ready assumption to attribute the detection of unexpected chemicals to laboratory or sampling error, rather than investigate the abnormal result.*

- *If the responsible authorities take no action, those chemicals could show up in PWS*
- *Too little is known about the geohydrology on this site to make any predictive assumptions of the likely dissemination of GW toxins.*
- *Mitigation measures employed failed to prevent the GW contamination.*
- *Adverse changes have occurred in GW, contrary to the EU Water quality framework directive.*
- *Lack of recommended follow up GW monitoring data for WL WF Extension precludes any assessment of continuing or residual GW impact on this site and on the WL3 site.*
- *Without understanding causation, it is not possible to devise effective prevention or mitigation to prevent further GW contamination at WL3, if consented.*

5 WINDFARM IMPACT ON PRIVATE WATER SUPPLIES

- 425 Much of the fine detail in relation to this section is contained in the Legal Submission submitted to this Inquiry. We attempt NOT to repeat that here.
- 426 During 2014, following press coverage of the bacterial contamination of the Airtnoch PWS I became aware of other PWS surrounding the Whitelee WF site that had been adversely affected at varying times over the construction period; some with complete loss of their water supplies.
- 427 With review of the PMO reports, which became available in 2015, it became clear that there had been significant impact on numerous PWS involving all quadrants of the perimeter of WLWF.
- 428 The widespread environmental problems and impacts on surface water, groundwater and private water supplies are detailed in the two monthly reports and were notified not only to all three involved competent authorities: EAC, ERC and SL, but also to Scottish Ministers. (PMO Report 1 September-October, 2006)
- 429 The affected PWS supplies for WLWF original and summary problems are listed briefly below:
- 430 **Cauldstanes** Complete loss of spring water with new bore hole supply (at owner's expense) required in 2007. Supply not monitored by SPR 2006-2013.
- 431 **Kingswell** Temporary loss of spring water over twelve weeks, 2007, with subsequent gross mineral contamination when supply resumed. Supply not monitored by SPR 2006-2013.
- 432 **Veyatie** (known also as Best Friends Kennels) – Complete loss of spring water with new bore hole supply(at owner's expense)required in 2007. Supply not monitored by SPR 2006-2013.
- 433 **Drumtee** PWS monitoring results are still not available (despite repeated requests). SW, conducting laboratory analysis for SPR refuse to divulge results under EIR/FOI regulations. Drumtee water was noted by PMO to have marked mineral and bacterial contamination, as well as oil spill. (May/June 2007 PMO report)
- 434 **Lochgoin** severe bacterial contamination. Installation of a borehole supply. (also supplying SPR construction compound).
- 435 **Airtnoch** Gross bacterial contamination with sediment spikes. Incomplete monitoring results available.
- 436 **Beechknowe** as for Airtnoch supply

- 437 **Hareshawmuir** as for Airtnoch supply
- 438 **Hareshawmuir Cottage** as for Airtnoch supply
- 439 **Hareshawmuir Bungalow** as for Airtnoch suppl
- 440 **Hareshawmuir lodge** as for Airtnoch supply
- 441 **East Collarie** as for Airtnoch supply
- 442 **West Collarie** as for Airtnoch supply
- 443 **Meadowhead** as for Airtnoch supply
- 444 **Low Overmuir** New borehole installed, August 2006. Gross sediment contamination 2010 – 2012, requiring frequent filter changes.
- 445 **Greenfield Cottage** Very high mineral and sedimentation contamination of source (1700% rise in iron between 2007 and 2008). Additional treatment filters installed 2008.(owner's expense).
- 446 **Dunwan Cottage** Previously normal spring supply (shared with Greenfield Cottage) Sediment blocked supply pipe early in 2008, requiring urgent borehole. (Owner's expense) ERC and SEPA informed.
- 447 **Ardochrig Mor (supply also to Ardochrig Farm)** Complaints of sediment blocking treatment filters. Numerous comments made in PMO reports regarding this PWS and sedimentation problems in adjacent Ardochrig burn . Investigated by SPR.(Jacobs report on Borehole Ardochrig Mor 18.2.08). Conclusion that windfarm construction may be contributory. This report not made available to owner until 2014.Increased frequency of monitoring did not occur.
- 448 **Carrot Farm (Five properties, Carrot Cottage, Carrot Farm, Carrot House, Ceder Lodge and Myers Lodge on this supply)** Several reports by PMO of gross bacterial contamination (e.g.PMO report July/Aug 2007) and extending into 2008.The tributary to this supply had mineral contamination and nearest borehole GW with Aluminium levels 30 times allowable DWS.
- 449 **Lochgoin Farm** Several reports by PMO of the greatest bacterial contamination (e.g.PMO report July/Aug 2007) and extending into 2008, with high sediment contamination.
- 450 **Craigendunton** High risk surface water supply. No Monitoring occurred at all.
- 451 **Craigendunton , Low Overmuir and Craighends** water supplies designated 'at risk' with requirement for monitoring during WL Extensions 2010-2013 – results are not

available and have not been notified to EAC. The gross bacterial and sediment contamination of the Airtnoch supply is detailed in Part One.

452 Response to this evidence

453 What seems extraordinary is that from the outset and the initial application for a windfarm on the WLWF site and the original PWS risk assessment provided by RPS Ltd in 2003, there were concerns from Environmental Consultants about the potential impact of windfarm development on PWS.

454 Contingency arrangements and emergency contact details/telephone numbers were to be set up to provide households with water should either the quality or quantity of water be affected. Pollution prevention plans 5.2 RPS_(Issue 02 Condition 6.8 and 6.9 (Phase 1 and 2) Monitoring Plan, 2010), (Whitelee PWS Risk Assessment Report). Yet no 'red flags' were identified as to when residents should be warned water was unsafe to drink, and no nominated person or authority designated to do this.

455 RPS 2003: PWS Risk Assessment for SPR / CRE

NEED FOR A CONTINGENCY PLAN

In the event of an incident, which has the potential to impact the quality or quantity of potable water supplied to a resident, an alternative water supply will be supplied to affected households.

(RPS, 2003)

456 Despite this and planning condition 6.8 and 6.9 for WL1 and WL2, despite gross bacterial contamination of several PWS and failure of supply altogether for three households, at no time were residents notified of any problems related to their supplies.

457 Planning conditions to protect quality and quantity of PWS were not upheld in any of the preceding WLWF developments.

458 For the WL Extensions, within planning conditions for PWS protection (Issue 02 Condition 6.8 and 6.9 (Phase 1 and 2) Monitoring Plan, 2010) for the four water supplies identified as being 'at risk', namely: Airtnoch (supplying 10 households), Craigendunton, Low Overmuir and Craigends. There was a stated requirement to directly notify householders if there was any change in quality or quantity of their water supplies and to provide emergency contact numbers to households:

'Prior to construction commencing every household identified above shall be supplied with an emergency contact sheet, outlining the following details:

Contact name and number at ScottishPower Renewables; and

Contact name and number for the local Environmental Health Officer

In the event of an incident, which has the potential to impact the quality or quantity of potable water supplied to a resident, the following steps shall be taken:

The property owner will be contacted and informed of the incident at the earliest opportunity;

If required, bowsers containing water and/or bottled water will be supplied to affected householders, and

The relevant Environmental Health Officer shall be contacted advising them of the incident and consulting on proposed measures to deal with the incident.

(Issue 02 Condition 6.8 and 6.9 (Phase 1 and 2) Monitoring Plan, 2010)

459 This did not happen.

460 I am unaware of any household on the Airtnoch/Hareshawmuir water supply who were either informed of adverse water quality monitoring, or who were supplied with emergency contact details for Whitelee extensions.

461 **Therefore, for WL3, there can be no confidence that provision of such arrangements will provide any degree of protection or reassurance for those PWS likely to be impacted by this development.**

462 There has been an implicit assumption by all concerned, that is SPR, its consultants, SEPA and the competent local authorities, that polluted water private water supplies are normal, that residents were aware that their water was polluted and that this was somehow acceptable to those who were reliant on those supplies.

463 Without any investigation of water sources or substantive evidence to support their presumption, local farmers and high rainfall were blamed by SPR, SEPA, and EAC for producing the gross unprecedented levels of bacterial contamination involving PWS, even when water sources are not on land supporting agricultural activity.

- 464 Bacterial and E.Coli contamination is related to faecal contamination from any mammal, including human beings.
- 465 These authorities have clearly failed to remember Public Health ‘events’ such as the spectacular outbreak of Hepatitis A amongst senior doctors that occurred in relation to faecal contamination of Carse of Gowrie raspberries, traced back to casual raspberry pickers relieving themselves on site¹⁰.
- 466 Since then, similar episodes of ‘distant’ faecal contamination causing disease outbreaks have reoccurred worldwide. The failure to provide convenient and adequate sanitation on site will impact on those who drink untreated water. As described in the groundwater section of this submission, because this site has a minimal or no unsaturated soil structure zone, with a very high groundwater level, the potential for natural biodegradation of bacteria and chemicals is markedly reduced. The same principles will apply to the WL3 area.
- 467 At the same time that high spikes of bacterial contamination were being reported in PWS (e.g. Airtnoch supply 21/08/07 E.Coli 2100/100ml), there were also high levels of coliforms and E.Coli reported in surface waters August – October on the site, both within surface water being monitored monthly by Scottish Water, and in multiple other locations across the site, (Ironsides Farrar Ltd, 2007)
- 468 Comment was also made by the PMO in that report that,
- several more burns had slightly more suspended solid content than baseline in the four months to August and that on 13.09.07 suspended solids slightly exceeded the SWAD guideline at Howe Burn, Pogiven Burn, White Burn, Brown Castle Burn. This may support the observation at Ardochrig (TSS data not presented) where filters require more frequent changing than previously. Increases in turbidity were observed that generally corresponded to the above suspended solid data.*
- (Ironsides Farrar Ltd., 2007)*
- 469 There is also evidence of increased turbidity and suspended solids above baseline in the borehole supply at Low Overmuir (Sept – October 2006).

¹⁰ Glasgow Herald 26/6/81: <https://news.google.com/newspapers?nid=2507&dat=19810626&id=-bVAAAAAIBAJ&sjid=yKUMAAAAIBAJ&pg=3037,5149939&hl=en>

- 470 Looking in detail at three properties affected during the construction period of WLWF, in even closer proximity to WL3 construction activities, it is apparent that there are major failings throughout the whole scoping, consenting, monitoring and regulatory mechanism which have contributed to the disastrous deterioration in water supplies to these three properties.
- 471 Kingswell PWS is an historic water supply and was part of the very large Rowallan Castle Estate supply which had its collection tank for very many estate farms located at the junction of the B764 and A77 roads, adjacent to the NW perimeter of the WLWF site and WL3 site.
- 472 The water for Rowallan Castle estate arises from the Whitelee plateau and Lord Rowallan remains one of the Trustees for the Covenanters Trust, which owns land leased to SPR around Lochgoin farm. That large PWS has now been largely replaced by a public water supply to most of the estate farms.
- 473 The collection tank for Kingswell lies on the North side of the B764 road, at some distance from Kingswell house, within privately owned forest planted in the last 20 years.
- 474 Residents at Cauldstanes and Veyatie are of the opinion that water from the KW holding tank also supplied their properties. This is not recorded on title deeds and has not been mapped, but is thought to be likely from personal investigation by the owner of Cauldstanes. It remains the case that the site and type of water source supplying the holding tank is unknown and is not recorded on title deeds. The Environmental Health Officer at EAC is of the opinion from their records that the Kingswell supply originates near Moor Farm.
- 475 **This would place the KW water supply within the WL3 windfarm site. As part of the current WL3 application, Moor Farm will be demolished.**
- 476 For WLWF, the National Grid References (NGR) show the relationship and short distances from Kingswell and adjacent properties to the windfarm boundary:
- | | | | |
|-----|-------------|-----|-------|
| 477 | Cauldstanes | 478 | 375 m |
| 479 | Kingswell | 480 | 933m |
| 481 | Veyatie | 482 | 745m |
- 483 Within the ES for WL WF original it is stated:
- a. *20.5 Pollution Risk assessment*
- 'It is proposed that as part of the ongoing windfarm design process pollution risk assessment studies are carried out for private groundwater supplies in*

close proximity (within 1km) to the windfarm and both private surface water supplies. The hydrological/hydrogeological nature of each water supply that may be affected by the windfarm should be investigated in detail...'

(WL Original ES)

- 484 **These four properties, Kingswell, Veyatie, Cauldstanes and Drumtee, are even closer to this proposed WL Ext 3 WF than to the original WL WF and yet it remains the case that no relevant impact assessment has yet been performed.**
- 485 Despite the proximity of the three supplies (Kingswell, Veyatie and Cauldstanes) to the windfarm, **at no time** has a detailed hydrological or hydrogeological study been performed, or is possible. (B.O'Dochartaigh, 2015)
- 486 No hydrogeological risk assessment was performed for Drumtee Farm, adjacent to Cauldstanes, but 250m from forestry clearance for WLWF.
- 487 Drumtee (D) was designated as high risk in two PWS risk assessments and therefore monitored, although these results from 2006-2009, have still not been sent to the Local Authority and we have been unable to obtain these from Scottish Water, conducting the analysis for SPR, under FOI Legislation. (Whitelee PWS Risk Assessment Report , 2003), (SPR. Environmental Risk Assessment, Private Water Supplies Whitelee Windfarm., 2006), (SW, FOI response 5139426 from SW re. notification by SPR of contamination spills at WL WF, 2015)
- 488 Cauldstanes , adjacent to Drumtee, was assessed as high risk in 2003 (within 1km and downhill of both the site boundary and major forestry clearance) and then reassigned a low risk status by Environ on the basis of a site visit and unsupported 'evidence' of a shared water source with Kingswell, on the North of the B764. As a high risk property, base line water testing at Cauldstanes in 2003 demonstrated normal mineral parameters,(Fe 42ug/l, Mn23ug/l, Al <20ug/l) but a bacteriological failure.(6 coliforms/100ml)
- 489 Kingswell was initially assigned a desk based, risk status of *medium*, downrated to *low risk*, after a site visit by RPS (2003) on the basis of an assumed water source on the North of the B764. Environ also assigned a low risk status to Kingswell on the basis of a site visit in which they neither identified nor photographed either the collecting tank or the water source.
- 490 Veyatie was not considered at all by RPS, despite being less than 1km from the WL site boundary. Environ assigned Veyatie a *low* risk status in 2006, on the basis of a shared supply (unidentified water source) with Kingswell.

- 491 As a consequence of the low risk status, none of these properties were monitored and all three suffered a complete and disastrous loss of water supply in 2007.
- 492 Both Cauldstanes and Veyatie installed boreholes to reinstate their water supply; Kingswell, having lost water, regained the spring supply after some 12 weeks.
- 493 Kingswell has water chemistry results spanning 20 years. It is apparent that although there was intermittent low level bacterial contamination prior to a domestic filtration and UV light system installed from 1987, mineral assessment historically remained within required drinking water standards of upper limit 200ug/l iron and 50ug/l manganese.
- 494 No water monitoring by either SPR, or EAC occurred at all during the construction of either WLWF or the WL Extensions (2006 -2013).
- 495 Local authority testing, to determine the cause of persistently discoloured water in 2013, revealed iron levels eight times and manganese more than three times UK and Scottish drinking water standards.

497 Table 1 - Kingswell Water Test Results

498	Date	499	Chemistry	500	Bacteriology
501	06.02.1984	502	pass,	503	fail
504	14.07.1987	505	pass,	506	fail
507	Ultraviolet and filtration system installed	508		509	
510	22.09.1992	511	pass,	512	pass
513	09.04.1997	514	pass,	515	pass
516	01.03.2000	517	pass,	518	pass
519	11.03.2004	520	pass	521	pass
522	03.12.2013	523	iron 1630 µg/L (normal 200µg/L , manganese 160 µg/L (normal 50µg/L),	524	pass
525	13.11.2014	526	iron 880 µg/L Manganese 215 µg/L	527	0

528 To correlate this with the changes that were happening in groundwater and surface water at the time, the closest GW monitoring bore hole site to KW was WS08 and the surface water monitoring site applicable to Kingswell, Cauldstanes, Drumtee and Veyatie is Catchment A (Environs, 2006) with surface water monitoring site 13, on Drumtee water.

529 Iron within GW at WS08 increased to a peak in 2007 of 8.4mg/l (8400ug/l) and in 2008, 9.8mg (9800ug/l). Aluminium also increased in GW at this borehole to 4.8 mg/l(4800ug/l)in 2007 and 4.9mg/l (4900ug/l) in 2008, twenty four times higher than DWS of 200ug/l. It should be remembered that although the assumed spring source for these properties has never been identified or charted by SPR for previous WF developments, our geohydrology experts have concluded that most spring sources arising from the Whitelee site are likely to be reliant on superficial groundwater, most susceptible to surface water pollution (Figure 26, page 64).

530 **The surface and GW monitoring results for this area during the WL WF developments would therefore seem to indicate a likely cause for loss of water supplies to these three properties as being due to excessive sediment and mineral contamination of an unmonitored water supply where the source had never been identified or protected.**

531 The marked elevations of iron and aluminium in GW, well above acceptable DWS, were raised as concerns in the (Ironside Farrar Ltd, August 2007), but no satisfactory explanation was offered to the PMO for this contamination.

- 532 There was an apparent reduction in mineral content in later GW sampling results during the WLWF construction period but later mineral sampling from GW was performed with ultrafiltration and the PMO was concerned that this may have spuriously lowered the mineral levels i.e. that GW mineral levels may have in reality continued to be significantly elevated.
- 533 For WLWF original (construction 2006-2009), the water catchment with the highest concentration of dissolved and particulate organic carbon was at catchment 13, Drumtee water, in 2007-8. The overall phosphate concentrations increased in the Drumtee waters, sited within a Statutory Drinking Water Protected Area, by tenfold from 2007 (H.Murray, 2012). This corresponded with extensive clear felling of adjacent forestry, as well as construction of turbine foundations. This is contrary to the terms of the Water Framework Directive.
- 534 The PMO makes comment in June 2007 of the increased surface water iron in Howe burn (a tributary of Drumtee water) and of significantly increased solids within Collorybog burn (another Drumtee water tributary)
- 535 It is clear that there was significant groundwater and surface water change in catchment A in 2007/8 with potential to impact on sensitive receptors, including PWS. Therefore it would seem more than mere coincidence that the adverse surface and groundwater changes in this area were associated with the sudden loss of spring (ground) water to Kingswell, Veyatie and Cauldstanes which also occurred in 2007.
- 536 Increased sediment load has a propensity to block pipes and at the same time in 2007, there were documented changes of sediment affecting a borehole PWS on the North East of the WL WF site. At Ardochrig Mor as well as at Greenfield Cottage and Dunwan Cottage to the North. At the same time, although data collection was poor, in August 2007 and 2008, to the South West, Airtnoch water supply was also experiencing its highest spikes in turbidity over the period 2006-2009.
- 537 Ardochrig Mor and Ardochrig Farm had been designated as a high risk PWS (SPR. Environmental Risk Assessment, Private Water Supplies Whitelee Windfarm., 2006). Special comment was attached in the risk assessment that there was a risk of impacting on that supply and that alternative contingency water supplies should be made available.
- 538 Despite this, in the (Ironsides Farrar Ltd, August 2007), complaints had been received that the supply was silting up and that filters were having to be replaced three times more frequently than normal. Complaints continued to occur and Jacobs Ltd were commissioned to investigate.

- *'In addition, because of the shallowness of bedrock, it is possible that surface and near surface activities in the vicinity of this supply, in particular in the area immediately to the north and northwest also contribute to the siltation process of this private water supply. The activities potentially impacting on the siltation of this private water supply include:*
- *Road traffic along Ardochrig road and any associated road run-off infiltrating in the vicinity of the PWS;*
- *The construction (from August 2006 to June 2007) and the operation of the nearby substation, associated settlement lagoons and discharges;*
- *The traffic and associated run-off from the northern Whitelee Windfarm access road and side road drainage features*
- *The quarrying and blasting activities taking place to the west of Ardochrig Hill are located in a different hydrological catchment, and on the opposite side of the hill. In addition, the associated settlement lagoons discharge into the wetlands located further west. For these reasons, quarrying and blasting activities are highly unlikely to have any impact on groundwater at Ardochrig Mor.'*

_(Jacobs report on Borehole Ardochrig Mor 18.2.08)

- 539 The extract from the report summary once again fails to make reference to any base line hydrogeological risk analysis. Ardochrig Mor is approximately 300m from the main Eastern access road for the WL site, as well as being in close proximity to main in site access roads and tracks. It is approximately 300m from a main construction and storage compound. The adjacent quarry depth (situated on the water catchment G boundary to Ardochrig Mor) (SPR. Environmental Risk Assessment, Private Water Supplies Whitelee Windfarm.) has not been stated and we know from PMO reports that road silt and slurry were dumped in some quarries. Quarries were also seen by the PMO to be leaking, despite apparent bunding.
- 540 If the underlying basalt had the same geological considerations and fractures as described in section 4, it would seem difficult to confidently exclude adjacent sediment impact into groundwater at the 30m depth for this borehole (Note that sediment also impacted on the borehole supply of Low Overmuir during Whitelee Extensions construction).

- 541 Greenfield Cottage is on the North of the WL WF site, adjacent and South of the B764. It shares a common well/ spring source and holding tank with Dunwan Cottage.
- 542 The Greenfield and Dunwan Cottage source was listed as being low risk in the Environ PWS risk assessment 2006. This conclusion was despite the earlier 2003 RPS risk assessment (Whitelee PWS Risk Assessment Report) categorising this property as high risk, as it is less than 1km and downhill from the nearest turbine.
- 543 The owner of Dunwan cottage has been reliant on this previously good spring supply since 2002, without problems.
- 544 The current owner of Greenfield cottage moved into the property in Nov 2006. Because of the downgrading of risk in 2006 by Environ compared to the RPS survey in 2003, no monitoring of this PWS occurred. Water results at the shared well source on: 6/12/2007 - iron 30ug/l.
- 545 In early 2008, significant discolouration and sediment in Greenfield cottage household water was noted.
- 546 On 22/4/2008 a new filtration system was added to the existing UV lamp, including two filters and a pH balancer at considerable expense.
- 547 Household water problems continued and repeat source testing 17/10/2009 demonstrated iron at 510ug/l – a 1700% increase on 'baseline' values. A water engineer was unable to explain the increase in iron level.
- 548 The well was completely pumped out twice (1/6/09 and 12/10/11) but the problems persisted.
- 549 Further testing on 18/9/12, due to continued problems, demonstrated source water iron of 530ug/l
- 550 Today, water at source still has extremely high levels of iron, high sediment and discolouration , although revised treatment systems have ameliorated the domestic water supply to Greenfield cottage. However, filters rapidly become clogged with iron and other residue and require regular, frequent maintenance, more than was necessary in 2006. A recent 2015 extensive kitchen tap water test (post treatment) by ERC, was within DW quality guidelines.
- 551 At the same time that Greenfield Cottage was experiencing severe problems with sedimentation and high iron levels in early 2008, Dunwan Cottage lost its water supply altogether.

- 552 SEPA and ERC were informed, but could not explain the sudden deterioration in water quality and high sedimentation. The owners were unable to clear the 2.3 km pipe from the holding tank to the house and were obliged to install a borehole supply and local treatment, at their own cost, to reinstate domestic water supplies.
- 553 Drumtee Farm, close to Cauldstanes, was designated as high risk by both Environs (2006) and RPS (2003). Drumtee obtains water from a spring adjacent to Howe burn; a tributary of Drumtee water.
- 554 SPR assured Graeme Pearson MSP (SPR letter to G Pearson 2014-11-12 (1)) (*Figure 30, page 101*) that all PWS monitoring results had been sent to EAC in 2013, after the discovery that the Airtnoch/Hareshawmuir PWS monitoring results had not been sent to EAC for seven years. Despite those assurances, as of April 1st 2015, EAC still had no knowledge of the water monitoring results 2006-2009, for the 'high risk' Drumtee property, or the 'medium risk' Lochgoin property, both intermittently monitored (according to the PMO reports) throughout the WLWF construction period. EAC has repeatedly requested this information from SPR, the last request being made in early April 2015. This is clearly contrary to the information supplied by a senior executive of SPR to a serving MSP.
- 555 Extract from Keith Anderson Chief Corporate Officer SPR, to Graeme Pearson MSP 06/11/2014: (see Figure 30).

Scottish Power Renewables fully acknowledges our responsibilities in accordance with the Planning Consents for both Whitelee and Whitelee Extension Windfarms. We acknowledge our responsibility that the PWS shall not be affected as a result of the activities associated with the Windfarm. The particular Planning Condition, which protects the Airtnoch PWS, is Condition No. 6.44 for Whitelee Extension Phase 2 Planning Consent dated 12 December 2009. Water sampling during the phased construction of Whitelee and the Extension has been conducted in accordance with the requirements of Planning Consent Conditions, which require that the test results from the water samples, taken on a quarterly basis, are issued to the Planning Monitoring Officer for review and action, we assume, where appropriate. Now it is acknowledged that some procedural failings were experienced during the Whitelee Extension construction activities (2010 to 2012) as a consequence of the lack of definition around the role of Planning Monitoring Officer within the Councils. While that is a failing of the system we can confirm that all water test results have since been issued to the relevant Councils. In this particular case East Ayrshire Council.

556

Figure 30 - Extract for SPR Letter to G.Pearson

5.1 Historical Summary of PWS impacts on the Whitelee WF site

- 557 Although the serious impacts on multiple PWS presented here relate to the previous WLWF developments 2006 – 2012, the consequences of those effects continue into the present **and into the future development of WL 3**. Those effects carried forward in consideration of this WL 3 will be summarised below.

- 558 There appear to be common problems related to the numerous PWS that have experienced problems of quality or quantity (or both) around the original WLWF and the WL Extensions sites and these deficiencies have the potential to impact on PWS again if the current WL 3 proposal is consented.
- 559 In previous PWS risk assessments on the WL site, assumptions were made that a water collection tank/holding tank was equivalent to a water source. This is a dangerous and simplistic assumption that allows no protection for a water source that might be located within a construction zone, whilst the holding tank is located some distance away.
- 560 SEPA now require prospective developers to chart water sources, not holding tanks. (SEPA, SEPA-guidance-on-assessing-the-impacts-of-development-proposals-on-groundwater-abstractions-and-groundwater-dependent-terrestrial-ecosystems, 2014)
- 561 Repeatedly, PWS risk status was assigned, and then reassigned, on the basis of a 'site' visit, which may, or may not, have actually visited, photographed or charted the water source, or even the collection tank. Subsequently a lower risk category was usually assigned, which resulted in no responsibility being assumed by SPR to monitor that PWS. Environ Ltd (SPR. Environmental Risk Assessment, Private Water Supplies Whitelee Windfarm., 2006) downgraded 18 PWS from 'high' to 'low' risk.
- 562 The 'low risk' category was reassigned to at least six, subsequently unmonitored properties, which was inappropriate, with four of those six properties losing their water supplies altogether and three urgently requiring to install boreholes to reinstate domestic supplies at their own expense. In addition, one medium risk category PWS with marked bacterial contamination was also required to install a new borehole (Lochgoin Farm).
- 563 At least two of those six low risk category supplies, previously with normal spring water mineral levels, developed severe, prolonged mineral contamination well in excess of drinking water quality guidelines.
- 564 At least twenty six households were severely impacted with deterioration of either quantity or quality of domestic and drinking water supplies during the period of WL WF construction and operation. (73 PWS in total identified by Environ as reliant on the Whitelee site for water)
- 565 Of those households, only two, the high risk properties at PWS Ardochrig Mor, were aware that the windfarm may be a contributory factor in the deterioration of the water supply and contacted SPR at the time.

- 566 Contrary to Planning conditions and pollution prevention plans 5.2 RPS (RPS, 2003), (Issue 02 Condition 6.8 and 6.9 (Phase 1 and 2) Monitoring Plan, 2010), as far as I am aware, none of the other households had contact details or emergency numbers, as was required, supplied by SPR in case of water failure.
- 567 Residents were not told either directly by SPR, their agents, the Planning Monitoring Officer or Local Authorities, that water was unsafe to drink either because of bacterial or mineral contamination. This is contrary to recommendations in the RPS risk assessment and contrary to Drinking Water Quality Regulator (Scotland) guideline. This failure to inform consumers of dangerous drinking water extended up to seven years for multiple properties.
- 568 There was an implicit and wholly negligent assumption by SPR, their agents and all regulatory authorities, that intermittent low level base line bacterial contamination, in some drinking water supplies, was already known to residents and that in some way this knowledge sanctioned gross bacterial contamination associated with windfarm construction on a scale which could be predicted to cause severe illness. When a water supply was investigated, the results of that investigation were not made known to the householder until years later.
- 569 Local authorities were not informed immediately of water quality failures which did not meet recognized Scottish drinking water quality standards. Local authorities still do not have the PWS monitoring test results. This failure to inform relevant competent authorities did not allow Planning or Environmental Health Departments to instigate appropriate mitigation or to notify residents of simple public health measures. (e.g. boiling contaminated water)
- 570 Of the 26 affected PWS, all of these properties were outwith the 250m exclusion buffer zone now recommended by SEPA in 'Land Use Planning System SEPA Guidance Note 31. 2014' for sensitive water receptors in relation to an excavation more than 1m deep. Whilst some of the properties and holding tanks were erroneously taken as a proxy for the water source, which have the potential to be within a 'buffer zone', some of these 26 affected supplies included identified water sources, including a borehole, outwith the SEPA designated buffer exclusion zone.
- 571 This simplified SEPA risk assessment model, which ignores any consideration of geohydrology or hydrology, has been demonstrated not to work on this large site and its predictive and protective value in respect of the needs of human drinking water should be urgently reassessed.
- 572 Numerous residents have had to suffer significant financial loss to remediate a previously satisfactory water supply, with no contribution or compensation from

- SPR. This loss is likely to continue for many years, to maintain more sophisticated domestic treatment systems that might otherwise not have been necessary.
- 573 Throughout this investigation there has been a complete failure of the Regulatory Authorities to work together, to share knowledge and resources and to take collective responsibility toward protecting the individuals who have had the effects of industrial development imposed on their water catchments and their water supplies.
- 574 A common theme for both SPR and regulatory authorities has been to apportion blame for water contamination on: the pre-existing PWS collection and distribution systems, farmers, agricultural animals, rainfall, pre-existing forestry, and laboratory error, usually without providing any substantive evidence to support that assertion.
- 575 There has been a historic failure by SPR to provide a duty of care, or even to comply with planning conditions to protect drinking water quality and quantity, resulting in actual detriment of public health. There has been a failure by SPR to behave responsibly to protect private drinking water supplies reliant on water sources from the Whitelee site by communicating monitoring results promptly to relevant authorities and residents directly. There has been frankly misleading reassurance made by SPR to a serving Member of Parliament in answer to questions made to that MSP by his constituents.
- 576 SPR has displayed a shocking level of patronization and disregard for its unfortunate windfarm neighbours throughout and no exhibited no willingness to investigate complaints.
- 577 The Influence of Previous Whitelee Windfarm development on PWS related to the current WL 3 application for consent.
- 578 SPR have stated that for the current WL3 application they intend to use the same 'best practice' mitigation that was informed by apparently successful and effective mitigation for WL original WL Extn 1 and 2.

Page 9. 69. Mitigation measures, based on best practice, have been proposed to control the effects on the receiving environment. The measures have been informed by experience gained on Whitelee Windfarm and Whitelee Extension with regard to potential site-specific issues and the most appropriate measures to avoid or reduce these. The activities on the Whitelee Windfarm construction site were managed in close liaison with Scottish Water and SEPA. These arrangements are being continued during

*construction of Whitelee Extension and would be applied **during the proposed Development**. (emphasis added)*

Non Technical Summary Whitelee Extension Phase 3 2012

P 10. 71. With the proposed mitigation measures in place, it is concluded that the proposed Development would not result in any residual effects on geology, soils or groundwater that are considered to be significant in the context of the EIA Regulations.

WL3 ES Appendix 9.2 Private Water Supplies

579 It is patently obvious from the documented surface, groundwater and PWS monitoring that occurred for WLWF and for the surface and PWS monitoring that occurred in relation to WL 1 and 2 construction, that this mitigation was ineffective and failed to protect either PWS that were being monitored, or those PWS that were not being monitored, but which suffered spectacular failures. This was to the detriment and financial hardship of those families dependent on those water supplies. Many of the properties previously affected by WLWF, will now be at risk again from the proposed WL 3.

580 To employ the same stated mitigation measures for WL Ext 3 would be to perpetuate an environmental disaster.

581 We have no confidence in the ability of SPR to produce an effective pollution prevention plan (PPP) for WL3 , given that the preceding WL PPP's

- failed to provide emergency contact details to affected households,
- failed to notify residents of gross bacterial contamination of PWS and
- failed to provide alternative water supplies to households where water supplies failed altogether.

582 WL Ext 3 ES: 9.1 6 states:

'Mitigation will be detailed within a site Pollution Prevention Plan to be implemented during the construction of the windfarm. This plan will be produced following consultation and agreement with SEPA and will

incorporate a Pollution Incident Plan, including emergency procedures’.

WL Ext 3 ES: 9.1 6

- 583 Water sources which were not mapped for previous EIA’s or risk assessments have still not been mapped for the current ES.
- 584 The current ES is therefore not fit for purpose, which is to provide consenting authorities (in this case the Scottish Government) with enough information to understand that the application has properly considered the impact and adverse aspects of the development on sensitive receptors and has demonstrated mitigation measures that will be effective in avoiding those adverse effects; in this instance, the effect on domestic and drinking water supplies reliant on the development site.
- 585 WL Ext 3 Hydrogeological Features: Mapping of PWS Fig 9.3 (reproduced here as Fig 17), fails to map Cauldstanes water source at all, far less recognize its borehole supply. Kingswell, known to have a *spring supply* is marked as a *borehole* (EK2 Fig 9.3)
- 586 Appendix 9.2, (WL3 ES) listing PWS on the WL site is so inaccurate as to be meaningless. For example, East Collary (East Collarie) Farm is listed three times with three, possibly four different water supplies.
- 587 For Cauldstanes, Kingswell and Veyatie there is only reference to an (unsubstantiated) supply to the North of the B764, with inaccurate NGR described in the 2006 PWS ERA. No OS map NGR is listed for the KW source.
- 588 This failure to identify and correctly characterise private water sources does not allow proper consideration or assessment of impact by planning authorities, and given the contamination and loss of PWS that occurred for the preceding WLWF and WL1 and 2, the ES is simply disingenuous to residential neighbours of existing and proposed Whitelee developments.

- 589 The water source for Kingswell has been described by EAC Environmental Health Officer as potentially arising from the vicinity of Moor Farm. Moor farm will be demolished as part of this application. Kingswell water source has not been charted and there is evidence that this supply was previously and still is , affected by previous WLWF construction and operation. There would be unacceptable risk to this water source from WL 3.
- 590 Cauldstanes and Veyatie are now reliant on borehole water supplies, as these properties lost their water supplies completely in 2007 during WL WF construction. Not only has borehole location not been mapped, but no consideration has been given to the lack of available detailed geohydrological information, or detailed geohydrological risk assessment(as was recommended from the initial risk assessment by RPS in 2003) ,such that BGS is unable to provide us with an independent informed risk assessment.
- 591 There is no consideration of the effects of groundwater flow of the adjacent igneous dyke,previously described by Atkins Ltd for SPR in 2010, in relation to water supply to Cauldstanes and Veyatie and the potential for this to concentrate contaminants to the limited aquifers on this site.
- 592 There is however, recognition in the WL3 ES that the construction activity has the potential to contaminate and change groundwater quality (in contravention of all the relevant legislation and guidance) and this has already been documented as occurring in relation to all GW monitoring boreholes for WLWF.
- 593 WL Ext 3 9.8.3.1 states:

Groundwater bodies

126. During construction there is the potential for a range of contaminants to enter groundwater through runoff or accidental spillage. Given the potentially locally limited thickness of glacial till and peat deposits above the Carboniferous strata aquifer, excavation during the turbine foundation construction could cause potential pollutants to migrate vertically and have an adverse affect on aquifers.

WL Ext 3 9.8.3.1

- 594 In short, there is inadequate local geological information to provide an adequate risk assessment for these boreholes. Test boreholes to evaluate local geology should be required as a minimum, as suggested by BGS.
- 595 The properties at North and South Drumboy, less than 1500km from the WL 3 site boundary have been marked as being outwith the hydrogeological catchment, but types of supply have not been indicated or even considered. Given the number of 'low risk' properties significantly affected around the margin of WL previously, these properties should be evaluated and the water source confirmed at the very least.
- 596 There is no evidence presented to suggest that any of the reassurances or measures that SPR provide in respect of protecting the hydrological environment of this site will be any more effective than those that were made in respect of the preceding WL WF developments which have occurred over the past nine years.
- 597 **We respectfully submit that for these reasons, this application should be recommended to Scottish Ministers for refusal.**

19 May 2015

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GLOSSARY OF TERMS

EAC – East Ayrshire Council
CWP- Community Windpower Ltd
SPR- Scottish Power Renewables
WL WF- Whitelee windfarm
PWS – Private water supplies
PMO- Planning Monitoring Officer
DWQR- Drinking water quality regulator
DWPA- Drinking Water Protected Area
SW- Scottish Water
SEPA- Scottish Environment Protection Agency
THM- Trihalomethanes
CPHM- Consultant in Public Health Medicine
LA- Local authority
DOC – Dissolved Organic Carbon
SRP – Soluble reactive phosphate
ES- Environmental Statement
BGS – British Geological survey
GW – Groundwater
DEHP - Bis (2 – ethylhexyl)phthalate
ECU – Energy Consents Unit
DWS – Drinking water standards
S.G. – Specific gravity