

# Appendix I

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22 September 2014

Dear Dr.Karunanithi

## Health Impact Assessment of Shale Gas Exploration in Lancashire

Thank you for your time at our meeting on 11<sup>th</sup> September, and for your letter of 16<sup>th</sup> September setting out the contextual issues for which you seek clarification in respect of Cuadrilla's proposed exploration for shale gas at the Preston New Road and Roseacre Wood temporary exploration sites in Lancashire. We are also grateful for the opportunity to respond to the points for clarification summarised in your consultant's summary of points for clarification, dated 19<sup>th</sup> August 2014.

It is noted that some of your points relate to the post-exploration stages of operation and, while we are able to provide generic information on these points, they are outside the scope of the proposal to undertake exploration activities at the Preston New Road and Roseacre Wood sites. All relevant information has already been provided in the detailed Environmental Statements and accompanying planning application documentation and the information set out below is therefore intended to clarify the content of the Environmental Statements for these sites, or their accompanying planning application documentation.

To maintain consistency of formatting, and to ensure that all of your queries are resolved, the following text sets out the questions first (in italics), followed by responses from the applicant:

1. *Further information around the extent of horizontal drilling and whether there is the potential to have more than one horizontal well per vertical bore hole?*

It is technically possible to drill more than one horizontal wellbore per vertical bore, however the planning applications make clear that Cuadrilla will only drill a single horizontal wellbore from each of the vertical bores at the two proposed exploration sites. The actual length of the horizontal wellbore will be determined by geology but will not exceed 2000 metres, as noted in Table 3 of the Planning Statement for the projects.

*2. How is the monitoring of fracture propagation post hydraulic fracturing being planned?*

The primary purpose of the micro-seismic array is to monitor propagation of fractures induced in the shales. The precise timescale over which fracture propagation will take place cannot be defined at this stage, however micro seismic monitoring will continue after cessation of the hydraulic fracturing activity for a number of hours; within this time the mechanism for which fracture growth is required is no longer active.

In addition to micro-seismic monitoring, the Traffic Light System (TLS) array will actively monitor the entire hydraulic fracture operation, including pumping, fracture propagation, stand-by, and flow back.

*3. What monitoring arrangements are being planned for post abandonment stage?*

Monitoring requirements may be imposed by the Environment Agency through the environmental permit for each site in respect of plugged and abandoned wells. Any such requirements deemed necessary in respect of circumstances at that time will form part of the closure plan for the site, compliance with which will form part of the Agency's decision under the relevant regulations whether to accept a surrender of the environmental permit. Groundwater monitoring at the Site will be performed for a minimum of one year following abandonment of the exploratory wells or in accordance with extant best practice or regulatory requirements at the time of abandonment. (see s.11.4.5; para.68 of ES).

*4. What health related criteria was used for site selection referred to in chapter five and what consideration was given to how close to the residential area could the well be placed?*

The criteria for site selection is set out in Tables 5.1 and 5.2 of the ES. Assessment criteria for individual topics (e.g. lighting, air quality, noise etc.) drawn from the relevant guidelines were used to evaluate each proposed site. Proximity of potential receptors to the site was considered in relation to these various thresholds.

*5. What quantitative risk assessments have been completed with reference to health risks?*

In response to the scoping report for Preston New Road, Public Health England set out its requirements (in its letter dated 27<sup>th</sup> February 2014) for a dedicated section in the ES, to summarise key information relating to public health, to be drawn from relevant technical chapters. This did not include a quantitative health risk assessment.

*6. What health risk assessments have been conducted for MOD sites as another potential transport site?*

Part of the MoD site at DHFCS Inskip has been proposed as a potential Heavy Goods Vehicle (HGV) transport route for the proposed Roseacre Wood shale gas exploration location. The MoD has completed assessments of health & safety issues associated with activities on its land at DHFCS Inskip.

*7. What health related standards were considered when formulating the Environmental Operating Standards?*

Thresholds for specific parameters such as air quality and noise may incorporate health standards, and where applicable these will be included in individual Control Plans within

the EOS. The EOS structure is summarised in the ES, pending receipt of planning conditions, and will be a live document, updated at regular intervals throughout the project. A separate Health, Safety, Security and Environment Risk Management Framework will be implemented, as set out in section 11.4.5 of the ES (para.64).

*8. Further information about the storage, transport and disposal of waste.*

Details of proposals for storage, transport and disposal of all relevant materials (including wastes) are set out in Appendix K; sections K2.3 and K2.5.

*9. What considerations were given to undertaking a full health impact assessment as part of the environmental impact assessment?*

In the scoping report for Preston New Road, a signposting section was proposed under section 4.4.2. In response to this, Public Health England set out requirements (in its letter dated 27<sup>th</sup> February 2014) for a dedicated section in the ES, to summarise key information relating to public health, to be drawn from relevant technical chapters. This comprises chapter 20 of the ES for Preston New Road.

*10. How is the completion of combusting during the flaring going to be measured?*

Flare monitoring details are contained in the Environmental Permit application, HSE-Permit-PNR-INS-007 and HSE-Permit-RW-INS-007 Emissions Monitoring Plan submitted to the Environment Agency. The combustion of natural gas will be flared in accordance with BAT Reference Document cww\_bref\_0203 “Best Available Techniques in Common Waste Water and Waste Gas Treatment / Management Systems in the Chemical Sector.

The temperature of the flare will be continuously monitored using thermocouples up to 1000°C (+). BAT requires the flare to operate at 800°C (+). At this temperature 98% of natural gas is converted into carbon dioxide and water vapour. Once the temperature and feedstock (natural gas) of the flare is recorded, a calculation method will be utilised to establish conversion rates.

In addition to continuous monitoring the flare, the well pad perimeter fence line will have 4 ambient air quality monitoring stations. Detail of the ambient air quality monitoring is outlined with the HSE-Permit-PNR-INS-006 and HSE-Permit-RW-INS-006 including Methane, Oxides of Nitrogen, Sulphur Dioxide and Volatile Organic Compounds.

*11. What unplanned scenarios were considered in the development of the environmental statements?*

Unplanned scenarios are considered in the Environmental Risk Assessment (ERA) issued to DECC for consideration on 24<sup>th</sup> April 2014. DECC confirmed that the ERA submitted in respect of Preston New Road met its requirements, and can be found on the Cuadrilla website <http://www.cuadrillaresources.com/protecting-our-environment/>.

**Points for clarification arising from the study by Ben Cave Associates (BCA):**

(NB: paragraph numbering has been amended to provide continuation from the above responses)

**General**

*We (BCA) suggest that the Director of Public Health for LCC:*

12. *Seeks further detail on the influence of people's understanding of safety on the surrounding areas. Including consideration of: property values; amenity value of outdoor space; and levels of physical activity.*

It is assumed that this point relates to the potential for public anxiety arising from shale gas exploration. The approach undertaken to site development, including mitigation that could influence public health, reflects this issue and the following responses are intended to provide further clarification of information contained within the ES, or accompanying planning application documents.

**Property values**

Detailed assessment of property values is not within the scope of the EIA.

Other sections of the planning documentation - principally the Statement of Community Interest and the Environmental Risk Assessment – refer to perceived potential effects of shale gas exploration on property values and related issues.

The potential for perception of effects of exploration activity to generate health impacts via anxiety is considered in section 20.5.4 of the ES, with the provision of adequate information being identified as the primary means of mitigating such effects. A comprehensive programme of community engagement has been implemented, is ongoing and is reported in the Statement of Community Interest (SCI) (s.3 (ERA) s.6 (Site selection) s.7 & 8 (EIA) and s.9 (engagement with parish councils)).

**Amenity Value of Outdoor Space**

Effects on outdoor space are considered in the ES, chapters 9 – Community and Socio-economic, and ch.14 – Landscape and Visual Amenity.

Ch.9 confirms that no Public Rights of Way would be affected by the proposed works (table 9.7 and Figure 9.15) and that there would be no adverse community effects associated with public access and recreational amenity;

Chapter 14 confirms that no significant visual impacts would be evident over the whole working period, however very localised changes would be observed during the drilling and hydraulic fracturing activities.

**Levels of Physical Activity**

The site and its surroundings are not publicly accessible and no Public Rights of Way are affected by the proposals (ES: Fig.9.15). There is therefore no mechanism for adverse effects on levels of physical activity.

13. *Seeks clarification of what effect (for example: direct, indirect, cumulative, differential, synergistic) the Project will have on proposed development within Fylde, including the proposed mental health unit at Whyndyke Farm.*

Cumulative effects are included in each technical chapter of the ES. It is not clear why the proposed mental health unit has been highlighted but the most relevant chapter in the ES in this context may be ch.18 – Transport; s.18.8 reviews cumulative effects on the local road network, and confirms that there will be no adverse effects arising from traffic flows associated with the proposals.

14. *Confirms when, and what, further information will be available regarding quantitative risk assessment (including unplanned events and reference to ½LFL ).*

An Environmental Risk Assessment (ERA) has been submitted to DECC in line with the recommendation of the Royal Society and the Royal Academy of Engineering Report and an environmental risk assessment was also submitted to the Environment Agency as one of the supporting documents to the environmental permit applications. No further risk assessments or information relating to quantitative risk assessments are required as part of the current regulatory regime. Therefore, no further risk assessment is planned for the temporary exploration works at Preston New Road or at Roseacre Wood.

15. *Confirms how the proponent will ensure and demonstrate that all pollution will be as low as reasonably practical using BAT. This applies to air quality (including PM<sup>10</sup> and PM<sup>2.5</sup>), noise, vibration, light and any other release from the activities on site or associated with the site.*

Each technical chapter of the ES contains comprehensive mitigation measures that will minimise residual effects arising from the proposed temporary development. Any conditions deemed necessary to ensure that Cuadrilla's operations represent Best Available Techniques (as defined in environmental regulation) will be included in the environmental permit for the Project.

Appendix E to the ES describes the Environmental Operating Standard (EOS) that will provide rigorous environmental management of the proposed temporary exploration site. Section 6 of Appendix E sets out the format of a series of Control Plans; this will define actions and responsibilities for maintenance of environmental control measures on the site.

#### **Lighting** (see Chapter 15 of the ES)

All lighting on the Project will be designed, specified, installed and commissioned in accordance with the relevant light intrusion and design standards and guidance to ensure minimum light pollution. All design work undertaken will be completed by an appropriately qualified lighting designer using appropriate software. The lighting design details will be submitted and agreed with the local authority prior to installation of lighting on site. Viewpoints from neighbouring properties and local sensitive ecological receptors will be regularly monitored to assess the visibility of the light sources from the Project at all stages of construction and final installation.

#### **Air quality** (see Chapter 6)

The effects of emissions of particulate matter are assessed to be not significant. The main risk of PM emissions occurs during construction and demolition. Mitigation measures to ensure no significant impacts occur have been recommended and delivery of these measures can be secured through planning conditions.

## **Noise and vibration** (see Chapter 16)

Use of best practicable means is required and has been assumed in the assessments. Where significant effects are predicted, mitigation is proposed to achieve targets and delivery of the mitigation can be secured through planning conditions.

## **Air quality**

16. *Seeks clarification as to whether there will be periods of higher exposure to radon (e.g. during the 120 day flare period assumed by the radon modelling) than is suggested by the ES reporting the exposure levels as an annual effective dose. Notably whether peak levels will exceed 100 Bq/m<sup>3</sup> at any receptor.*

The estimated exposure (0.3 microSv) associated with a maximum 120 d flare period has been normalised to an annual effective dose to allow for comparison with the statutory annual dose limit for a member of the public (see Appendix F of the ES). Based on the estimated concentrations of radon within the flared gas, and a maximum flare period of 120 d, it is not envisaged that there will be periods of higher exposure. It is pertinent to note that the estimated exposure (0.3 microSv) represents 0.02 % of the average annual public exposure to radon in the UK. Based on an estimated radon concentration of 200 Bq/m<sup>3</sup> within the flared gas, it is highly improbable that a radon (in air) concentration will exceed 100 Bq/m<sup>3</sup> at any off-site receptor.

17. *Request clarification of whether one or two flares been modelled by the radon modelling. It would be useful for actual receptors and weather data to be used in the radon modelling.*

The radon assessment assumed that the flaring of gas would occur from a single stack. With regard to weather data, the Environment Agency's Initial Radiological Assessment Methodology assumes a sectorised Gaussian plume model (with a breakdown of atmospheric stability classes which is considered appropriate for discharges made within mainland UK). Given the radiologically-insignificant exposure estimated using the methodology (Appendix F), which allows for the calculation of a relatively cautious ('order of magnitude') estimate, it was determined that no additional refining of the assessment was required.

18. *Request additional modelling of the likely radon exposure levels during unplanned events (e.g. loss of gas containment at ground level) for occupational and residential receptor doses. For each radon modelling result (including those requested above), data in unit of µSv/year and Bq/m<sup>3</sup> would be useful.*

With regard to unplanned events ['loss of gas containment at ground level' is cited as an example], the on-site storage of significant volumes of natural gas is not part of the proposal (Chapter 4 of ES), hence there is no feasible risk of a significant unplanned event with off-site radiological consequences of the nature suggested. In terms of a ground-level release, if the 120 d flare period discharge occurred at 0 m, the dose to the local population (resident at 100 m from the discharge point) is estimated to be 1.5 microSv (i.e. approximately 50 % of the daily exposure due to background radon, received by a member of the public within the UK). Assessment of the risk of occupational exposure to potentially dangerous substances is a requirement of the Ionising Radiations Regulations 1999 as well as serving to fulfil employer's general

duties to safeguard employees and others under the Health and Safety at Work etc., Act 1974.

19. *Seeks clarification on the approximate minimum period of time between extraction of natural gas containing radon during extended flow testing and its final combustion by domestic and commercial end users. If this period of time is short and large volumes are being used by single sources, the risks of the carcinogenic decay products of radon further down the supply chain should be investigated.*

Sampling of natural gas and analysis for radon will occur during flow-testing of the wells (and subsequent assessment of any potential, significant domestic exposure), prior to any transporting of natural gas to domestic consumers. Natural gas must be sampled and meet the requirements of the UK National Gas Grid prior to being allowed entry into the gas grid network and onwards to domestic or industrial customers

20. *Request information on what alternatives have been considered for the capture and the use of methane during the 90 day initial flow testing stage and clarify how the decision to flare has been reached.*

The requirement to flare natural gas is based on a need to collect natural gas data. As described within the Waste Management Plan (HSE-Permit-INS-PNR-006) the initial flow test purpose is to enable a continual uninterrupted flow from the well head to a natural gas flare. The uninterrupted flow of natural gas is required to provide the necessary data to measure the flow rate of natural gas and the initial decline rate of flow and pressure, as well as the gas composition. This allows for the forecasting of potential future production flow from the well. Interrupting the flow, or risk of interruption from utilising the natural gas on site, would impact the necessary data collection and ability to predict future decline curves of natural gas.

Once the initial flow test has established the required data, natural gas flowing from the well during the extended well test would be sent to the gas grid rather than flaring. The extended well test is based on site specific information e.g. the gas composition and flow rates established during the initial flow test, to enable a connection to be made into the gas grid.

This approach is recognised in UKOOG standards (Clause 10) and in the USA EPA.

Clause 10 from UKOOG states:

#### 10. Minimising Fugitive Emissions

Operators should plan and then implement controls in order to minimise all emissions. Operators should be committed to eliminating all unnecessary flaring and venting of gas and to implementing best practices from the early design stages of the development and by endeavouring to improve on these during the subsequent operational phases.

Emphasis should be placed on “green completions” whereby best practice during the flow-back period is to use a “reduced emissions completion” in which hydrocarbons are separated from the fracturing fluid (and then sold) and the residual flow-back fluid is collected for processing and recycling. However this approach will not always be practicable at the exploration/appraisal stage of a development where separation and flaring of natural gas should be the preferred option, minimising venting of hydrocarbons wherever practicable.

#### EPA Standards for Gas Well Affected Facilities:

Each well completion operation begun on or after January 1, 2015, must employ REC in combination with use of a completion combustion device to control gas not suitable for entering the flow line (we refer to this as REC with combustion). (EPA, Page 41, 40 CFR Part 63 Oil and Natural Gas Sector: New Source Performance Standards and National Emission Standards for Hazardous Air Pollutants Reviews)

Once reliable data is validated from the initial well testing phase and reviewed by the infrastructure body (i.e. gas is suitable to enter a flow line), a connection to the gas grid will be made for the extended well testing phase.

#### Noise

21. *Requests additional mitigation be incorporated into the Project to ensure that at all receptors noise levels attributable to the Project neither exceed the WHO general health based threshold of 50/55 dB LAeq, 16hr (45); nor the WHO night noise threshold of 40 dB Lnight, outside.*

The ES presents the highest assessed noise levels associated with drilling and hydraulic fracturing pumping operations. The drilling noise levels will comply with the suggested daytime criteria at the closest dwellings. At night, there is a forecast slight -exceedence of the ES assessment criterion at the closest property on Preston New Road. However the measured ambient night time noise level here during the quiet night time period (46dB LAeq) was only 1dB(A) below the predicted drilling noise level and is in excess of the WHO night noise guideline.

The hydraulic pumping stage of the fracturing process will cause higher noise levels, but will not be undertaken at night and will be typically for a period of only 3 hours per day in the period whilst hydraulic fracturing of drilled wells is ongoing. The hydraulic fracturing pumping operation is predicted to cause 67dB LAeq at the closest dwelling. This compares to a measured daytime level during quiet time of day of 62dB LAeq.

As the existing daytime level of 62 dB LAeq is well above the WHO daytime target, work is daytime only, the site is temporary (and the fracturing operation itself is only part of the time for which the site would operate) and the noise level is only for a few hours per day, we have assessed this as a 'not significant' effect and as such are not currently proposing further mitigation.

22. *We suggest that the Director of Public Health for LCC requests regulatory authorities control the working hours and days for Project activities, particularly drilling and hydraulic fracturing, to ensure that at all receptors noise levels attributable to the Project do not exceed the WHO thresholds (44;45) of the preceding recommendation. Consideration could be given to only operating the fracturing pumps during weekday daytime and ceasing activity during weekends and bank-holidays.*

The hydraulic fracturing pumping, which is the major noise source, will be restricted to weekday daytimes and will be typically for a period of only 3 hours per day during daytime hours, (and the hydraulic fracturing itself is only part of the time for which the site would operate) as set out in the ES.

Drilling will be a 24 hour operation, but gives rise to much lower noise levels.

It would be inappropriate to design to the target noise levels provided by the WHO Night Noise Guidelines for Europe, for drilling activity, because existing noise levels are already in excess of the target values.



23. *For noise impacts attributable to the Project which are justified on the basis of being of a similar decibel level to background noise, requests further reporting of the frequency spectrum and time-structure of such noise to evidence that it will not be clearly audible against background levels.*

It has not been stated in the ES that the noise will not be audible, but favourable comparison has generally been made with the existing noise levels Sections 16.7.1 to 16.7.7 incl.).

Traffic noise is broadband, containing noise from tyre-road interaction, engine noise and exhaust noise. The drilling and fracturing processes are also broadband, the fracturing using diesel engine pumps, similar to a HGV, so except for the absence of tyre noise, the sound character should be similar to road traffic.

### **Hydrogeology and ground gas**

24. *Seeks clarification of how, and for how long, the applicant will monitor the ground water quality to the east of the Woodfold fault to confirm the hypothesis, advanced in the ES, that the fault creates a barrier to water movement between the ground water contamination of the application and the public water supply. Sufficient information should be provided to satisfy the Director of Public Health for LCC that public water supply will not be contaminated directly or indirectly as a result of the Project, including long-term impacts. This issue is also applicable to the Roseacre Wood application which is closer to the Woodfold fault.*

As discussed in Section 11.6.7 of the ES, evidence to support the hypothesis that the Woodfold Fault acts as a barrier to groundwater flow includes: observed groundwater level change across the fault; groundwater quality change across the fault; calibrated EA groundwater model with the fault modelled as impermeable; observations from comparable faults in the area. In addition the Woodfold Fault is distant from the volume of rock that will be fractured, approximately 8km east of PNR and 3km east of Roseacre Wood at surface. The public water supply abstractions are in turn several kilometres east of the Woodfold Fault and there is no plausible pathway between PNR and RW wells and the public water supply abstractions (Section 11.7.7 Induced fractures extend beyond the target zone). Groundwater monitoring is proposed around the PNR and RW well pads and will be subject to EA approval.

25. *Requests further information on how the application will affect long-term low level gas permeation to the surface including permeation to the surface which may be distant to the proposed site. Estimates of potential surface concentrations and areas of effect would be helpful.*

Existing ground gas sources, present before any drilling or hydraulic fracturing, are identified in the ES (Section 11.6.11), and include an existing conventional gas reservoir in the Collyhurst Sandstone, below the Manchester Marl. The potential for gas migration as a result of the proposed development is discussed in the ES Section 11.7.7 (Ground gas migration due to loss of well integrity, Induced fractures extend beyond the target zone and Gas migration via induced fractures). Considering the geological setting, controls on fracture growth and other mitigation measures to ensure well integrity (Section 11.4.5), there is no plausible pathway for gas migration to receptors at the surface.

26. *Seeks confirmation of what action will be taken if a significant pathway, along a fault or other discontinuity, is established for gas to the surface.*

Cuadrilla has undertaken extensive characterisation of the subsurface including the mapping of faults (see section 12.4.2, para.18), prior to drilling in order to avoid hydraulically fracturing directly into regional faults.

The fracturing programme has been designed to keep induced fractures offset from regional faults by a distance of two times the anticipated fracture length. Micro-seismic monitoring will be used to detect fracture growth. If, during hydraulic fracturing, monitoring data indicate possible interactions with a preferential flow pathway, the pumping of fracturing fluid would be terminated and the HFP would be adjusted as necessary (Ch.4). However even if a fault or other discontinuity was encountered during hydraulic fracturing, a permeable pathway would need to be present along the full distance between the source (in the Bowland Shale) and the surface for gas migration to the receptors. Based on several lines of evidence set out in Chapter 12 in the ES, the extent and permeability of faults in the site area is considered to be too low to allow significant migration.

27. *Requests that regulators require an appropriate long-term monitoring plan post decommissioning / abandonment to ensure that the Project does not cause adverse legacy issues for air, ground or water contamination. Responsibility for monitoring should be clearly defined and set through condition, legal agreement and / or bond. The Director of Public Health for LCC should remain engaged with the monitoring information that emerges from the planning and permitting processes.*

Groundwater monitoring, including baseline, during operation and post-abandonment, is addressed by the environmental permitting regime and regulated by the EA. Groundwater monitoring post-well abandonment will be performed in accordance with the Environment Agency's requirements or other regulatory requirements in place at the time of abandonment.

## **Waste**

28. *Confirms with the regulator (EA) that the Project's impact on the capacity of regional waste sites to treatment/disposal of medical waste is being considered as part of the permitting process. The Director of Public Health for LCC should remain engaged with the process and information that emerges on this issue from the planning and permitting processes.*

Material that could compete with medical waste for treatment or disposal capacity will not be generated by the exploration process, and is therefore not included in the environmental impact assessment.

29. *Seeks clarification on how suspension brine will be disposed of, as the ES does not describe this waste management pathway.*

Suspension brine (salty water) disposal is stated in the environment permit application in the mining waste management plan. For reference, section 5.7 of the mining waste management plan describes the waste under the European Waste Code (EWC) 01 05 08. This will be sent for disposal to a waste facility permitted accept the waste stream.

## Induced seismicity

30. *Considers Verdon (47), who, having looked at analogous drilling, fracking and deep injection associated with CO<sub>2</sub> storage, concludes that deep injections have a direct action on fault lines; and requests clarification of how this analysis relates to conclusions in the ES concerning impacts on induced seismology associated with hydraulic fracturing.*

The comparison between induced seismicity associated with CCS storage and shale gas exploration is not appropriate as the volumes of injected liquid associated with CCS storage are significantly larger than for shale gas exploration. In addition the mitigation measures set out in section 12.9 of the ES, for limiting induced seismicity includes the mapping of faults prior to drilling in order to avoid hydraulically fracturing directly into regional faults, and real time monitoring that allows the Fracturing Manager to stop hydraulic fracture operations if a fault is suspected of being activated.

31. *Requests clarification that the applicant has considered the implications of seismic activity on historical and/or current salt/brine mining activity in the area (other than the Preesall proposed gas storage site). If so, this information should be provided.*

The potential effects of induced seismicity on Preesall salt mining have been considered in section 12.7.4 and assessed and the risk is considered to be very low. It is considered that the Preesall salt mining is analogous for other salt mining operations (historical, current and future) in the region. Salt cavern collapse associated with salt mining is understood to be a source of induced seismicity rather than a consequence of induced seismicity related to another source.

32. *Seeks supporting evidence on the degree of accuracy to which the microseismic arrays measure the extent of hydraulic fractures. Including clarification of the relationship between fracture growth and the measurement of induced seismicity as a surrogate for this growth.*

The ES provides a description of how the proposed buried (microseismic) array will detect the extent of hydraulic fractures and how this will be used to control hydraulic fracture growth (chapter 4). This is an established and successful methodology for detecting the location and extent of hydraulic fractures and more information can be found on the websites of companies that offer this service (i.e. Microseismic Inc).

As set out in section 4.4 of the ES, micro-seismic monitoring will take place in real time and with subsequent post processing. The accuracy of real time microseismic monitoring depends on position of the hydraulic fractures relative to the buried instruments and the strength of the seismic signal. The location that is determined is a statistical best fit solution, and due to the collective listening power of the buried array the detection accuracy is expected to be in the order of a few 10s of metres.

The relationship between fracture growth and the measurement of induced microseismicity is described in Chapter 4 of the environmental statement. The intention of hydraulic fracturing is to induce tensile fracture opening, which as a result will create shear slippage of the rock around the fracture producing a microseismic signal. This shear slippage creates microseismic signals, which will be detected by the proposed buried (microseismic) array and allow the growth of hydraulic fractures to be accurately monitored and controlled.

## Visual impacts

33. *Seeks clarification on whether the flares will be associated with condensation plumes due to convection effect in the atmosphere under certain weather conditions. Any plume could increase visual disturbance and introduce an industrial element into the rural landscape.*

The flare stack is designed to minimise visual intrusion, including effects of flame or condensation. Under extreme weather conditions a small condensation plume may be visible, however this would be likely to occur for a short period of time, during the maximum 90-day flow test period which, by definition, will be a temporary activity. Any such plume is therefore extremely unlikely to contribute to adverse effects on landscape character (see s.14.11 of the ES).

## Transport

34. *Confirms if the transport safety audit included the transport of hazardous wastes (including those with NORM) from the site to treatment facilities. It is noted that hazardous loads are a familiar feature of the UK road network. Once the locations of relevant treatment facilities have been identified, the Director of Public Health for LCC could comment on the need for routing away from population centres and accident hotspots.*

A road safety audit is intended to identify any road safety issues and suggest measures to eliminate or mitigate any concerns. The road safety audit covers all potential road users, including vehicles, cyclists and pedestrians. This would include the vehicles used to transport materials to and from the site.

Chapter 11 (Section 11.7.3 – Table 11.10) identifies “Off-site road traffic accident resulting in spill of potentially contaminating materials” as potential source of pollution along a single exposure pathway to two potential receptors (water environment and human health). This assessment covers all potentially contaminating materials including any that contain quantities of low level NORM (e.g. flowback fluid).

Section 11.7.7 then goes on to assess the risk in more detail, specifically in paragraphs 211 and 212 which states the control measures Cuadrilla would have in place to minimise the likelihood of a spill occurring and also the measures in place to manage any impacts in the event of a spill. These control measures apply to the transport of all material including flowback fluid which could contain quantities of NORM. With these measures paragraph 212 concludes that the probability of a source-pathway-receptor linkage being created would be low.

On the basis of the above the planning submission has considered both the road safety issues associated with using the proposed access routes and the risks to receptors if a spillage on the highway were to occur.

35. *Confirms that the traffic impacts (including air quality) of the proposals have considered seasonal road congestion, for example during the summer months standing traffic can become a feature of roads leading into Blackpool.*

Traffic impacts have been based on assessment of flows collected in October, which represents a recommended month for data collection as defined by the Department of Transport in their Guidance on Transport Assessment.

A review of traffic flows in 2013 on the M55 (which is the main route into Blackpool) indicates that there is limited seasonal variation between months and October represents an above average month.

### **Water resources**

36. *Confirms with the regulator (EA) that the Project's impact on public water capacity in the event of hot weather, drought or other unusually high periods of increased demand is being considered as part of the permitting process. The Director of Public Health for LCC should remain engaged with the process and information that emerges on this issue from the planning and permitting processes.*

An assessment of water stress/scarcity in the region has been made using water availability maps from the Environment Agency to understand if the volumes of water required during hydraulic fracturing could result in water stress (see ES s.19.6.4). This shows the Site is located within a zone with high water resource availability, where water is available at least 95% of the time. This shows that generally, the region is not 'water stressed'.

The Site is located within United Utilities' "Integrated Resource Zone" supply zone. This means that water supplies are not fed from specific sources (i.e. an individual water treatment works), but are supplied via an integrated network of water mains and sources that are interconnected to maintain resilience of the network and flexibility of supply. UU are able to move water supplies around this region to meet demand. This helps UU to maintain adequate supplies to major areas of the Integrated Resource Zone in times of dry weather.

For Preston New Road, United Utilities PLC has been consulted and has confirmed, through modelling, that drawing up to 765m<sup>3</sup> over a 24 hour period from their 15" water main can be undertaken without flow restriction and will not adversely affect the supply to other users of their network, providing a Pressure Management Valve is installed to reduce the risk of bursts. Their letter is contained in ES Appendix S.

I hope the above information provides sufficient clarification to enable you to complete your report to the Council, however if you require any further clarification please let me know.

Yours sincerely



Gordon Richardson  
Associate Director – Environment & Sustainability