Aberdeen Harbour Expansion Project

Construction Environmental Management Document

AHEP-DRA-APP-0001 Rev 5
23 October 2019

DRAGADOS

Contents

Chapter 16
Nigg Bay Site of Special Scientific Interest Management Plan

Revision Log

Minor updates to formatting have been made throughout the document. The main/significant changes are listed in the table below.

Revision Number	Date	Location of Revision	Revision Details
Rev 3	16/05/2018	Front of Document	Document updated to Revision 3 and date updated.
		Throughout Document	Reference to UFI has been updated to Pelagia (UK) Ltd. For ease of reading, reference to specific drawing numbers removed.
		Section 16.1.2	Addition of Works Completed section
		Section 16.1.3, Table 16.1	Table updated to remove individuals names
		Section 16.3.2	Update of text on Pelagia outfall temporary relocation
		Section 16.3.3	Update of Temporary Haul Road layout and text. Figure 16.2 also updated.
		Section 16.3.4	Update of text to outline works completed.
		Section 16.3.5	Minor changes to text
		Section 16.3.6	Section previously 16.3.2, moved down to improve flow of text.
		Section 16.3.8	Re-profiling text moved to section and figures updated
		Section 16.6.4	Updated of section and additional mitigation measures and commitments added.
		Appendix A	Drawings updated
Rev 4	08/02/2019	Front of Document	Document updated to Revision 4 and date updated
		Section 16.3	Updated works planned
		Section 16.3.2	Updated SNH UFI consent variation
		Section 16.3.5	Reworded section to reflect current works
		Section 16.3.6	Updated information on haul road
		Section 16.3.7	Included information on sea protection platforms
		Section 16.5	Added section about working within the SSSI
		Appendix	Updates to appendix

Rev 5	23/10/2019	Front of document	Document updated to Revision 4 and date updated.
		Section 16.1.2	Updated works completed as of October 2019
		Section 16.3.2	Updated for Pelagia outfall diversion works
		Section 16.3.8	Updated number of holes drilled for blasting
		Section 16.3.9	Added sentence regarding proposed landscaping works

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16 Nigg Bay Site of Special Scientific Interest Management Plan

16.1 Introduction

16.1.1 Overview

A Site of Special Scientific Interest (SSSI) is a statutory designation made by Scottish Natural Heritage (SNH) under the Nature Conservation (Scotland) Act 2004. SSSI's are those areas of land that SNH considers to best represent the natural heritage of an area – its diversity of plants, animals, habitats, rocks and landforms, or a combination of such natural features. The Aberdeen Harbour Expansion Project (AHEP) proposed development site is adjacent to and within the boundary of the Nigg Bay SSSI located on the south west of Nigg Bay, approximately 1km south of Aberdeen Harbour (National Grid Reference NJ966045).

This SSSI Management Plan outlines any risks to the Nigg Bay SSSI associated with the construction of the AHEP as detailed within the Environmental Statement (ES)[1]. As part of the Construction Environmental Plan (CEMP) this document must be used in order to avoid, mitigate and manage these risks.

The requirement to produce a Nigg Bay SSSI Management Plan is listed under Schedule 3.2.4, section a, of both the Marine Construction Licence, Marine Dredging Licence and Schedule 2 of the Harbour Revision Order. This Plan is considered to fulfil these requirements.

The location of the SSSI can be seen in Figure 16.1

[1] Waterman and Fugro (2015), Environmental Statement

Figure 16.1: SSSI boundary in relation to AHEP

16.1.2 Works Completed

The following mitigation works as outlined in Table 16.5 have been implemented on site to ensure the slope within the SSSI is protected from potential impacts resulting from AHEP:

- Demarcation of areas to restrict ground investigations, construction workers and construction plant movements in the vicinity of the slope;
    - The SSSI has been clearly marked on site to denote the boundaries. The SSSI has also been covered within toolbox talks provided to all workers on site.
- Drainage ditches, collection drains and sustainable drainage systems (SuDS) ponds have been installed within the southern compound to carry water away from the SSSI slope;
    - The drainage systems and ponds are checked during the site walkover assessments, and during periods of heavy and sustained wet weather to ensure they remain operational and effective.
- Spill kits are available on site and located in all agreed areas as outlined in the Pollution Prevention Plan; and

- Refuelling areas and fuel and chemical storage areas are all located in agreed areas in accordance with the Pollution Prevention Plan

The following consents to work within the SSSI have been provided by SNH:

- Investigation for unexploded ordnance, dated 9 August, 2017;
- Creation of a trench and laying of a HV cable, communication ducts and Marine Scotland water supply pipe, dated 15 November 2017; and
- Temporary diversion of the Pelagia outfall pipe to within the Nigg Bay SSSI, dated 28 March, 2018. Eradication works for the invasive species Japanese knotweed (*Fallopia japonica*) that was found to be present within the SSSI, did not require consenting from SNH. As the eradication works outlined the spraying regime over a three year period, which would avoid damage to the protected natural features of the SSSI. The first spray was therefore undertaken in 2017, with further treatment carried out in 2018 and 2019.
- In April 2019 vibration monitoring equipment was installed within the SSSI exclusion zone to monitor levels during the Southern shore works.
- In 2019 the following activities were also undertaken as part of the Southern shore works:
    - Clearing and creating an area to temporarily stockpile core material and rock armour.
    - Construction of the access haul road using core material or site won material. (Consent received from SNH in June)
    - Construction of sea protection platform using core material or site won material.
    - Protection of seaward slopes with rock armour
    - Consideration is being given to further landscaping in the SSSI area and is under review by regulators at time of writing

16.1.3 Role, Responsibilities and Cross- Referencing

The following roles are responsible for ensuring that the requirements of this Nigg Bay Site of Special Interest Management Plan are implemented at the AHEP site.

Table 16.1: Roles and Responsibilities

Job Title	Responsibilities
Environmental Manager	Ensure that spill kits are appropriately located and appropriate oil and chemical stores are in place on site. Ensure risk assessments are undertaken for planned construction activities close to or within the SSSI and consents sought from SNH as appropriate.
Environmental Clerk of Works	Ensure all construction works are undertaken in adherence with the SSSI Management Plan.

Job Title	Responsibilities
	Site inspection Tool Box Talks During construction works the Environmental Clerk of Work (ECoW) will be responsible for inspecting the SSSI slope for any adverse changes and also inspect drainage measures to ensure they are operating effectively
Construction Manager	Ensure Environmental Manager is aware of all construction activities planned and ongoing close to or within the SSSI.
Blasting Contractor	Produce Blasting plan Undertake Test Blast
Ground Investigation Contractor	Follow SSSI Mitigation

16.1.3.1 Cross-Referencing

The Nigg Bay SSSI plan should be read in conjunction with the following CEMDs:

- Construction Method Statement;
- Pollution Prevention Plan; and
- Piling Management Plan.

16.1.4 Description

The Nigg Bay SSSI was first designated in 1984 and covers an area of 4.72 hectares (ha). The Nigg Bay SSSI consists of the exposed cliff face as well as the foreshore as pictured in Appendix A. The Nigg Bay SSSI is designated for its geological features and is described as follows:

Nigg Bay is a classic locality for Quaternary stratigraphy in north-east Scotland. The sequence of deposits at Nigg Bay represents several glacial events, and the sediments record at least two glaciations. The exposed section at Nigg Bay shows six distinct horizons, *"including two tills, a layer of "morainic" gravels and a basal layer of sand and gravel containing Scandinavian erratics. There has been considerable debate about the number of ice advances represented by these deposits. Currently, all the deposits are believed to relate to the Late Devensian (last) glaciation (circa 33 000-15 000 years ago), except the basal sand and gravel. The latter was probably deposited during an earlier glacial event. Since the late 19th century, the Nigg Bay section has been recognised as a key reference site for interpreting the glacial history and ice movement patterns in north-east Scotland. Moreover, it illustrates particularly well the complexity of deposits which may be produced during a single glacial episode*."[2]

The exposed slope face, within the designated SSSI area is currently over-steep. Localised historical slope failures are evident across the slope face, and associated debris is present at the toe of the slope. It is considered that the slope face is

[2] SNH (2011), Nigg Bay Site of Special Scientific Interest Citation.

currently undergoing a progressive failure through natural weathering, and will continue to do so until the slope achieves its natural angle of stability.

16.1.5 Information Sources

The following sources of information have been reviewed to inform this document:

- SNH, (2011) Nigg Bay Site of Special Scientific Interest Citation[3];
- SNH (2011) Nigg Bay Site of Special Scientific Interest Site Management Statement;
- SNH (2011) Nigg Bay Site of Special Scientific Interest, Operations Requiring Consent from Scottish National Heritage; and
- Earth Science Documentation Series, Nigg Bay Site of Special Scientific Interest, December 1992.

[3] All documentation relating to the features of interest, management and operations requiring consent at Nigg Bay SSSI can be found at https://gateway.snh.gov.uk/sitelink/siteinfo.jsp?pa_code=1224 Accessed: 23/02/2017

16.2 Legislation

16.2.1 Operations Requiring Consent

Operations requiring consent (ORCs) are those activities that SNH believe could damage the natural features of a SSSI, and for which SNH are responsible for giving consent. If you propose to carry out, or permit to be carried out, any of the operations listed in Table 16.2 consent must first be obtained from SNH. Any works, whether within or out with the SSSI boundary, that have the potential to damage a SSSI, require consent from SNH. SNH may refuse consent to prevent an activity taking place if they believe it could damage the natural features of the SSSI. Consents are issued under the Nature Conservation (Scotland) Act 2004[4].

Since 1981, SNH has refused only a small number of consents. Where there is perceived risk of damage to the natural features of a SSSI, SNH will usually agree that an operation can be acceptable if carried out in a particular way or confined to a certain area or season. In such situations, conditional consent will be granted[5].

Acting without consent or intentionally or recklessly damaging a SSSI's natural feature, constitutes a criminal offence.

A list of operations requiring consent by SNH[6] at Nigg Bay, has been provided by SNH and is summarised in Table 16.2. Those operations in **bold** have the potential to occur as part of the AHEP.

Table 16.2: SNH list of operations requiring consent

Standard reference number	Type of operation
7	Dumping, spreading or discharging or any materials.
19	**Erection of sea defences or coast protection measures, including cliff or landslip drainage or stabilisation measures.**
20	Extraction of minerals including sands and gravels.
21	**Construction, removal or destruction of roads, tracks, walls, fences, hardstands, banks, ditches or other earthworks, or the laying, maintenance or removal of pipelines and cables, above or below ground.**
22	**Storage of materials within any part of the site.**
23	**The undertaking of engineering works, including drilling.**
24	Modification of natural features by battering, buttressing or grading cliff face.

[4] SNH (2016). SSSI Management and Protection. http://www.snh.gov.uk/protecting-scotlands-nature/protected-areas/national-designations/sssis/sssi-management/. Accessed 09/02/2017.
[5] SNH. Sites of Special Scientific Interest: Operations within SSSIs. http://www.snh.org.uk/pdfs/publications/designatedareas/sssi.pdf. Accessed09/02/2017.
[6] SNH (2011), Nigg Bay Site of Special Scientific Interest: Operations Requiring Consent from Scottish Natural Heritage.

16.3 Proposed Construction Works Near the SSSI

The proposed sequence of construction is detailed within the Construction Method Statement provided within the CEMD.

The proposed construction works within the vicinity of the SSSI include:

- Clearing and creating an area to temporarily stockpile core material and rock armour.
- Intrusive ground investigation works near to the top of the SSSI slope
- Intrusive ground investigations on the route of the Haul Road within the SSSI
- Construction of sea protection platform using core material or site won material.
- Protection of seaward slopes with rock armour
- Backfilling the landward side of the sea protection platform using core material or site won material to extend the working area
- Pre-construction and construction of the new cycle path adjacent to the top of the slope within the SSSI
- Pre-construction, construction and reinstatement of Southern Compound area (Greg Ness headland), including offices, laboratory and storage areas
- Blasting in the vicinity of the SSSI, relating to the formation of the toe trench and the rock armour revetment, dredging works to deepen the bay locally and re-profiling works along the southern headland slopes
- Ongoing maintenance and progression of haul road as blasting works progress
- Piling of the open deck section of the west quay, using a rotary bored pile type
- Installation of a temporary and permanent solution for the Pelagia (UK) Ltd. outfall discharging into Nigg Bay.
- Staged removal of the sea protection platform after blasting works (and reinstatement)
- Removal of the haul road (and reinstatement).

The following works are required inside the SSSI: construction of the access haul road using core material mainly in the intertidal zone below the scarp at the eastern edge of the pre-existing platform at the foot of the SSSI cliff and construction of revetments. In Figure 2 (and more clearly in Appendix A), the cliff and the pre-existing platform are marked as ‘Protected Area’ indicating a zone in which works will not be undertaken. The plant operating area, as shaded, focusses on the intertidal below the scarp at the edge of the pre-existing platform, except at the northern end where the haul road crosses MHWS to connect to infrastructure in the West Quay area. At the eastern end of the SSSI, there is no pre-existing platform between the foot of the rock face and the shore. In this area, construction will run below the MHWS line at the foot of the rock face. This access road will be used to construct the revetment at area B1.

Drawings in Appendix A identifies the location of the proposed construction works in relation to the SSSI.

The temporary relocation of the Pelagia (UK) Ltd. outfall has been approved by SNH, further details are provided in Section 16.3.2.

In addition, consent for the haul road at the base of the cliff will be applied for at least two months prior to haul road construction works commencing.

16.3.1 Intrusive Ground Investigation Works (Completed)

Additional intrusive ground investigation works have been carried out along the top of the slope adjacent to the SSSI to investigate the sequence and engineering properties of the strata within the slope. The proposed drilling works in the vicinity of the SSSI include for sinking six cable percussive boreholes with rotary continuation.

Boreholes were located at least 5m from the top of the slope to provide a safe working area during drilling works.

It should be noted that none of the proposed exploratory holes were located within the SSSI boundary. Reference should be made to drawings in Appendix A, which shows the location of the boreholes in the vicinity of the SSSI boundary.

Subject to consent from SNH, all samples and data from the boreholes in the vicinity of the SSSI will be retained for SNH and quaternary researchers to access.

16.3.2 Pelagia Outfall Temporary Relocation (In progress)

The temporary installation of the outfall will be undertaken approximately 43m into the boundary of the SSSI. The outfall will be in place for approximately a year after which the temporary pipe will be removed and the area reinstated to the previous profile or a profile agreed by SNH and AHB.

All works will be undertaken in accordance with the method statement provided on 1st October 2018, as well as the SNH consent, and its conditions. These conditions state that:

- A detailed method statement for removal of the pipeline will be submitted to SNH for approval, 6 weeks prior to the works commencing. This method statement is to include reinstatement and landscaping plan measures to mitigate impacts to the SSSI;
- The fence erected for the instatement of the pipeline will be removed by the end of January 2019; and
- Spoil heaps and other materials required for the temporary diversion of the pipeline will be not stored on the SSSI out with the defined areas as provided in the method statement. Any storage of materials or equipment shall not obstruct access to the SSSI and the cliff slope.
- As of August 2019 a temporary diversion to the pipeline was required. These works are additional to the consented temporary diversion works that were carried out earlier in the year. The location of this temporary diversion is at the northern boundary line of the SSSI area and falls within the plant operating area

of the B1 Revetment works which are included in the consented South Shore Works Method Statement. The new outfall diversion was built through the West Quay and was therefore outside the SSSI boundaries. The decommission of the current installation was carried out at the same time that the transition between of the SSH and the West Quay was built.

16.3.3 Cycle Path (Completed in 2017)

A cycle path has been constructed adjacent to the top of the SSSI slope. The route will initially be a temporary route during construction but will be incorporated into the permanent works at the end of the construction period. The path is completed as far as Doonies Farm. The final 200m is currently under construction.

The proposed cycle path route is shown on drawings in Appendix A. In general the path is out with the SSSI boundary, with the exception of a small length of cycle path, that encroaches into the north west corner of the SSSI.

No excavation was undertaken for the construction of the cycle path. The cycle path ties into the existing coast road carriageway and slope at 2.5% away from the SSSI, so that any surface water flows onto the existing carriageway and is collected by the road drainage network.

A 0.50m wide landscape strip has been constructed along the edge of the cycle path nearest to the SSSI, which will soften the transition between the edge of the cycle path and the top of the slope, while also providing cover to the top of the slope to help prevent further weathering. The landscaping strip is in the order of 150mm thick.

16.3.4 Southern Compound Area (Completed in 2018)

The Southern Compound area and associated access roads are located on the southern headland, immediately to the east of the Coast Road. It is proposed that the southern compound area will include roofed structures, hardstanding areas, and associated access roads and car parking facilities.

The boundary of the compound area is defined by a new 2.4m high steel mesh fence.

The fenceline is located approximately 10m south of the SSSI boundary, at its closest point.

Originally, traffic flow through the Southern Compound area was controlled in that access was restricted to the south west gate only and egress was via the north west gate only. However this arrangement has been revised and access is only via the north west gate, with internal access roads to the Southern breakwater, the Accropode batching plant and the general lay-down areas on the southern areas of the compound.

The access roads within the Southern Compound area will be used by HGV, LGV and cars. The Southern Compound Roads Layout can be seen in Appendix A

The access roads are located within the fenceline, approximately 20m from the SSSI boundary at its closest point. All car parking areas and associated earthworks are also within the fenceline, located approximately 13m from the SSSI boundary.

Reference should be made to drawings, in Appendix A for details of the Southern Compound layout plan.

The proposed buildings will be founded within the existing natural soils beneath the area.

During the construction of the Southern Compound area drainage has been installed, including a swale filter trench along the northern edge of the compound area, between the hardstanding area and the boundary fenceline. This will gather run-off from the compound area and discharge it to the sea after treatment, to the north side of the Southern Breakwater.

Reference should be made to the drainage layout and drainage detail drawings in Appendix A, for further details.

16.3.5 Rotary Piling Works (In progress)

Construction of the western open quay has initiated and part of the northern quay shall be constructed using a piled open deck section. The pile will be a rotary pile type, and no impact piling techniques are proposed.

The piling works are be land based and include the formation of piles, terminated at a deepest level of -42mOD (tbc). It is envisaged that the rotary piling works will include 2456.1m of drilling within soil and 257.5m of drilling in rock. It is estimated that drilling works will take 2 days per pile on average.

The nearest pile is located approximately 20m east of the SSSI slope, and the furthest pile is located 380m to the north of the SSSI.

It is envisaged that drilling within soil will not generate significant vibration. Drilling within rock will generate vibration, however the selection of a bored piling method will significantly reduce the magnitude of vibrations generated in comparison to the previously envisaged driven method.

Any vibrations generated from the piling works will quickly dissipate laterally through the rock. Based on the estimated rotary piling rate, it is considered that vibrations will only be generated over a relatively short period of time.

Furthermore, given the nearest pile is located 20m from the SSSI slope, it is envisaged that the vibrations generated during the works will be no greater than the vibrations generated by the regular HGV traffic currently traveling along the Coast Road immediately to the south and west of the SSSI.

Further descriptions of piling can be found in the Piling Management Plan.

16.3.6 Temporary Haul Road at Toe of SSSI Slope

The temporary haul road is required to facilitate access along the Southern Shore area for construction of the sea protection platform, working platforms for drilling and blasting and the revetment.

The proposed route runs from north west to south east through the SSSI area as pictured in Figure 16.2.

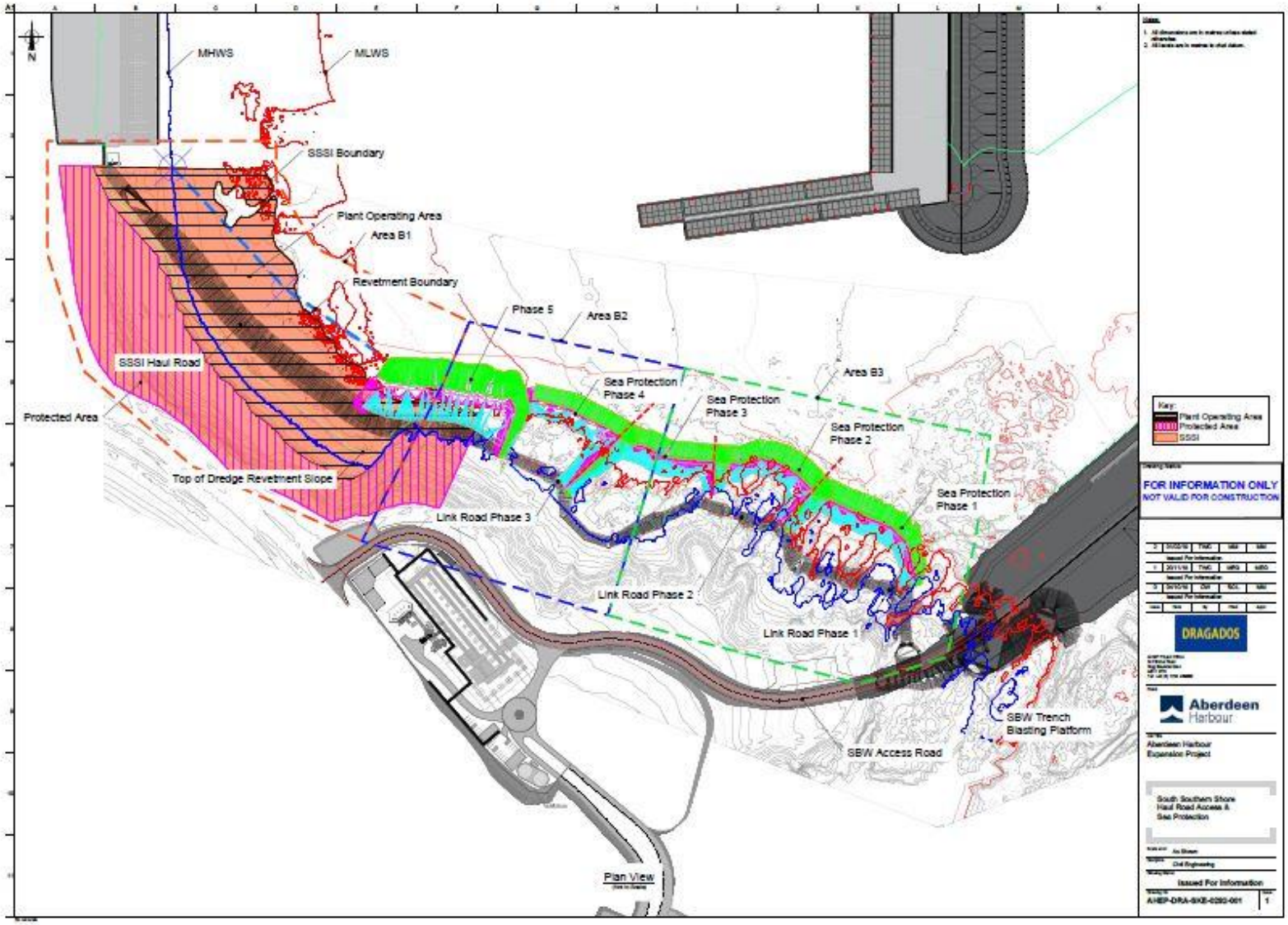

N
MHWS
MLWS
SSSI Boundary
Plant Operating Area
Area B1
Revetment Boundary
Phase 5
Area B2
SSSI Haul Road
Protected Area
Top of Dredge Revetment Slope
Link Road Phase 3
Sea Protection Phase 4
Sea Protection Phase 3
Area B3
Sea Protection Phase 2
Sea Protection Phase 1
Link Road Phase 2
Link Road Phase 1
SBW Trench Blasting Platform
SBW Access Road
Plan View
Key:
Plant Operating Area
Protected Area
SSSI
FOR INFORMATION ONLY
NOT VALID FOR CONSTRUCTION
DRAGADOS
Aberdeen Harbour
Aberdeen Harbour Expansion Project
South Southern Shore Haul Road Access & Sea Protection
Issued For Information
AHEP-DRA-SKE-0260-001

Figure 16.2: Temporary Southern Haul Road (indicative route)

The construction of the temporary southern haul road will comprise of around 50,000m^3 of core material and around 5000m^3 of 1-3 ton armour stone, either procured from the local quarry or dredged material (depending on timing). The method of construction will be similar to that of the South and North breakwaters but on a smaller scale, with trucks placing the core material on the end of the haul road and a dozer / excavator pushing the material outwards. Following the completion of the blasting works, the haul road will be deconstructed. An excavator will be used to remove the core material and rock armour. The material will then be reused in the construction of the breakwaters or for infill in quayside areas.

Initially, from the West Quay access road, the temporary haul road passes across the flat area at the toe of the SSSI slope, for approximately 90m, after which the haul road shall pass over the foreshore area beyond the flat area at the toe of the SSSI slope. The majority of the haul road is either above the mean high water mark or within the area that will be re-profiled during dredging and/or drilling and blasting, to create a stable slope for the harbour area.

Reference should be made to Figure 16.2 which shows the route of the haul road in relation to the SSSI boundary.

The haul road is closest to the SSSI slope at chainage 250. A cross section of the haul road at this location during the dredging works is shown in Figure 16.3.

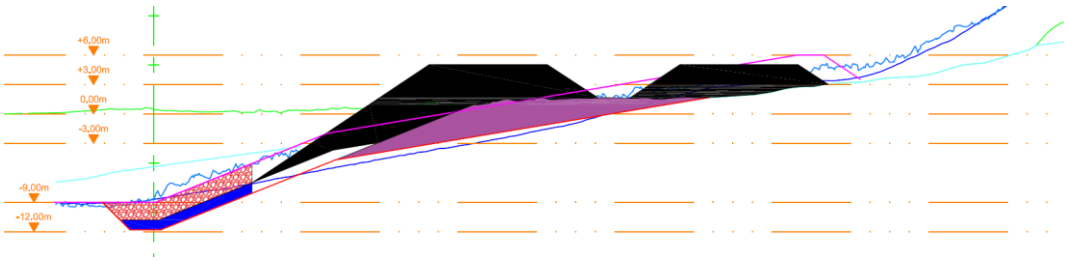


Figure 16.3: Chainage 250 Cross Section

As shown in Figure 16.3 the haul road will be constructed upon an embankment. The embankment will be constructed using site won granular fill, compliant with core material of 0-500kg size. This material will be porous to allow run-off from the SSSI slope to drain freely through the embankment and therefore avoid the accumulation of water between the haul road embankment and the SSSI slope.

A fence will be erected at the base of the cliff to restrict construction plant movements in the vicinity of the slope.

16.3.7 Temporary Working Platforms & Sea Protection

The temporary working platforms and sea protection bunds are required to allow a land drill rig to drill shot holes for blasting works in areas below MHWS.

In the Aberdeen Environmental Statement 2015 it was assumed that all blasting along the southern shore area would be carried out utilising a Drilling and Blasting

vessel, with the material then dredged by a Back Hoe Dredger working from a vessel. However as the project has progressed it is has become evident that this is not technically feasible due to the shallow depth of water.

The access, sea protection and working platforms will be constructed in stages as required to provide sufficient working area for the drill and blast contractor at all times. Once blasting has been completed in one phase, the drill and blast contractor will move on to the next phase and the platform in the previous phase will be removed. Work will continue in this way until all phases are complete and the last temporary platform has been removed. Although the methodology is different, part of the works will be undertaken from land rather than from the marine environment. These activities are covered under the existing Marine Construction & Dredging Licences, the boundaries of which are detailed in Figures 3 and 4 below.

Works will commence in October 2018. Works will be ongoing thereafter to maintain, repair and progress with the link road and sea protection platform as detailed in Table 1 below.

Expected working hours:

Monday to Sunday, 24 hours (excluding blasting)

16.3.8 Blasting Works

Drilling and blasting of rock will be carried out across two regions, as detailed in Table 16.3;

Table 16.3 - Summary of Blasting Works

Drilling and Blasting Location	Approximate Distance from SSSI (m)
North area	300
South area	0

Drilling and blasting operations will be carried out from onshore and over water. The field of blasting typically comprises 25 to 100 holes, and the drilling pattern is chosen in such a way to ensure there is an open face on one side, so that rock can freely expand sideways during blasting. The number of holes drilled and the quantities of explosives packed into them can vary depending on the desired outcome of each blast.

The field is immediately blasted upon its completion. It is anticipated that blasting will take place twice daily (maximum).

Drill holes will be sunk using rotary bored methods to the design depth, an igniter/starter is placed at the bottom of the hole and the explosive is pumped into the hole. The holes are typically charged using approximately 1kg of explosive per cubic metre of rock.

Rock characteristics are likely to be different in each blasting field, and this will influence the magnitude of vibrations generated during blasting works. Impact of vibrations will also be dependent on the distance from the blast.

Prior to blasting, the immediate vicinity of the blasting area will be subject to a photographic survey with particular care taken to capture details of the SSSI. One or more vibration meters will be installed close to the SSSI by the blasting contractor to measure the vibration and acceleration during the blasting works. The first number of blasts are executed with reduced loads and are used to calculate the optimum blasting parameters. .

Prior to blasting works, trial digs may be carried out by excavator to verify rock location and depth to minimise potential unnecessary blasting works.

16.3.9 Revetment/ Re-profiling of Slope

On completion of blasting, the haul road will be removed and the Southern Shore areas will be re-profiled incorporating rock cut slopes and an engineered revetment. The purpose of the revetment and re-profiling is to reduce wave action on the southern shore area.

Figure 16.4 details the areas requiring works to be carried out in the Southern Shore area.

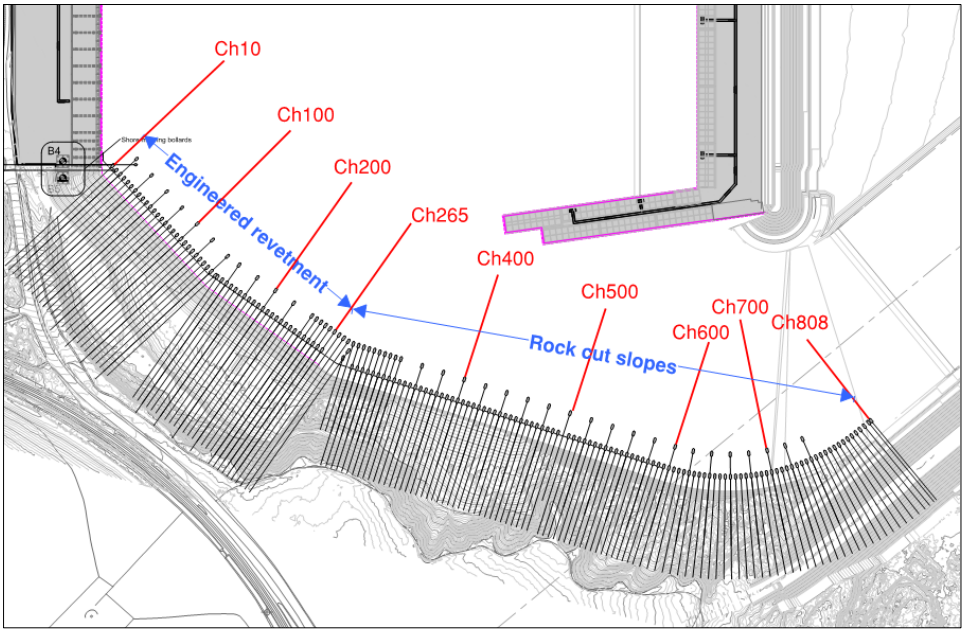


Figure 16.4: Extent of southern revetment area (Extract from NBY-ARP-Z1-XX-DR-CM-0000)

The revetment slope will comprise of a primary rock armour overlaying a rock fill core material. Figure 16.5 provides an example of the rock fill revetment.

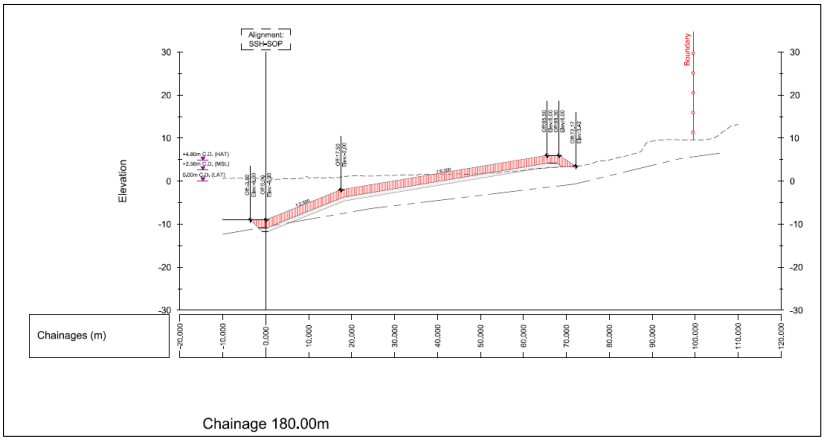


Figure 16.5: Rock fill revetment design

Any construction works at the foot of the cliffs (i.e. along the shore) will be designed to stabilise the cliffs and, coupled with the reduced energy reaching the shoreline due to the breakwaters, any potential erosion to the SSSI will be significantly reduced.

Overall these works will provide protection to the area immediately in front of the SSSI, which under current conditions is at substantial risk of erosion that would, over time, be likely to destabilise the cliff, resulting in adverse effects on the SSSI. Consideration is being given to further landscaping in the SSSI area and is under review by regulators at time of writing

16.4 Potential Risks to SSSI

Given the proposed development and the construction programme detailed in Section 16.3, the following potential risks to the SSSI have been identified.

1. Vibration:
    - Ground Investigation Drilling Works
    - Construction and Reinstatement Works in the Southern Compound Area
    - Construction works associated with the cycle path
    - Plant Movements
    - Trial excavations to verify rock location and depths
    - Blasting Works
    - Construction and use of haul road
    - Piling Works
2. Surface Water Run-Off:
    - Run-off from haul road
    - Run-off from the cycle path
    - Run-off from Southern Compound
    - Redirection of existing groundwater flow as a result of new haul road and Southern Compound area
3. Slope Stability:
    - Increase load at top of slope due to cycle path, haul road and compound area
    - Reduction in passive resistance at toe of slope during construction of revetment
    - Increase load at top of slope due to uncontrolled vehicle parking
4. Contamination:
    - Fuel spillages and leaks
    - Migration of contamination via surface water run-off

16.5 Working within SSSI

Marine cliff faces, such as that in the SSSI, are subject to natural erosion risks from weathering and saturation by rainwater. Slumping can also occur if debris is removed from the foot of the slope, however, the definition of the edge of the pre-existing platform as the boundary of the plant operating area means that debris will not be removed in this case. In construction projects elsewhere, vibration from plant movement, drilling and blasting has provoked toppling of rock from cliff faces that have already been weakened by natural factors.

Works will not commence in the SSSI area until consent is granted by SNH.

16.6 Monitoring of Baseline Condition

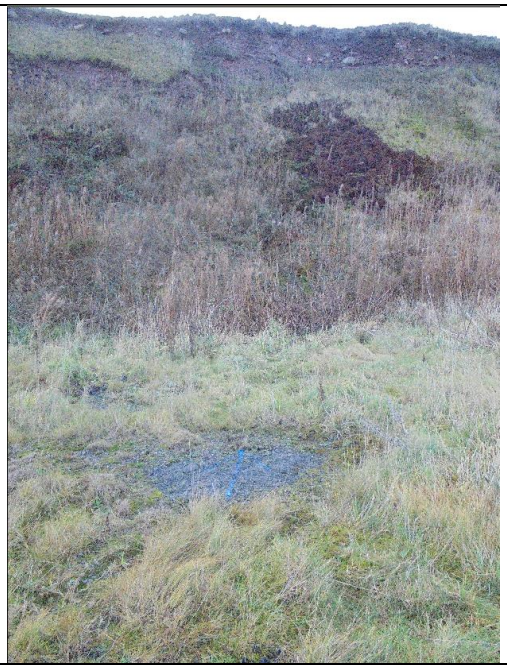
1st December 2018 is taken as a baseline for the condition of the SSSI with regard to the proposed works.

16.6.1 Photography

Since September 2017, the ECOW has carried out weekly observation of the cliffs and has taken photographs of the cliff face from the vantage points on the pre-existing platform. Markers painted on the pre-existing platform define the places and directions from photos are taken for comparison of the slope and identification of changes. Sample photos from these positions are shown in Figure 7. If there is any change in the profile of the soil edges shown in photos taken from these locations during construction, the works will be paused pending notification of SNH and discussion of the causes of the change and possible mitigation.

The east-facing cliff of the SSSI below the Concrete Batching Plant has been viewed from the air in December 2018 (see Figure 8).

a) Photo 1 (NJ9656604477)



b) Photo 2 (NJ9657904450)

c) Photo 3 (NJ 96588 04437)

d) Photo 4 (NJ 96468 04968)

e) Photo 5 (NJ 96610 04415)

Figure 7: Pictures of slope from marked points (as at 18 December 2018) to be the focus of routine photographic comparison.

Figure 8: Photographs of East Slope in SSSI taken from drone in December 2018

16.6.2 Survey

Since November 2017 DUK has monitored four cliff top points (Cliff Point 1-4) in the SSSI for survey purposes, with weekly measurements of lateral displacement and level to within 1 cm and warnings set at ±5cm (that have not yet been triggered). These are defined in Table 2 in Section 4.3.2 below.

DUK routinely monitors the movement of these points (see Figure 9). When weather prevents weekly measurement, the measurement may be fortnightly. DUK will take a level change of 3 cm during construction as indicative of potential slumping on the cliff face and will pause works to notify SNH and will not resume the works until a response has been agreed with SNH as described in Section 4.4.

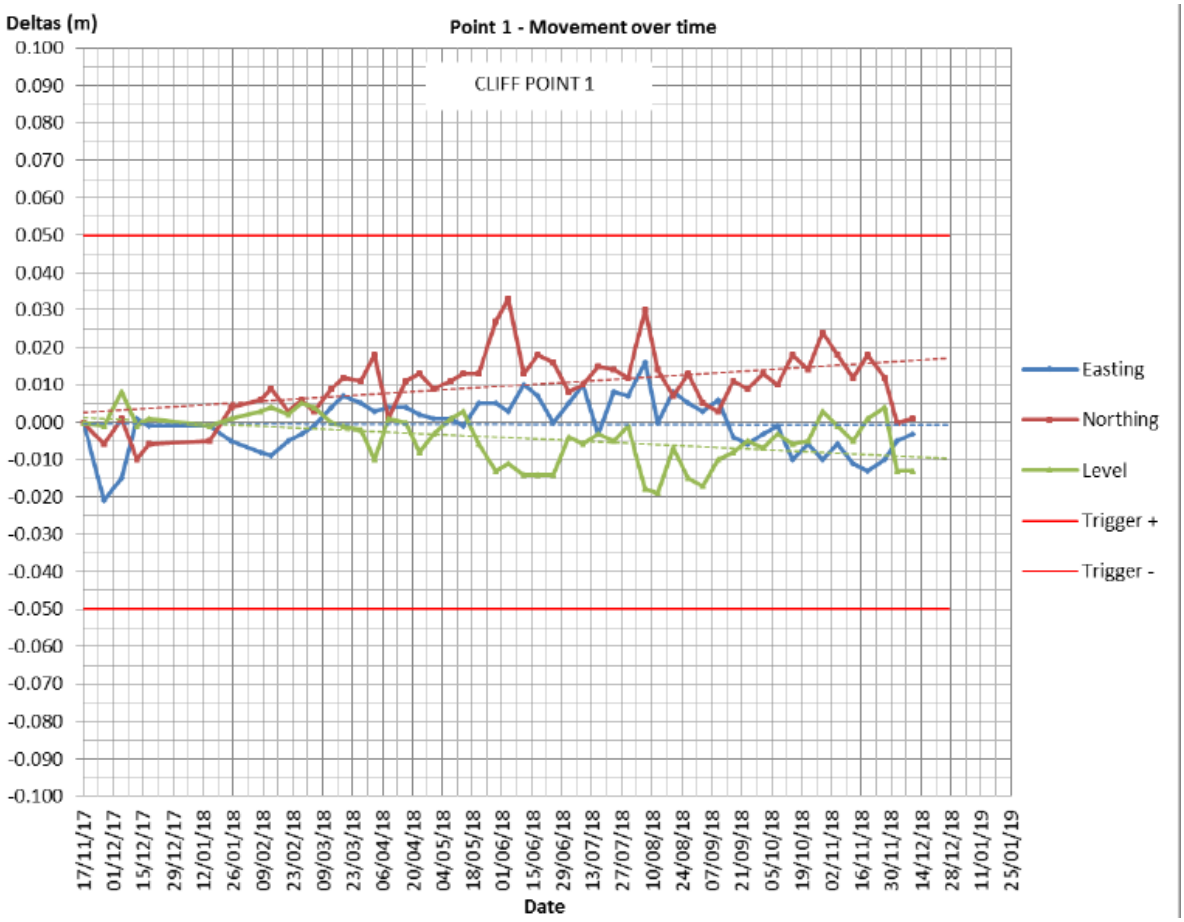


Figure 9: Example of routine survey point monitoring

16.6.3 Vibration Monitoring

DUK has a remote vibration monitor located on a raft of hard core and tarmac on the pre-existing platform within the SSSI (see the map in Appendix D), because it was not possible to fix a vibration monitor to the SSSI slope. It employs a horizontal heavy steel baseplate (adjusted by spirit level) with spike feet to ensure reliable vibration transmission. The monitor records peak particle velocity continuously. It has limit levels set at 8 mm/s and 12 mm/s. The monitor sends email alerts to key DUK construction and environmental staff when these levels are exceeded. 12 mm/s has been adopted from Network Rail as indication the potential for inducing slippage on the SSSI slope. During Southern Shore construction works, the vibrations recorded in the SSSI will be reviewed by environmental team daily, taking consideration of vibrations associated with blast events. If the alerts are connected to movement of plant within the SSSI or blasting, the ECOW will observe the slope for signs of incipient slumping. Recent weather conditions will be taken into consideration.

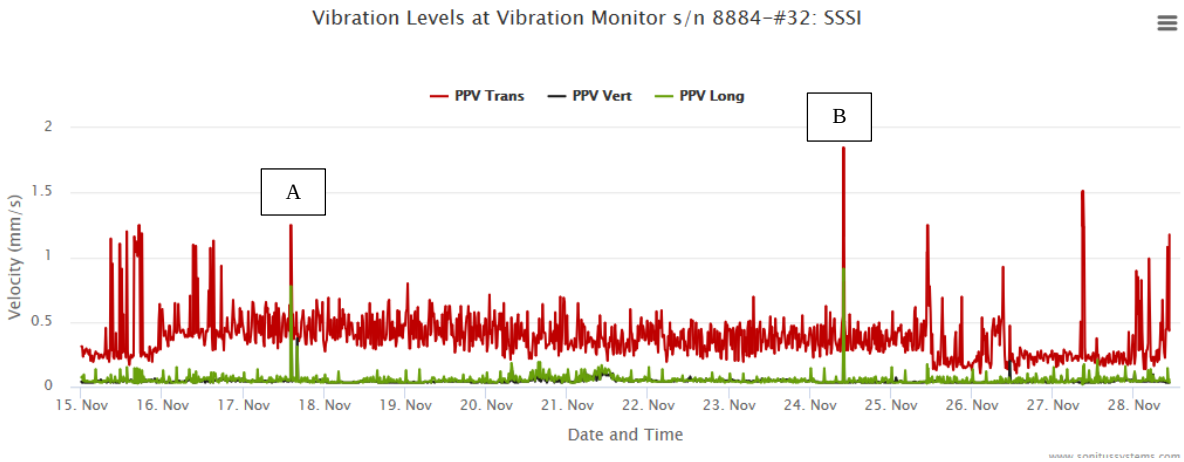


Figure 10: Sample of Vibration Monitor Data from SSSI. Peak A coincides with blasting in north of bay and test onshore blasting in south. Peak B coincides with blasting in north of bay.

16.7 Risk Assessment

The Engineering Risk Assessment presented in Section 16.10 considers that:

- Additional loading at the top of the slope due to traffic movements and parked vehicles may increase active pressures within the slope resulting in slope failure, but that this can be mitigated by 20 m separation of the road and car parking in the Southern Compound from the top of the cliff.
- Excavation at the toe of the slope may reduce passive pressure resulting in slope failure, but no material is to be removed, rather embankment construction for the road will add material over existing debris.
- Vibration caused by construction works, vehicle movements, blasting works and piling works could result in material falling from the exposed slope face. This can be mitigated by not removing material from the toe of the slope, setting the haul road embankment back from the toe of the SSSI slope, constructing the haul road on the shallower debris slope, and, where practical, allowing space for any material from new slope instability to settle between the slope and the embankment. The embankment itself will dissipate traffic vibrations so it is unlikely that vibrations from the haul road will impact the slope.

Figure 11 locates the chainages for which sections through the SSSI slope have been prepared. Examples of the sections presented in Figure 12 for chainage 460m and 500m, show how the road embankment or natural features can arrest the movement of debris.

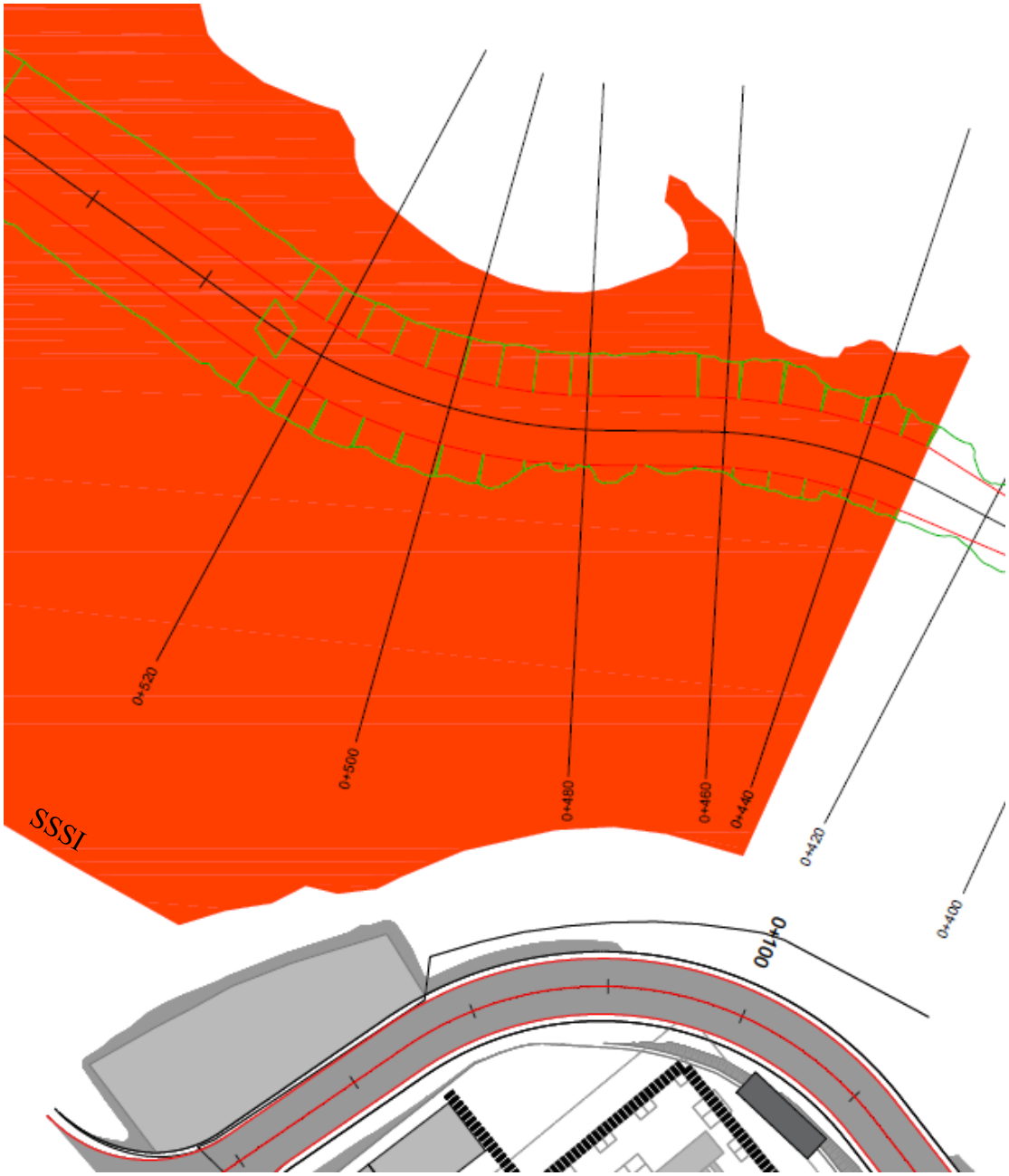


Figure 11: Sections through Slope at East End of the SSSI

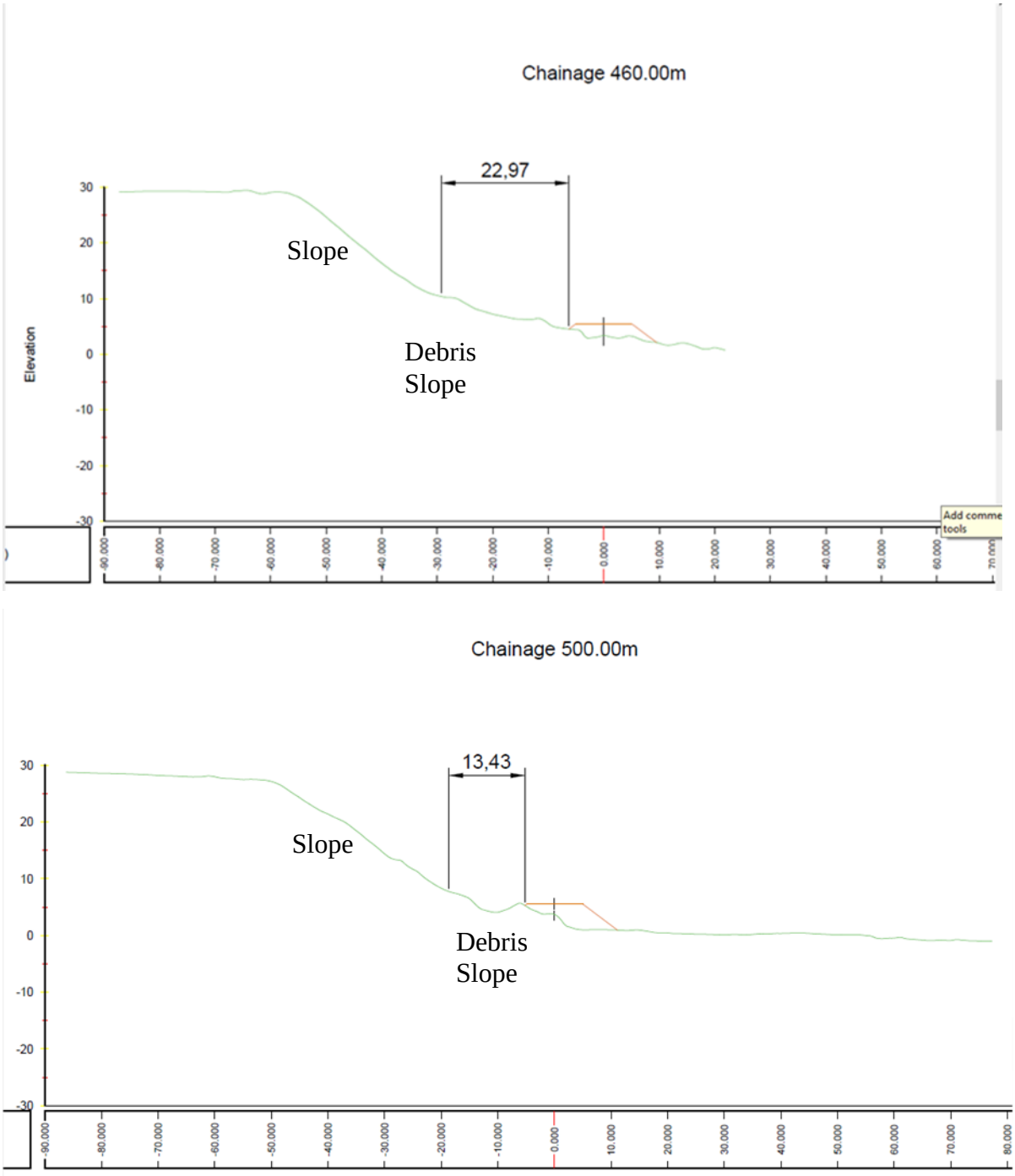


Figure 12: Sections through SSSI slope at chainage 460m and 500m.

Given the gradients involved at the foot of the east slope of the SSSI between chainage 440 and 520, DUK considers that the haul road can be constructed safely, but that regular observation of the condition of the slope should be carried out.

16.8 Proposed Additional Monitoring

16.8.1 Weather Station

DUK has installed a weather station in the Southern Compound. The Environmental Manager will review daily rainfall data recorded by the weather station in the month before works in the SSSI commence. If the rainfall recorded is sufficiently high to indicate that the cliff face is water saturated and at high risk of slope failure, the project ECOW will observe the cliff face and pre-existing platform for water flowing down or from the cliff and for signs of incipient instability before the works commence. The haul road will be sufficiently porous to allow rainwater to run off without accumulating on the pre-existing platform below the cliff.

The Environmental Manager will review daily rainfall data from the weather station weekly during works in the SSSI.

16.8.2 Survey

For the shore works, DUK has added four additional Cliff Points (Points 5-8) for fortnightly survey located on the debris piles at the toe of the cliff face.

Survey Points			
Name	Location	Lat Long	Grid Reference
Cliff 1	Top of the SSSI slope in front of the Southern Compound car park	57°7'48.318 N 2°3'20.356 W	NJ 96760 04355
Cliff 2	Top of the slope by former cycle path. Above the photographed features	57°7'48.955 N 2°3'27.161 W	NJ 96616 04375
Cliff 3	Top of the slope by former cycle path. Above the photographed features	57°7'50.488 N 2°3'30.636 W	NJ 96558 04422
Cliff 4	Top of the slope by the former cycle path.	57°7'51.595 N 2°3'32.383" W	NJ 96528 04457
Cliff 5	Foot of the slope by the photographed features	57°7'49.388" N 2°3'26.413" W	NJ 96628 04387
Cliff 6	Foot of the slope by the photographed features	57°7'49.636" N 2°3'26.857" W	NJ 96621 04396
Cliff 7	Foot of slope	57°7'50.563" N 2°3'28.476" W	NJ 96594 04425
Cliff 8	Foot of slope at zig-zag of the path below the South Compound car park	57°7'48.637" N 2°3'21.523" W	NJ 96711 04365
Photograph points			
Photo 1	Blue arrow towards slope		NJ 96566 04477
Photo 2	Blue arrow towards slope		NJ 96579 04450
Photo 3	Blue arrow towards slope		NJ 96588 04437
Photo 4	From red point towards blue markers		NJ 96468 04968
Photo 5	From vibration monitor towards car park		NJ 96610 04415

Table 2: Co-ordinates of Survey Points and Photograph Points

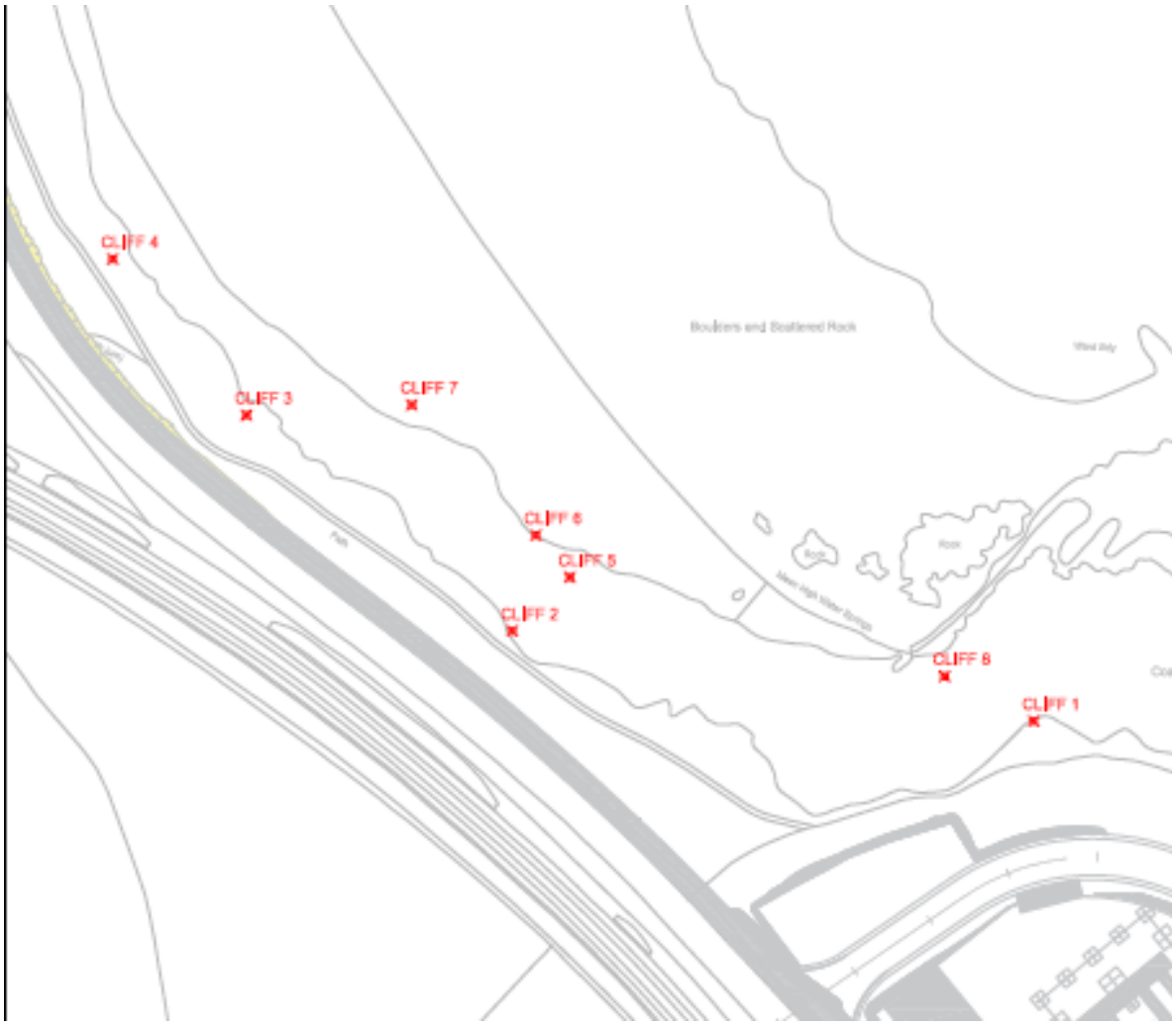


Figure 13: Survey points in the SSSI (excerpt from Appendix E).

If the recorded level of these points shows uplift outside the normal range of variation for the Cliff Points (±3cm), it will be taken as a sign of incipient slumping. Works in the SSSI will be paused, SNH notified and the condition of the cliff face will be reviewed.

16.8.3 Other

Where the edge of the plant operating area, as shown in Figure 2, coincides with the seaward edge of the pre-existing platform below the cliff, a fence will be erected to prevent construction plant from entering the pre-existing platform. This will create a zone of separation between the works and the cliff face behind the pre-existing platform.

By the north facing slope below the concrete batching plant, where there is no pre-existing platform in the SSSI, the line of MHWS set by DUK surveyors on monitors in the cabs of the rock moving plant will indicate the line not to be crossed by the construction equipment operators.

DUK may temporarily add an additional vibration monitor on the north-facing slope below the South Compound car park (by survey point Cliff 8) until it has been established that the vibration data recorded by the SSSI vibration monitor located on the pre-existing platform returns data representative for the whole SSSI.

16.9 Procedure for Observing Cliff

Site personnel will be briefed through tool box talks (see Appendix F) before work commences in the SSSI (and reminded in daily briefings) to recognize the signs of slope failure and to notify the work supervisor and ECOW as soon as possible if they are observed.

During construction work in the SSSI, use of the haul road in the SSSI and blasting in the southern part of Nigg Bay, the ECOW will carry out a weekly inspection of the slope above the haul road and take photographs from the marked positions defined in Section 4.1 above, including photographs showing the positions of flags set in the top of the slope. The Environmental Team will compare photographs for signs of change in the slope, if adverse changes are observed work will be paused. All data, including the photographic record and weather data will be considered together in assessing the risk of land slippage. SNH will notified immediately and the work will not resume until a response has been agreed with SNH.

During construction work in the SSSI, the works supervisor or site engineer will carry out a daily visual observation of the cliff slope for signs of instability or recent slippage: cracks or slope movement; new accumulations of weathered debris at the bottom of the slope; moisture changes, pooling at the foot of the slope and changes in streams coming from the slope; changes in slope profile; changes in vegetation; and changes to the alignment of flags. The observations will be recorded on a daily checklist (see Appendix G). Each week the checklists will be passed to the Environmental Team for evaluation.

If the ECOW or the works supervisor/site engineer observe any changes to the SSSI slope indicative of incipient slumping, work will be stopped in the area of concern, and the site team will set up a safety exclusion zone with barriers and warning notices. The ECOW / Environmental Manager will be informed and SNH will be notified of the observations. All data, including the photographic record and weather data will be considered together in assessing the risk of land slippage. DUK will consult SNH to agree appropriate mitigation measures and/or remedial action. Work will not be resumed until mitigation is agreed with SNH.

- Depending on factors including the cause of the slope instability or failure, its location and severity, weather and access constraints remedial action may include:
- Reduction in speed limits for site vehicles
- Reduction in the size and weight of vehicles using the haul road
- Setting up a permanent exclusion zone below the weakened area of cliff

- Modifications to the blasting program

If inspection of the cliff face following vibration monitor exceedances in the SSSI suggests that blasting is causing incipient slope failure, blasting will be suspended until, taking all data into account, a response has been agreed with SNH. DUK and the blasting contractor will review the data and consider the practicality of modifying the blasting arrangements (e.g. limiting quantity of explosives used in subsequent blasts).

Figure 14 presents the roles and responsibilities described above as work flow charts.

1. Before Works in SSSI

Environmental Manager
Check
- Rainfall from weather station
- Vibration Monitor Data
- Survey Point Data
- Comparison of Photographs
Place flags at top of slope

ECOW
- Observation from foot of slope (weekly)
- Photography (monthly)
- Give TBTs

2. During Works in SSSI (and blasting in south)

Worker
-Work to defined survey lines
- Observe slope when working
- Report change observed to Supervisor

Site Supervisor/Engineer
- Daily visual slope inspection
- Pass checklists to ECoW weekly
- Report change observed to ECoW

ECOW
- Give TBTs
- Observation from foot of slope (weekly)
- Photography (weekly)
- Report change observed to Environmental Manager

Environmental Manager
Check
- Vibration Monitor Data
- Survey Point Data
- Comparison of Photographs
Report to SNH every two weeks that no change has been observed

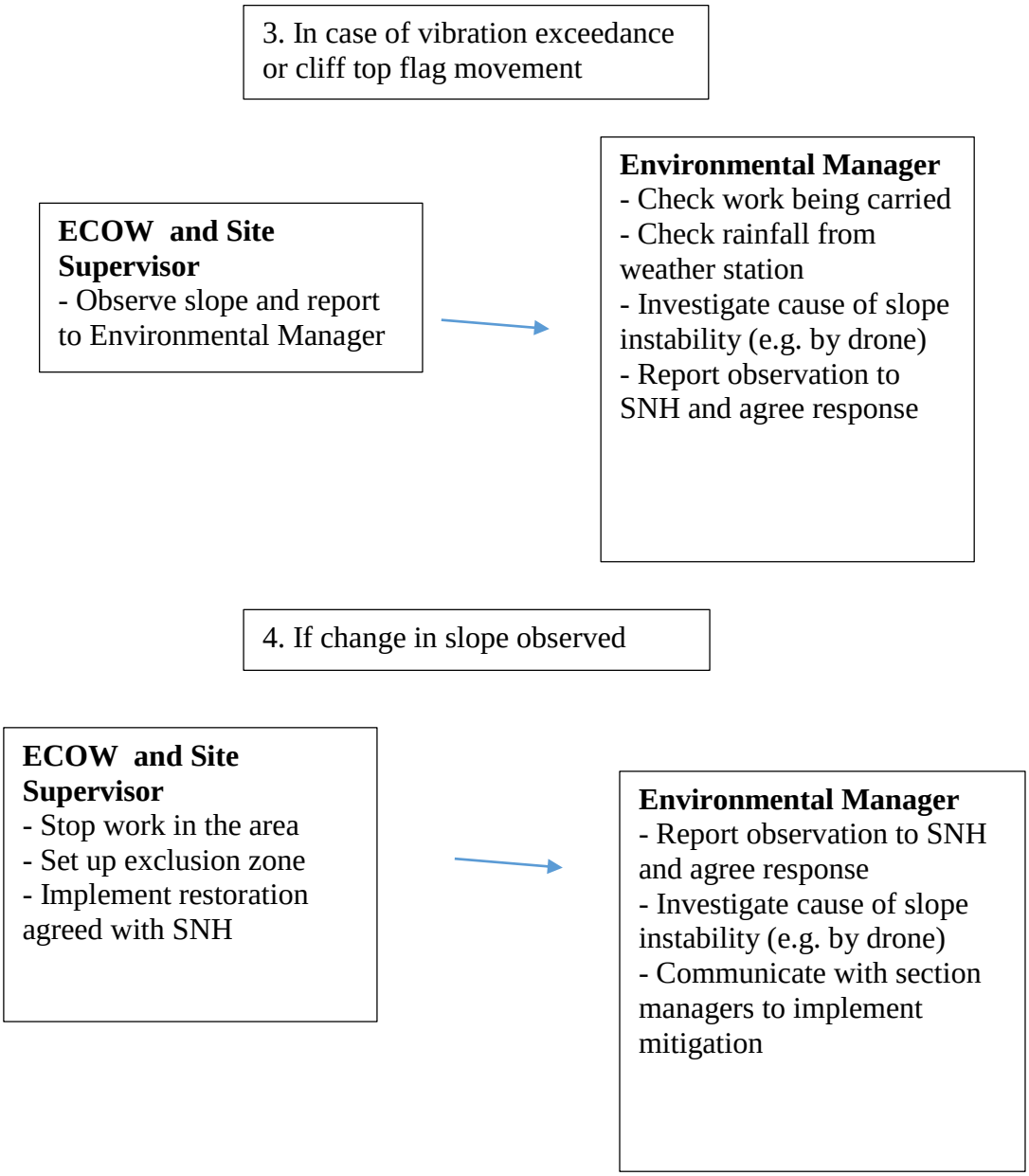


Figure 14: Flow charts defining roles.

16.10 Engineering Risk Assessment

The following engineering risk assessment provides an assessment of the probability of the risks identified in Section 16.4, occurring, given the proposed construction works discussed in Section 16.3. The assessment also considers the existing site conditions, including the current condition of the SSSI, topography and existing road and drainage networks.

When considering the potential risk to the SSSI, it is important to note that the existing exposed slope face is currently over steep. There is clear evidence of historical slope failures, and the slope will continue to slip progressively until it achieves a natural stable slope angle. This will continue to occur through natural erosion as well as from continued disturbance from currently existing infrastructure in the surrounding area.

Table 16.4: Engineering Risk Assessment

Risk Item	Details	Risk Assessment	Mitigation Measures Required? (Y/N)
Vibration	Vibration caused by construction works, vehicle movements, blasting works and piling works, may cause excessive vibration which could result in material falling off the exposed slope face.	**Ground Investigation** Ground investigation works are proposed along the top of the SSSI slope, and located at least 5m back from the top of the slope. It is envisaged that cable percussive drilling will progress at a rate of 5-10m per day depending on ground conditions encountered. Vibrations will be localised to the bottom of the drill hole while drilling through the superficial soils, and therefore it is unlikely that vibrations from the drilling works within the superficial soils will impact the SSSI slope. Similarly, rotary drilling within the bedrock will result in vibrations being localised to the bottom of the drill hole, which will be below the toe the SSSI slope given the depth to rockhead. Therefore, it is unlikely that vibrations from the rotary drilling works will impact the exposed slope face within the SSSI. It should also be noted that ground investigation plant will not track within 5m of the top of the slope, to minimise the potential impact of slope instability due to vibrations from plant movement. It is noteworthy that the majority of the proposed ground investigation locations are no closer to the edge of the SSSI boundary than the existing Coast Road in places, therefore the ground investigation works are unlikely to expose the slope to vibrations any worse than those current experienced due to passing traffic along the existing Coast Road. **Pre - Construction** Nearest rotary piling operation is at the southern edge of the West Quay, which is 20m from the SSSI slope. Therefore it is considered highly unlikely that vibrations from piling operations will impact the SSSI. Piling works will be carried out using a rotary bored pile type, which is a low vibration method of pile installation. It is envisaged that pile drilling works will progress at a rate of approximately 1	N N Y N

Risk Item	Details	Risk Assessment	Mitigation Measures Required? (Y/N)
		pile per 2 days, therefore it is unlikely that any vibrations in the vicinity of the SSSI will be over a prolonged period of time. Given the method of pile installation selected, the distance of the nearest pile from the SSSI and the duration of drilling, it is unlikely that vibrations from the piling works will impact the exposed slope face within the SSSI. During construction of the temporary haul road at the bottom of the SSSI, and the Southern Compound area, plant machinery may need to operate near to the SSSI in order to construct the roads and southern compound area. The haul road at the toe of the exposed slope in the SSSI will be built across the fill material that has been placed across the toe of the slope to protect it. Outwith the SSSI the haul road will be built upon granular embankment fill. However, it is envisaged that the number and frequency of plant on the haul road is more onerous than the traffic loading currently on the Coast Road. That being said the haul road is constructed upon an embankment which will dissipate the traffic vibrations and loading. The Southern Compound area is located at least 10m from the SSSI boundary, with car parking areas and access roads within the compound located 13m and 20m from the SSSI. Given the dense nature of the underlying deposits it is considered that the vibrations from vehicle movements within the compound area will be dissipated by the compound construction and underlying natural soils, so as to pose a negligible risk to the SSSI slope. A new cycle path is to be constructed along the edge of the existing coast road. The cycle path passes locally within the SSSI area, but is located approximately 20m back from the top of the SSSI slope. No excavation works are proposed as part of the construction works for the cycle path, and the cycle path construction is relatively thin. On the basis of the limited construction works and distance from the top of the SSSI slope it is considered that vibrations from the construction works will be low and will dissipate sufficiently so they do not influence the stability of the SSSI slope.	N Y Table 16.5, Reference Number 1 N

Risk Item	Details	Risk Assessment	Mitigation Measures Required? (Y/N)
		It is recommended that demarcation is provided to stop vehicles (both public and construction plant) from parking or crossing between the SSSI and the southern compound area, cycle path, or across the verges along the top of the SSSI.	
		Blasting works are proposed in two locations, firstly at the toe of the southern slopes in order to excavate a trench to construct the revetment, and secondly within the bay area to remove rock so that the required depth of water within the harbour can be achieved. The blasting will typically be undertaken by a charge within a blast borehole.. The plug will contain the blast energy at the toe of the borehole. Adjacent boreholes will be triggered with a small incremental time delay to reduce the overall impact of the blast.	Y
		Prior to blasting, the immediate vicinity of the blasting area will be subject to a photographic survey with particular care taken to capture details of the SSSI. One or more vibration meters will be installed close to the SSSI by the blasting contractor to measure the vibration and acceleration during the blasting works. The first number of blasts are executed with reduced loads and are used to calculate the optimum blasting parameters.	Y (Refer to pre-construction phase)
		The blasted rock will be removed out by excavators on the land side or on marine based barges	
		Prior to blasting works, trial digs may be carried out be exactor to verify rock location and depth to minimise potential unnecessary blasting works	Y (Refer to pre-construction phase)
		Construction The haul road and Southern Compound area are not located any closer to the exposed slope face within the SSSI than the existing Coast Road. Therefore, it is considered that vibrations as a result of	N

Risk Item	Details	Risk Assessment	Mitigation Measures Required? (Y/N)
		day to day operations within the compound will not be greater than level of vibration currently imposed on the exposed slope face by the existing Coast Road. Therefore, no mitigation is required. The use of the cycle path will be limited to bicycles and pedestrians. Therefore, negligible vibrations will be generated along the cycle path during the construction works. Demarcation set up during the pre-construction phase should remain in place during the construction phase. **Reinstatement** During reinstatement, all material used to construct the temporary haul road will be removed and reused elsewhere on site, within the construction works. The fill material will be removed using land based mechanical excavators, which will the fill material onto a dumper truck that will transport the material to the location of its proposed use. Therefore the risks to the SSSI and appropriate control measures are the same at those identified during the pre-construction phase. A geologist will be appointed to monitor the deconstruction of the haul road. This will ensure that the SSSI features of interest are protected and left exposed to ensure the visibility is maintained. Dragados will work with SNH to identify key areas of the SSSI which must be exposed;	
Water Movement	Construction of new haul roads and Southern compound area may generate additional volumes of surface water run-off, and/or interfere with the existing groundwater flow regime. Additional	**Pre – Construction** During construction of the Southern Compound area, swale filter drains will be installed along the northern edge of the Southern Compound area, which will collect any surface water run-off from the compound area. The collected run-off will then flow eastwards, away from the SSSI, before being discharged into the sea. Dragados shall be responsible for carrying out regular inspections to ensure drainage remains effective and operations for the life of the construction period.	Y Table 16.5, Reference Number 3

Risk Item	Details	Risk Assessment	Mitigation Measures Required? (Y/N)
	water movement across the face of the exposed SSSI slope, may damage the SSSI by washing material away from its surface. Significant loss of material from the slope face could result in a global slope failure.	The proposed haul road will be build using site won granular fill, complying with Class core material (0-500kg) size material, that will sufficiently porous to ensure no run off accumulates between the haul road embankment and the SSSI slope. The construction works associated with the cycle path are limited and during construction it is unlikely that the associated works will result in an increase in surface water flow, therefore no mitigation measures are proposed. **Construction** Drainage within the haul road and Southern Compound area shall be sufficient to capture surface water run-off, and ensure it will not impact the exposed slope face within the SSSI. Surface water run-off from the cycle path will drain onto the existing coast road, and be collected by the road drainage. Therefore, there is no impact to the SSSI. **Reinstatement** During reinstatement, the site will be left such that the run-off regime is equivalent or preferable to current conditions.	N N N N
Slope Stability	Additional loading at the top of the slope due to the new haul road, traffic movements, and parked vehicles, may increase active pressures within the	**Ground Investigation Works** Ground investigation plant will be a minimum of 5m from the top of the slope to allow a safe working area when drilling. Demarcation will be required locally to minimise the risk of plant passing within 5m of the top of the slope. **Pre - Construction**	Y Table 16.5, Reference Number 5 Y

Risk Item	Details	Risk Assessment	Mitigation Measures Required? (Y/N)
	slope resulting in slope failure. Similarly, excavation of soil and rock from the toe of the slope may reduce passive pressure, which can also result in slope failure.	During construction of the haul road and cycle path construction plant machinery may require to move within the vicinity of the top of the slope. Demarcation will be required locally to minimise the risk of plant machinery and public vehicles moving near to the top of the slope. The establishment of a barrier around the edge of the road and the compound areas will also stop vehicles and other plant parking at the top of the slope during the construction works. **Construction** The finished road level of the operational haul road is typically at grade and is located 15m from the top of the slope to be protected at its closest point. Therefore, it is unlikely that the haul road or vehicles travelling along the haul road will have an adverse impact on the slope stability. It is advisable that the wayleaves established during the construction period remain in place to stop vehicles parking off the haul road, near the top of the slope to be protected. Use of the cycle path will be limited to bicycles and pedestrians. The construction thickness of the cycle way is thin, therefore the additional load from the cycle path will be negligible, and is therefore unlikely to impact the slope stability within the SSSI **Reinstatement** During reinstatement works the risks in relation to the slope stability of the SSSI are considered to be the same as during construction. Reference should be made to the risk assessment during construction phase.	Table 16.5, Reference Number 6 Y Table 16.5, Reference Number 6 N Y (refer to construction phase)
Contamination	Potential impact on SSSI as a result of fuel spillages and leaks, and potential for contaminants associated with the works within the	**Ground Investigation** Fuel and hydraulic fluid leaks will be managed under the ground investigation contractors risk assessment and method statement. Plant will be inspected daily to ensure it is fit for purpose and to check for leaks. Spill kits will be carried by all plant during the ground investigation works **Pre - Construction**	Y Table 16.5, Reference Number 7

Risk Item	Details	Risk Assessment	Mitigation Measures Required? (Y/N)
	Southern Compound area and cycle path to migrate towards the SSSI. This may result in damage to the SSSI and discolouration on the slope face.	Fuel spillages and leaks will be managed under the pollution prevention plan. Given that the general topography falls towards the north east it is unlikely that any spillages or leaks will impact the SSSI. However, isolated spillages or leaks in the immediate vicinity of the SSSI may also occur. Spill kits should be carried by plant while on site and plant refuelling should only be carried out within designated areas within the compound areas. This is further outlined within the Pollution Prevention Plan (PPP). **Construction** Fuel and chemical storage within the Southern Compound area will be within agreed bunded areas. Fuelling areas are to be designated by the Contractor, and detailed within the PPP. **Reinstatement** During reinstatement the associated risks are considered to be identical to those considered during the construction phase. Reference should be made to the mitigation measures provided during the construction phase.	Y Table 16.5, Reference Number 7 Y Table 16.5, Reference Number 8 Y (refer to construction phase)

16.11 Mitigation Measures

16.11.1 Objectives for Management

SNH wish to work with owners and users to protect and maintain the site, and where possible, enhance its features of special interest. The management objectives of the Nigg Bay SSSI are:

1. **To maintain the visibility of exposures:** vegetation growth has obscured some of the exposures. However, vegetation stabilises the slope and is relatively easy to clear. It is thus recommended by SNH that vegetation is only removed if suitable research projects arise.

2. **To maintain access to the site and to the exposures.**

16.11.2 Historical Management

In 1984, tipping of rubble, concrete, tarmacadam, cassies, paving slabs and unknown waste was carried out to protect the bottom of the cliff from coastal erosion. This created a platform along the entire extent of the cliffs, halted erosion and obscured the lower sediment layers. By halting erosion, vegetation growth was promoted on the cliff face which further covered the deposits[3].

In 1999, a report managing coastal erosion in Aberdeen Bay was produced and recommended that Nigg Bay should be left to allow coastal processed to continue, allowing SSSI deposits to become re-exposed in the longer term. This recommendation was to be reviewed at regular intervals with a view of monitoring any lowering of the foreshore in front of the retained road and car park. In 2010, an inspection confirmed that that coastal erosion was breaking down the platform and it was considered likely that the southern section of the SSSI would be re-exposed within a few years[3].

In 2002, a series of vegetation ‘windows’ were cleared on the cliff face to expose samples of the deposits. Some sediments remain visible but some slumping and regrowth of vegetation has occurred[3].

16.11.3 Current Management

There is currently little or no active management of the SSSI and public use tends to be confined to occasional bonfires and motorbike scrambling. Illegal tipping has been a problem in the past but has ceased in recent years[3].

The University of Aberdeen has used Nigg Bay, however, leachate from the nearby landfill site is believed to be detracting from the use of the site as an educational resource[3].

The SSSI is part of the Balnagask to Cove Local Nature Conservation Site for its botanical and bird interest and a local Biodiversity Action Plan has been prepared for the whole Nigg area. Prior to construction works commencing, there was an interpretation panel including information about the SSSI in the car park in the north of Nigg Bay[3]. This car park has been demolished as part of the construction works,

so a new interpretation board will be installed along the coastal path once construction is complete.

16.11.4 Mitigation Measures and Commitments During Construction

Based on the proposed development works and associated risk assessment, the following commitments and mitigation measures are proposed. These are further detailed in Table 16.5. These should ensure the slope within the SSSI is protected from impacts resulting from AHEP construction.

- A geologist will be appointed to monitor the deconstruction of the haul road. This will ensure that the SSSI features of interest are protected and left exposed to ensure the visibility is maintained. Dragados will work with SNH to identify key areas of the SSSI which must be exposed;
- Prior to blasting, the immediate vicinity of the blasting area will be subject to a photographic survey with particular care taken to capture details of the SSSI;
- As outlined in Section 16.3.8, vibration monitoring will be undertaken during the blasting works;
- Visual monitoring will be undertaken during blasting works, with particular attention paid to periods of persistent wet weather. This will ensure that any changes in slope stability are monitored and recorded and mitigation measures applied if required (e.g. temporary stoppage of blasting adjacent to slope area); and
- A fence will be erected at the base of the SSSI slope to mark out a restricted access area to construction plant and personnel.
- Prior to blasting works, trial digs may be carried out by excavator to verify rock location and depth to minimise potential unnecessary blasting works

Table 16.5: Recommended mitigation measures

Reference Number	Risk	Operation	Phase	Timescales	Mitigation	Responsible Person/Party
1	Vibration	Construction Plant Movements	Construction & Reinstatement	From pre-construction works (April 2017) for the duration of works	Demarcation of areas to restrict construction plant movements in the vicinity of the slope	Construction Manager ECoW
2	Vibration	Blasting	Construction	Prior to commencement of blasting	Blasting contractor will undertake blasting trials, at which time the slope stability will be monitored. Prior to blasting works, trial digs may be carried out by excavator to verify rock location and depth to minimise potential unnecessary blasting works	Construction Manager/ Blasting Contractor/ Environmental Manager
3	Water Movement	Surface water run-off	Construction & Reinstatement	Installed during pre-construction work (April 2017) and checked throughout the duration of works.	Drainage ditches and /or collection drains to be installed locally to carry water away from the SSSI. Weekly inspections required to ensure drainage remains effective and operates for the life of the construction period. Increased inspections to daily during periods of heavy and sustained wet weather.	Construction Manager ECoW
4	Water Movement	Surface Water run-off	Operation	Installed during pre-construction work (April 2017) and checked throughout the duration of works.	Drainage within the haul road and Southern Compound area will be adequate to capture surface water run-off.	Construction Manager

Reference Number	Risk	Operation	Phase	Timescales	Mitigation	Responsible Person/Party
5	Slope Stability	Plant movements at top/toe of the slope	Ground Investigation	From pre-construction works (April 2017) for the duration of works	Demarcation of areas to restrict ground investigation plant movements in the vicinity of the slope	Ground Investigation Contractor/Construction Manager
6	Slope Stability	Plant movements at the top/toe of the slope	Construction, Operation & Reinstatement	From pre-construction works (April 2017) for the duration of works	Demarcation of areas to restrict construction plant movements in the vicinity of the slope	Construction Manager
7	Slope Stability/ Visibility	Deconstruction of haul road	Construction	From completion of construction of haul road and when deconstruction begins	A geologist will be appointed to monitor the deconstruction of the haul road. This will ensure that the SSSI features of interest are protected and left exposed to ensure the visibility is maintained. Dragados will work with SNH to identify key areas of the SSSI which must be exposed	Environmental Manager
8	Contamination	Chemical spillages and leaks	Construction & Reinstatement	From initiation of construction works (April 2017) for the duration of works	Spill kits to be carried by site plant. Refuelling only to be carried out in agreed areas, as set out in the Pollution Prevention Plan	Health and Safety Manager
9	Contamination	Chemical spillages and leaks	Operation	From initiation of construction works (April 2017) for the duration of works	Fuel and chemical storage to be within bunded areas in the Southern Compound area, in accordance with the Pollution Prevention Plan.	Health and Safety Manager

In addition to the above, it is recommended that weekly tool box talks are carried out on site to highlight the risks detailed above and recommended mitigation measures. These will be given by the ECoW.

Discussion will also be held with SNH on whether, when machinery is on site for construction purposes, any additional works could be completed at the SSSI to enhance the SSSI management, such as clearing of an area of the face to better expose the geological feature. SNH will be contacted near the end of the operational stage of the temporary haul road to discuss any consents required to undertake this work as well as methodology for the removal of vegetation including the removal of any non-native invasive species if found to be present.

16.12 Conclusion

Some of the proposed construction works associated with the Aberdeen Harbour Expansion Project, will be within the SSSI area or within influence of the SSSI.

However, it is important to note that the area of particular concern within the SSSI is the exposed slope face, which is currently in an unstable condition as it is over steep, and will continue to progressively fail naturally until the slope achieves its natural angle of stability.

The majority of the proposed construction works will not result in exposing the SSSI to conditions any worse than it is exposed to currently. The proposed construction works on and within influence of the SSSI have been assessed in relation to;

- Method of construction, and where possible timescales
- Existing site conditions
- Proposed layouts
- Proposed engineering measures already incorporated within the works

The potential risk to the SSSI was assessed over the duration of the construction works, and spilt into pre-construction, construction and reinstatement phases.

Overall, the majority of the proposed construction works were considered not to have an impact on the SSSI, however where an aspect of the proposed works was assessed to present a potential risk to the SSSI, mitigation measures have been recommended, and include;

- Control of vibrations during blasting through blasting trials, and agreement of vibration levels with the client/authority
- Demarcation of zones near at the top of the SSSI near the Coast Road
- Incorporation and maintenance of drainage within haul roads and Southern Compound area to control surface water run-off
- Establishment of refuelling zones within the compound areas and management of potential contamination incidents in accordance with the Pollution Prevention Plan

The implementation and management of these mitigation measures will ensure that the proposed construction works will have a negligible impact on the SSSI.

If the proposed construction works vary from what is described within this report, the CEMP will require to be revisited and impacts to the SSSI reassessed to ensure no further mitigation measures are required.

Appendix A

Drawings

A1 Drawings

A2 APPENDIX A

Southern Shore Access Haul Road & Platforms

AHEP-DRA-DRA-SKE0292-001

DRA-T-SSH-TW0001-DWG-200002-001

A3 APPENDIX B

SSSI Revetment Drawings (example sections)

DRA-P-SSH-D00002-DWG-800001-000

DRA-P-SSH-D00002-DWG-800001-003

DRA-P-SSH-D00002-DWG-800001-013

DRA-P-SSH-D00002-DWG-800001-023

A4 APPENDIX C

South shore finished profile (example sections)

DRA-P-SSH-D00002-DWG-800001-032

DRA-P-SSH-D00002-DWG-800001-036

DRA-P-SSH-D00002-DWG-800001-054

DRA-P-SSH-D00002-DWG-800001-070

A5 APPENDIX D

Vibration Monitoring Plan

AHEP-DRA-PRO-0055-DWG

A6 APPENDIX E

SSSI Survey Points at Clifftop and Cliff bottom.

Cliff Point 3: Coastal Road Monitoring 22/01/2019

A7 APPENDIX F

Toolbox Talk on Recognising Incipient Slope Failure

DRAGADOS	TRAINING. LIST OF ATTENDEES

INDUCTION ☐ **TOOL BOX TALK** ☐ **OTHER DURATION** ☐

LOCATION: AHEP Site

NAME OF COURSE: SSSI slope failure signs **DATE:**

CONTENT:

A Special Scientific Interest (SSSI) is an area legally protected by Scottish Natural Heritage (SNH) as it represents a particular type of plants diversity, animal habitat, rocks or landforms. The unstable slopes in the south west of Nigg Bay SSSI contain one of the best examples of a particular type of glacial geology. To work within the SSSI boundary, AHEP requires consent from SNH.

The temporary haul road to be constructed from the South breakwater to the West Quay area passes through the SSSI. Natural causes like heavy rain and frost can overcome shear stresses in the rock and make it easier for the slope to slip. Vibration from construction, heavy vehicles or blasting can also start rock slides in the slope.

Common signs of slope failure to look out for, especially after heavy rain or frost are:

- Visible cracks. If you can see that cracks have opened in the surface of the slope, there's a strong possibility that the underlying structure has shifted.
- If vertical structures in the slope start to lean or move, (e.g. guardrails at the top of the slope, flags placed in the slope or bushes) it could mean the slope is unstable.
- If new rocks, debris or soil from the slope are noticed at the uphill side of the haul road, the slope could already be starting to give way
- If you notice humps or bumps in the slope that weren't there before, they may be telling you the ground beneath is moving.
- If you notice water flowing down the slope where it didn't before or streams flowing from the slope in new places (or if places that used to hold water are suddenly dry) it may be a sign that the slope is changing and that the geology has shifted.
- If you notice that the alignment of marker flags set in the top of the slop has changed from previous days, it may mean the slope is starting to slip.

If you notice any of these signs, point them out to your supervisor or to the ECOW.

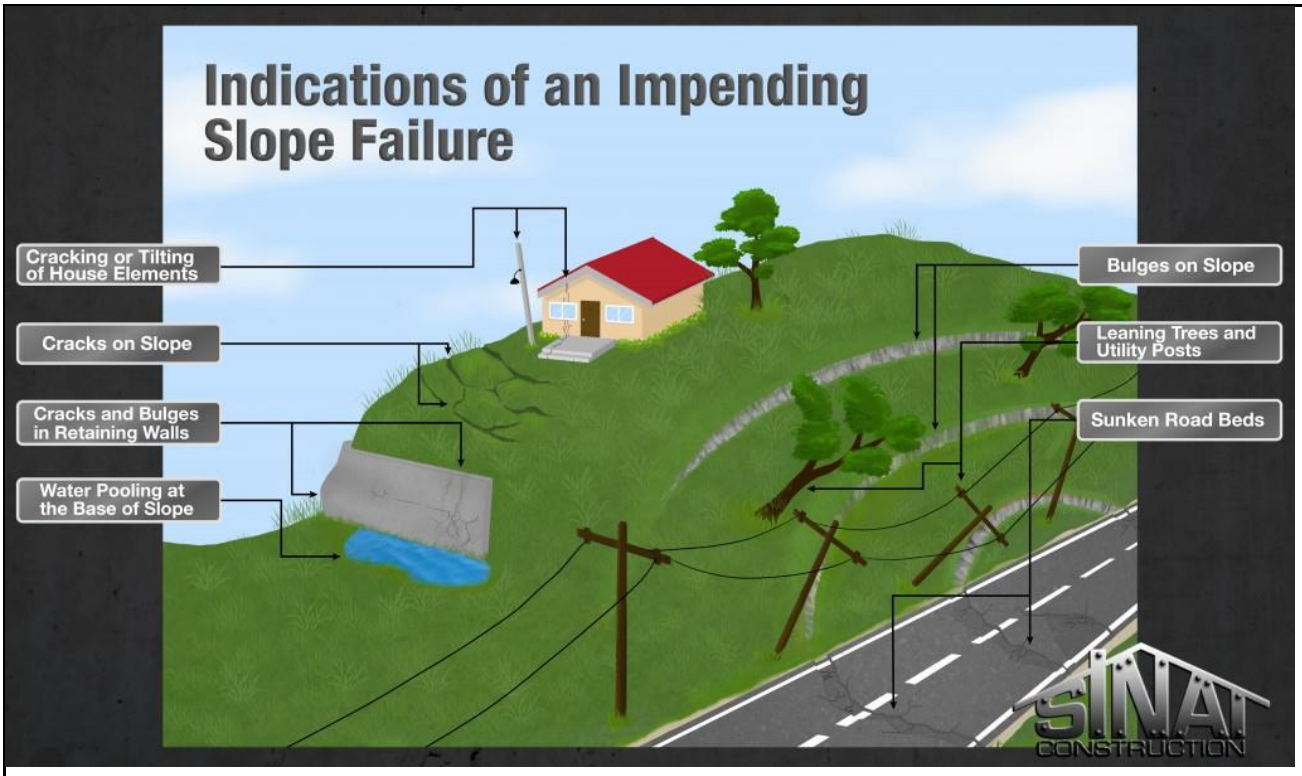


Figure: examples of signs of slippage.

To identify any potential issues within the SSSI during construction of the haul road:

- The ECOW will inspect and photograph the slope every week.
- The head of section and/or site engineer will complete a daily checklist identifying signs of slope failure for the Environmental Team.
- Any signs of slippage noted on the checklist must be brought to the ECOWs attention immediately.
- The daily forms will be collected and passed to the Environmental Team at the end of each week.

As soon as any signs of slope failure are observed, work must be stopped immediately and the observations must be reported to project ECoW or Environmental Team for investigation.

ID	NAME	COMPANY	SIGNATURE

Appendix G

Checklist : Observing Slope Failure in SSSI

AHEP SSSI Daily checklist Central

Date / /	Time	Print Name	Visible cracks or slope movement	New boulders or debris at base of slope	Moisture changes (drainage, pooling water at base of slope)	Hummocky slope surface	Changes in vegetation	Change in flags alignment at top of slope	General comments / observations
Monday									
Tuesday									
Wednesday									
Thursday									
Friday									
Saturday									
Sunday									