Scottish Natural Heritage
Research Report No. 1160

Scottish Natural Heritage Earth Science Site Condition Monitoring methodology 1999-2019

Appendices 1 to 7

Scottish Natural Heritage
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RESEARCH REPORT

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Appendices 1 to 7

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Appendix 1: Early JNCC interagency Earth science Site Condition Monitoring guidance

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Note that all these documents have been recreated from scans of printed originals.

JOINT NATURE CONSERVATION COMMITTEE

OPERATIONAL GUIDANCE FOR EARTH SCIENCE SITE MONITORING

- DEVISING SITE-SPECIFIC CONSERVATION OBJECTIVES
- MAKING A SITE-CONDITION ASSESSMENT TEMPLATE
- RECORDING SITE CONDITION

Neil Ellis, Joint Nature Conservation Committee
January 1999; revised June 2000

HOW TO RECORD THE 'CONSERVATION CONDITION' [CONSERVATION STATUS] OF AN EARTH SCIENCE SITE

Overview

This document summarizes how site-specific conservation objectives can be drawn up for an Earth science site. It also provides a reference or "master" list of questions from which a 'condition assessment form' (a monitoring template or pro forma) can be drawn up for a site, this 'master list' is extensive but not exhaustive. By answering the relevant questions on an assessment form during site survey, you will be able to determine site condition. The questions are aimed to be as simple as possible, requiring "yes" or "no", or "less" or "more", answers.

This document is designed to be used in conjunction with the JNCC report of Earth Science site monitoring (Ellis, 1998, where general guidance and discuss on of the broad considerations for site monitoring are given), and your own country agency guidance.

Selecting from the "master" list of monitoring questions for a particular site can best be done using this document once you know the Earth Science Conservation Classification (ESCC) category of the site in question (e g Disused Quarry, Coastal Cliff). The ESCC category gives a first approximation for a monitoring template. However, not all of the questions on the 'master list' for a given ESCC category will be relevant to a particular site – e.g. grazing will not be an issue at every "relict geomorphology" site. The intention is that you select the questions that are relevant to the site under study in order to produce a condition assessment form for that site.

The questions under each ESCC category are listed under subheadings 'Setting/context/structure", "Quantity" and "Quality". However, it is not always easy to ask questions that relate solely to "quantity" of geological entities present in a site (regardless of their condition) or "quality" (their physical condition) or "structure" (physical setting or context). Often, quality and quantity can be inter-related, particularly in active geomorphological systems. "Setting/context/structure" relates to the layout of the important geological elements in the site and the internal structure of those elements in unconsolidated material (which might be susceptible to collapse or vegetative disruption for example). The arbitrary division into the three types is merely a device to group similar types of monitoring question and does not affect the interpretation of site condition.

(A) Drawing up a site-specific conservation objectives

1. Using technical information, identify the key geological elements/entities or assemblages at the site that led to its selection as a GCR site (hint look for geological jargon!). You will need to know which GCR "Block(s)" [geological site selection categories] the site was selected for. Sources of information SSSI Citation, GCR statement, site documentation report/ site management brief, published GCR volumes or draft GCR texts at JNCC Is it the *similis pulchra* biozone? Is it the granophyre? Is it that the site yields rare flying reptile fossils?
2. Work out how the key geological elements/entities are manifested at the site - where are they and what do they look like? Photographic sources, with annotations, will be helpful. You may need to refer to the relevant national team geologist. [This assessment may have to be done on-site, rather than beforehand] Is it the layer of red flaky rock? Is it the whole sequence of rock layers? Is it the contacts between different rock types? Is it the esker, the kame, or both? How much "contextual material" is to be conserved with the key entities? How "islanded" can the key entities afford to be? (You cannot conserve a rock layer half

way up a cliff without conserving the supporting strata. It might not matter if the lower levels are covered over, however. Equally, the relationship to the underlying strata could be the most important thing about the site). Where non-expert geologists are going to be doing the monitoring, it may be helpful to translate "Upper Carboniferous turbidite" into "key sequence of rock units" and "contacts between rock units above and below". I have attempted to classify geological entities into such plain language in the JNCC general guidance (Ellis, 1998) on Earth science site philosophy and strategy [*Monitoring the Condition of Earth Science Sites: A Framework and Guidelines for Earth Science SSSIs and ASSIs* - see the list of entities referred to as "Earth Science Elements" at the top of each sheet giving guidance on monitoring a particular category of the ESCC]

3. What is the Earth Science Conservation Classification that *applies to the key entity/ entities?* There may be more than one ESCC at a given site (e.g. coastal cliff and relict geomorphology atop), and both may need to be considered in such "mixed" cases Source of info: Site management plans/briefs.
4. Refer to the relevant JNCC general conservation guidance sheets for Earth science site monitoring - which are arranged by ESCC category - for a discussion of general considerations (Ellis, 1998)
5. With the general guidance and your own country agency information as a guide, draw up a specific list of conservation objectives for the site taking into account site layout, extent of key entities and baseline condition. (The baseline condition will refer to the extent and condition of the key entities at first recording, e.g. giving dimensions and indicating degree of cover by soil/ debris/ vegetation and weathering, and identifying principal threats). The list of objectives may simply be such things as "No artificial afforestation", or "quantity of exposure of key rock layers the same or increasing", "rock exposure unobscured and not covered by soil, scree vegetation or artificial constructions"
6. Consider what the "critical point" for each objective is (i.e. define the "limit of acceptable change"), using the general guidance to help. It will help you decide whether the site has become unfavourable in its conservation status later. Again, the limit might be simple "no evidence of tree planting", "no more than 10% of the exposure covered by soil/ vegetation", or "amount of rock exposure being reduced by levels consistent with normal ("natural") coastal erosion", "critical point is when cliff line has receded to x".
7. Consider the vulnerability of the site to threats that may damage the important geological entities present, and decide upon a recommended frequency of monitoring - once every 6 months (fragile sites), or once every three years (robust sites). The aim should be that every site is surveyed at least once within any given 6-year period.

(B) Devising the a condition assessment template for a site

To carry out the site survey and to work out the conservation condition of a site, the answers to a series of indicative questions will be needed each time the site is surveyed. To draw up the list of indicative questions pertinent to the site, refer to relevant ESCC(s) monitoring question "master" lists given below. Eliminate questions that are not relevant to the site (e.g. intactness of a "No hammering" sign might not be relevant). This will give you a question template for that site.

A compromise may need to be agreed if there are conflicting conservation requirements (e.g. coastal erosion that is removing a kettle hole at a coastal geomorphology + Quaternary site). See discussions in the general guidance (Ellis, 1998) under the relevant ESCC.

(C) Site Survey and assessment

1. During the site visit, first, locate the features of interest at the site, and take fixed-point photographs (if appropriate)
2. Answer the questions on the question template for the site. Answer "yes" or "no", or "specialist assessment required" unless otherwise indicated. Record the date of survey.
3. Referring to the site assessment flowchart (in the general guidance), and considering the limits of acceptable change for the site and its baseline condition/last recorded condition, use the answers to the questions to correctly record the current conservation status. If appropriate, compare the answers (and fixed-point photographs) to those recorded at the last site survey.If your answers indicate that the site is in within the "limits of acceptable change", the site is in "favourable" condition. If the site was in "favourable" condition at the last assessment, the site will be "favourable - maintained" If your answers indicate that there are now some problems i.e. the key Earth science elements have been adversely affected or have naturally deteriorated, you will need to judge how severe the changes/modifications have been and whether or not the site is still, on balance, within the limits of "favourable condition" or whether it is now in "unfavourable condition". Refer to the discussion on site conditions ("Favourable - Maintained" etc.) in the general guidelines (Ellis, 1998) for the relevant ESCC, and note any special circumstances described in the site specific conservation objectives. Referral to specialists may be required in equivocal cases
4. Report assessment to Earth science HQ staff and JNCC (GCR Unit).

EARTH SCIENCE SITE MONITORING: CONSERVATION OBJECTIVES AND SITE MONITORING QUESTIONS

January 1999

This note provides guidance on (A) Drawing up site-specific conservation objectives, (B) making a monitoring question template, and (C) recording site condition for an Earth Science site

Overview

This document summarizes how site-specific conservation objectives can be drawn up for an Earth science site. It also provides a reference or "master" list of monitoring questions from which a monitoring question template, tailored to particular site, can be devised. The answers to the questions on a monitoring template will help assess site condition during survey. The questions are aimed to be as simple as possible, requiring "yes" or "no", or "less" or "more", answers.

This document is designed to be used in conjunction with the JNCC report of Earth Science site monitoring (Ellis, 1998; where generic guidance is given), and your own country agency guidance.

The "master" list of monitoring questions is collated by Earth Science Conservation Classification (ESCC) category (e.g. Disused Quarry, Coastal Cliff), so knowing the ESCC category will give a first approximation for a monitoring question template. However, not all of the questions for a given ESCC category will be relevant to a particular Site – e.g. grazing will not be an issue at every relict geomorphology site.

The questions under each ESCC category are listed under subheadings "Structure", "Quantity" and "Quality". However, it is not always easy to ask questions that relate solely to "quantity" of Earth science elements present m a site (regardless of their condition) or "quality" (their physical condition) or "structure" (physical setting or context). Often, quality and quantity can be inter-related, particularly in active geomorphological systems. "Structure" used in this document relates to the setting/context of the Earth science elements m the site and the internal structure of the Earth science elements m unconsolidated material (which might be susceptible to collapse or vegetative disruption for example). The arbitrary division into the three types does not affect the interpretation of site condition.

(A) Drawing up a site specific conservation objectives

1. Using technical information, identify the key geological entities or assemblages at the site that led to its selection as a GCR site (hint: look for geological jargon!). You will need to know which GCR "Block(s)" [geological site selection categories] the site was selected for. Sources of information: SSSI citation, GCR statement, site documentation report/site management, published GCR volumes or draft GCR text at JNCC.
2. Work out how the key geological entities are manifested at the site- where are they and what do they look like? Photographic sources, with annotations, will be helpful. You may need to refer to the relevant national team geologist. [This assessment may have to be done on-site, rather than beforehand] Is it the layer of red flaky rock? Is it the whole sequence of rock layers? Is it the contacts between different rock types? Is it the esker, the kame, or both? How much "contextual material" is to be conserved with the key entities? How "islanded" can the key entities afford to be? (You cannot conserve a rock layer half way up a cliff without conserving the supporting strata; it might not matter if the lower levels are covered over, however. Equally, the relationship to the underlying strata could be the most important thing about the site) Where non-expert geologists are going to be doing the Monitoring, it may be helpful to translate “Upper Carboniferous turbidite” into “key sequence of rock units” and “ contacts

between rock units above and below". I have attempted to classify geological entities into such plain language in the generic guidance (Ellis, 1998)

3. What is the Earth Science Conservation Classification *that applies to the key entity/ entities?* There may be more than one ESCC at a given site (e.g. coastal cliff and relict geomorphology atop), and both may need to be considered in such "mixed" cases
4. Refer to the relevant JNCC generic conservation objectives/ targets sheets for Earth science site monitoring (Ellis, 1998), which are arranged by ESCC category
5. With the generic objectives and your own country agency information as a guide, draw up a specific list of objectives for the site taking into account site layout, extent of key entities and baseline condition. The baseline condition will refer to the extent and condition of the key entities, e g. giving dimensions and indicating degree of cover by soil/ debris/ vegetation and weathering, and identifying principal threats. The list may simply contain objectives like "No artificial afforestation", or "quantity of exposure of key rock layers the same or increasing", "rock exposure unobscured and not covered by soil, scree vegetation or artificial constructions"
6. Consider what the "critical point" for each objective is (i.e. define the "limit of acceptable change"), using the generic guidance to help. It will help you decide whether the site has become unfavourable later. Again, the limit might be simple "no evidence of tree planting", "no more than 10% of the exposure covered by soil/ vegetation", or "amount of rock exposure being reduced by levels consistent With normal ("natural") coastal erosion; critical point is when cliff-line has receded to x"
7. Consider the vulnerability of the Site to threats that may damage the Earth science elements present, and decide upon a recommended frequency of monitoring - once every 6 months (fragile sites), or once every three years (robust sites). The aim should be that every site is surveyed within any given 6-year period.

(B) Devising the a monitoring question template for a site

To carry out the site survey and to work out the conservation condition of a site, the answers to a series of indicative questions will be needed each time the site is surveyed. To draw up the list of indicative questions pertinent to the site, refer to relevant ESCC(s) monitoring question "master" lists given below. Eliminate questions that are not relevant to the site (e g intactness of a "No hammering" sign might not be relevant). This will give you a question template for that site. A compromise may need to be agreed if there are conflicting conservation requirements (e.g. coastal erosion that is removing a kettle hole). See discussions in the generic guidance (Ellis, 1998) under the relevant ESCC.

The attached Excel file (geol_qus xis) contains the master list of questions (sheet 1), together with the questions for each site class filtered out (subsequent sheets). You will just need to print out the sheet for the relevant site type and eliminate any questions that are not relevant for the particular site.

(C) Site Survey and assessment

1. During the Site visit, first, locate the features of interest at the site, and take fixed-point photographs(if appropriate)
2. Answer the questions on the question template for the site. Answer "yes" or "no", or "specialist assessment required" unless otherwise indicated. Record the date of survey. If appropriate, compare the answers (and fixed-point photographs) to those recorded at the last site survey. If your answers indicate that the site is within the "limits of acceptable change", the site is in "favourable" condition. If the site was in "favourable" condition at the last assessment, the site will be "favourable - maintained". If your answers indicate that there are now some problems, i.e. the key Earth science elements have been adversely affected or have naturally deteriorated, you will need to judge how severe the changes/modifications have been and whether or not the site is still within the limits of "favourable condition " or whether it is now in "unfavourable

condition". Refer to the discussion on site conditions ("Favourable - Maintained" etc.) in the generic guidelines (Ellis, 1998) for the relevant ESCC, and note any special circumstances described in the site specific conservation objectives.

3. Referring to the site assessment flowchart, consider the limits of acceptable change for the site and its baseline condition/ last recorded condition and use the answers to the questions to correctly record the current conservation status.
4. Report to Earth science HQ staff and JNCC (GCR Unit).

RELICT GEOMORPHOLOGY

Structure
Questions· S1-6, S8-19, S21-24, S26, S27

Quantity
Questions: Q2, Q3, Q8-17, Q21, Q22

Quality
Questions: QL1, QL3, QL6, QL8, Q9, QL14-16, QL18-30

ACTIVE PROCESS GEOMORPHOLOGICAL SITE

Structure
Questions: S1-24, S26, S27

Quantity
Questions: Q2, Q3, Q7-17, Q21, Q22

Quality
Questions: QL3, QL6, QL8, QL9, QL14, QL15, QL16, QL18-30

CAVES AND KARST

Structure
Questions: S1-10, S13-23, S25-27

Quantity
Questions: Q2, Q3, Q21-23

Quality
Questions: QL3, QL4, QL6-24, QL26-35

"UNIQUE" MINERAL, FOSSIL OR OTHER GEOLOGICAL SITE

Structure
Questions: S1-8, S10, S14-19, S21-27

Quantity
Questions: Q1-16, Q23

Quality
Questions: QL1-24, QL26, QL29-34

MINE DUMP

Structure
Questions· Sl-4, S6, SS-10, S14-19, S21-27

Quantity
Questions: Ql-3, Q5, Q6, Q18-20, Q2

Quality
Questions: QL3, QL6, QL8, QL9-24, QL26-30

MINE/ TUNNEL SITE

Structure
Questions: Sl-5, S8, SIO, 814-16, 818-23, 825-27

Quantity

Questions: Ql-6, Q23

Quality
Questions: QLI-4, QLS-17, QL21, QL22, QL26, QL29, QL30

INLAND OUTCROP OR STREAM SECTIONS

Structure
Questions: S1-19, 821-27

Quantity
Questions: Ql-6, Q8, Q12-15, Q21, Q23

Quality
Questions: QLI-30

FORESHORE EXPOSURE

Structure
Questions: S1, S5, S7, S9, SIO, S14, SIS, S17, S23, S26, S27

Quantity
Questions: Ql-6, Q9-ll. QIS-17, Q21-23

Quality
Questions: QLI, QL3, QL6, QLS-22, QL24, QL29, QL30

COASTAL AND RIVER CLIFFS

Structure
Questions: S1-19, S21-27

Quantity
Questions: Ql-6, QS-17. Q21-23

Quality
Questions: QL1, QL3, QL4, QL6, QL7-30

ACTIVE QUARRIES AND PITS

Structure
Questions: Sl-8, S9b, S10, Sl4-25

Quantity
Questions: Q1-7, Q13, Q14, Q23

Quality
Questions: QLl-4, QL6, QL8-18, QL21, QL22, Q24, Q27, Q30

DISUSED QUARRIES, PITS AND CUTTINGS

Structure
Questions: Sl-6, S8, S9b, S10, S11, S13-19, S21-27

Quantity
Questions: Ql-7, Q13, Q14, Q23

Quality
Questions: QLI, QL3-22, QL26-30

MASTER LIST (1) Structure- internal structure and setting/ context:

Sl	Tipping	(a) Has there been unconsented tipping or dumping on the Site? (b) Has any unconsented dumping obscured key Earth science elements?
S2		Has consented tipping been earned out according to agreed planning and working conditions?
S3		Does access need to be impeded to prevent unconsented tipping? (i.e. will continued tipping ultimately lead to the covering of Earth science elements?). If already impeded, is the barrier effective?
S4		Are "No tipping" signs intact, readable and prominent?
S5	Engineering works/ artificial changes	Have exposed faces/ key Earth science elements been artificially modified or concealed by unconsented engineering or other works?
S6		Has any development or tree planting within the site been consented?
S7		Have any Important active processes been constrained within the site or adversely affected by artificial developments adjacent to the Site? (erosion might be important to reveal "fresh" faces at some sites, but if too rapid some restriction might be helpful. Conversely, active geomorphology sites need natural, unmodified processes to act for favourable status
S8		Are planning conditions and working/restoration agreements/plans being observed on Sites undergoing consented modification?
S9		Are there any new unconsented river management/ coastal management works?
S9b		Have slope stabilisation measures been undertaken without consent? (battering and regrading of slopes)
S10		Are artificial changes (a) superficial (b) non-intrusive (c) reversible (d) on non critical parts of the site (e) unlikely to cause damage? {Please answer for (a) to (e)}
S11	Agricultural use	Has the agricultural use of the site changed? If yes, has the new use affected/ will it damage the key Earth science elements? (e g first time deep ploughing)
SI2		Has the grazing regime been retained? (see also questions about "vegetation")
SI3		Have potentially damaging ongoing agricultural uses been curbed or stopped?
SI4	Access/ safety	Is the site access adequate or appropriate for education and research [gateways and pathways not obstructed)? (This does not relate to access restriction by the owner or where Earth science elements are naturally inaccessible (e g halfway up a cliff)
SI5		Do buildings /other structures/ unconsented storage of materials impair access to exposures/ key Earth science elements?
S16		Do artificially modified water levels impair access to complete sequence or full range of features of interest?
S17		Does vegetation impair access to key exposures/deposits?
SIS		If Site access is regulated, are the regulations being observed?
S19		Is there access restriction only to unsafe parts of the site (where the site is otherwise accessible to the public?)
S20		Is the key cave passage/ mine tunnel compromised by unacceptable underground hazards?
S21	Water level	Does the use of surrounding land lead to water level or other changes that would chemically or hydrologically alter the system, e g adversely affecting water levels, causing water contamination or chemical composition within the site?
S22		(a) Is there any artificial flooding? (b) Is there any unconsented water abstraction or drainage? (c) Does consented drainage/ pumping improve site access (where access is not otherwise regulated)? (d) Is natural flooding a problem?
S23		Does mineral, peat, water or other extraction threaten the integrity of the site?
S24	Internal structures	Is the internal structure of key deposits intact / undeteriorated from time of baseline survey?
S25		Is covering (e g burial or protection from weathering) of rare or limited Earth science elements (e g rare fossils) desirable?
S26	"Natural" Setting	Are drainage, exposure to natural weathering, extent and type of vegetation, soil or scree cover not artificially altered? If altered, is it within limit of acceptable cover? Does the cover benefit the key Earth science elements (protect rare elements)?
S27	Compound factors	Have cumulative small changes reached a level that is becoming critical to site integrity?

(2) Quantity of Earth science elements (i.e. extent of resource within the site)

Q1	Intactness/ quantity of Earth sc1ence elements	Has there been a reduction in the degree of exposure of key Earth science elements, e.g. Is there adequate lateral and vert1cal exposure?
Q2		Is there a complete recorded sequence or full range of key Earth science elements exposed/intact?
Q3		Has there been any unconsented excavation (e g sand and gravel extraction, quarrying) of key Earth science elements? Has consented excavation destroyed key Earth science elements and not re-exposed them elsewhere?
Q4		If the section is not exposed, can it be re exposed (i.e. is it permanently covered)? Is there a possibility of developing a permanent exposure?
QS		Has the potential for re-excavation been retained? (no permanent developments, and no excessive build-up of cover)}
Q6		Could other parts of the site show the features lost or damaged - Is there a resource of as-yet-uncovered material/ capacity for new exposure (through natural erosion or active working-which)?
Q7		Are the key quarry faces obscured by the storage of materials?
Q8	Coastal erosion effects	Is the rate of cliff line retreat such that the Important Earth science elements might be eroded away? Has any managed retreat been earned out With consent and m a manner sympathetic to the key Earth science elements
Q9		Have coastal protection works protecting capital assets been carried out with consent and in a manner sympathetic to the Earth science elements?
QIO		Has there been any coastal reclamation that has covered key Earth science elements?
Q11		Have soft coast protection schemes (where necessary) been earned out m a manner sympathetic to the conservation of the key Earth science elements?
Q12		Do cliff foot accumulations disguise key Earth science elements? If yes, does the system naturally retain the ability to erode the accumulated material?
Q13		Does scree accumulation provide better access to higher parts of the section?
Q14		Is the cover by scree protecting vulnerable, key Earth science elements?
Q15		Has the action of coastal or fluvial erosion processes been further impeded by artificial means since the last assessment? Has the action of coastal or fluvial erosion processes been *increased* by artificial means since last assessment?
Q16		Has coastal protection through natural or artificial means impeded access to the key Earth science elements beyond acceptable levels of the site?
Q17		Has beach replenishment been earned out with consent? Has beach replenishment altered the natural system so that it is now outside of acceptable conditions?
Q18	Unconsolidated material	Is the complete mine-dump system intact - Is the dump undisturbed, or has the disturbance been consented? If formation of secondary minerals is important, or rare metallophyte plants are present, complete lack of disturbance to key parts of the dump will be an important factor Conversely, "turning" the dump may reveal new specimens
Q19		Is there adequate volume of material remaining in key dumps?
Q20		Is the dump being replenished with similar material?
Q21	Landscape features	Are the characteristic geomorphological features and system free to evolve and develop naturally? Are all the key Earth science elements present m the system" (If no, see next question)
Q22		(a) Have the key Earth science elements that have been destroyed been lost as a result of natural processes (e.g. storm surge) (b) Has the system retained the capacity to restore/ recreate lost elements? Is the system reverting to natural conditions after an intervention?
Q23	Vulnerable deposits	Have vulnerable materials been adequately protected or removed and placed in a suitable repository?

(3) Quality of physical condition of the key Earth science elements

QLI	Condition on exposure	Is the face in good, clean, stable condition? Is the level of partial concealment within tolerated limits? Is there any build up or spread of soil, mud, sand, shingle or dead seaweed to permanently impair access to exposures or deposits
QL2		Have conserved faces been left intact by quarrying operations?
QL3		Are key features of interest undamaged?
QL4		Are stabilized faces/ tunnels stabilized in a way sympathetic to the Earth science elements?
QL5		Is the roof/ shelter protecting exposed Earth science elements from weathering intact?
QL6		Has there been any track or road building that has damaged the key Earth science elements
QL7		Has damage beyond the critical point been caused by recreational rock climbing (e.g. striations obscured)?
QL8		Has the degree of visibility of key Earth science elements been retained?
QL9	Collecting/ research	Has any excavation or sample collecting (where restricted) been consented? Is there any evidence of specimen/stone collecting or removal?
QL10		Is the level of collecting sustainable?
QL11		Is the site littered with collecting debris?
QL12		Is there a "no hammering" sign? Is it prominent, unobscured and intact?
QL13		Does collecting need to be regulated? / Are regulations being observed?
QL14		Does the owner/occupier know of any geological use of the site? Is such use potential damaging?
QL15		Has consented research activity been restricted to acceptable levels?
QL16		Has the site been re-buried after excavation?
QL17		Is over-collecting a problem?
QL18	Vegetation	Does vegetation impair access to or obscure exposures/deposits?
QL19		Has the quantity of invasive vegetation (i.e. scrub, self-sown trees, seaweed) increased? If yes, has the vegetation affected/ will it damage the key Earth science elements? Has there been root-disruption of soft sediments? Has the vegetation stabilized parts of the site liable to undergo rapid erosion? Has it caused a reduction in the degree of the visibility of the elements?
QL20		Does vegetation impair access to the site or adversely affect geomorphological evolution?
QL21		Has cover by scree, soil or vegetation impeded access to key Earth science elements beyond acceptable levels for the site? Are the key Earth science elements accessible through excavation (If they have been covered, or cover has been allowed to accumulate for protection)? Is the cover undisturbed, or below acceptable levels of build-up so that consented research is now significantly hindered/ maternal is virtually irretrievable?
QL22		Has the degree of cover by scree, soil or vegetation exceeded acceptable levels?
QL23	Condition of landscape elements/ processes	Does build -up of scree, soil or other material naturally impair geomorphological evolution?
QL24		Is temporary build- up of material within normal range?
QL25		Is the feature affected by deep ploughing or other human activity?
QL26		Have recreational uses begun to cause significant damage to the key Earth science elements (accelerated erosion for example through scrambling for example)
QL27		Has there been any unconsented spreading or discharge of materials?
QL28		Do artificially modified water levels impair geomorphological evolution?
QL29		Is the slump/ rock fall un-induced? Can the slumped material be excavated, where it obscures important exposure? Will natural processes remove the slumped maternal?
QL30		Does scree or landslip (where not part of interest) impair access to, or obscure, the complete sequence or full range of features of interest?

QL31	Caves and tunnels	Are remaining cave sediments intact and undamaged?
QL32		Has there been collapse of tunnel/ cave?
QL33		Has restriction to tunnels etc. been consented and is it reversible?
Q34		Have damaging fixings or wastes been left by cavers? Are unacceptable levels of caver's debris/ litter present?
QL35		Is pollution or contamination of cave water detected?

JOINT NATURE CONSERVATION COMMITTEE

EARTH SCIENCE SITE MONITORING

A FRAMEWORK
AND
GUIDELINES
FOR EARTH SCIENCE SSSIs and ASSIs

Neil Ellis, Joint Nature Conservation Committee, July 1998

OVERVIEW

Government has requested that we report on the condition of the Site of Special Scientific Interest/Area of Special Scientific Interest (SSSI/ASSI) series at both country and UK levels. Rather than using the rather vague "loss and damage" statistics for SSSI/ASSIs, what we really need to report is

- how well we are conserving each *type* of "Special Scientific Interest"
- and how effective practical conservation measures have been.

The "Special Scientific Interest" - the underlying reason why a site is protected under law – is what is called the "Feature" in monitoring terminology. Examples might include Kittiwakes, Chalk Grassland, Coastal Geomorphology and Fossil Reptiles. A list of "Features" representing the different Earth science "Special Scientific Interests" is given in the table on page 10ff. Of course, one site may be Important for several "Features"- several Earth science Features and/or biological ones- and separate assessments for each "Feature" will be made and reported separately

For species/habitat conservation, broad conservation objectives for each "Feature" might read, for example, "maintain a viable population of kittiwakes", and this statement would be qualified and delimited by factors such as the accepted variation of number of chicks per nest, number of occupied nesting sites and natural demographics In comparison, broad conservation objectives for each Earth science "Feature", such as "Marine Permian Stratigraphy", cannot be easily delimited m general terms But broad conservation objectives for different *physical types of site,* e g disused quarries, foreshore exposures, coastal cliffs and so on can be helpful, because their conservation requirements are similar.
For example, coastal protection works are a threat to many foreshore exposures

This document aims to

√ Guide monitors on the use of site condition phrases "Favourable recovering" etc. for Earth science sites.
√ Provide guidelines for setting conservation objectives for a site where needed.
√ Guide monitors, who may not be expert geologists or may be contractors, on the principles behind Earth science site monitoring.
√ Ensure that site condition phrases are consistently applied by monitors for sites which have similar needs.
√ Help JNCC and country agencies report on the condition of the ASSI/SSSI-designated part of the ESCR/GCR site series, not only as a whole but also by the categories ("Features") for which Sites were selected.
√ Help us to understand trends in the condition of clusters/types of sites so that we can identify those sites that are most vulnerable or most frequently in “unfavourable” condition.

Unity

We need to establish common standards for collecting, analysing and reporting monitoring data in order to amass it, fulfil our obligations and understand trends.

This is because

- monitoring data will originate from many sources, monitors *and* sites will need to be compared with each other
- the gathered monitoring data itself will probably need to fulfil many requirements, so each agency will use its own format
- the sites surveyed vary enormously in their size, phys1cal type and management requirements

We need to be sure that we are using the same benchmarks. We must constrain what we mean by a Feature being in "favourable condition" as tightly as possible, so that information from different sources is compatible.

Why compare chalk with cheese?

This document sets out a *framework* for setting, and measuring achievement of, conservation objectives for Earth science sites[1] based on *physical types* of Site. This framework is chosen because sites of similar physical type have similar conservation requirements. However, sites of *different* physical type will be designated as SSSI/ASSIs for their contribution to the *same "Feature"* and it is in the "Feature" that we are most interested After all, Sites are SSSIs/ASSIs because of their geological content, not because of their physical type. Therefore, for example, we will need to compare the condition of a disused quarry with that of a coastal cliff, because both are conserved for their contribution to the study of Middle Jurassic rocks in Britain. The comparison is necessary because sites were not selected individually ("in their own right") but always because of their contribution to a particular Earth Science "special interest", that is, "Feature". To use a cliché, "the whole is greater than the sum of the parts"

Realism

The common standards framework must be sufficiently robust to ensure that the standards are implemented effectively across the UK, yet be flexible enough to cater for the different operational practices and systems which have evolved in each country. It is essential that the framework helps us produce consistent information within the resource constraints under which we all operate

It is recognised that the establishment of an effective site monitoring system at this level is far from easy. Nevertheless, we aim to define a system that local staff or contractors can reasonably be expected to follow that allows comparison between sites and surveyors, and the aggregation of data.

[1] "Earth science" is used rather than "Earth heritage" because it is the scientific part of the Erath heritage that is under scrutiny, not the cultural or aestheric parts.

WHY SET CONSERVATION OBJECTIVES BY PHYSICAL TYPE OF SITE?

Ultimately, we need to focus on "Features" and how well we are conserving them. However, it was indicated in the overview that it is not helpful to set generic conservation objectives *directly* for Earth science "Features" This is because sites of different physical type (that have very different threats and management needs) can be selected for the same "Feature". For example, it is not possible to set generic objectives directly for the conservation of "Marine Permian Stratigraphy" that have real practical use. Any attempt to draw up generic objectives for this "Feature" directly would be littered with exceptions to the general rules, to cope with the different problems associated with disused quarries, coastal cliffs, foreshore exposure etc.

Nevertheless, it is possible to develop a framework for generic conservation objectives by classifying *sites of a similar physical type.* For example, it is possible to produce general objectives (without immediate reference to the "Feature") for the conservation of an important body of rock in a *disused quarry* (e.g. concerning visibility, degree of physical obscurity, extent of accessible exposure of the rock body and so on) Similarly, general objectives for rocks exposed on *foreshores* might be set, and broad objectives might be devised for landforms in an area *where active geomorphological processes* are at work (e.g. a river system).

This document provides a framework for setting *generic* conservation objectives. *Site-specific* conservation objectives may be derived from these more general ones by considering the particular needs of the site under study. If conservation objectives have already been devised for a site without the benefit of the guidelines provided in this document, we simply need to relate the specific site assessments to the general model so that data can be compared and collated later.

In consequence to the different conservation management activities that Sites of different types require, we have adopted the Earth Science Conservation Classification (ESCC) of site types (disused quarry, foreshore exposure etc., see page 6) as the basis for the framework for devising broad Earth science site monitoring targets.

EARTH SCIENCE CONSERVATION CLASSIFICATION

Classification of site types

In this classification there are two main types of site

- **Integrity sites** contain finite deposits or landforms which are irreplaceable if destroyed. A typical situation is a landform, of limited lateral extent, such as a kame terrace or esker. Other examples include presently active, and previously active, geomorphological sites, caves and karst, unique mineral or fossil sites, and some stratotypes
- **Exposure sites** provide exposures of a rock that are extensive or also well-developed below the ground surface. Exposure sites are numerically the more common type and may include exposures in disused and active quarries, cuttings and pits; exposures in coastal and river cliffs; foreshore exposures; mines and tunnels; inland outcrops and stream sections.

The broad conservation objectives for these types of site are different "Integrity" sites are, by definition, finite and irreplaceable. To conserve them a “protectionism” approach must be adopted. In contrast, the broad conservation principle for "exposure" sites depends on the maintenance of an exposure, the precise location of which is not always critical. Quarrying may be welcomed under some circumstances because it creates a fresh exposure and progressively reveals new rock surfaces enabling rock body to be

analysed in three dimensions. Similarly, marine erosion is often vital in the creation of fresh rock faces at coastal sites, particularly in softer rock formations. Conversely, maintaining a high quality exposure of soft sediments by regular cutting of "faces" where research is infrequent may lead to unnecessary erosion or removal of the important material.

Conservation management of a geomorphological site depends on whether it is a relict landform or an active process site. Broadly, the requirements for the former will be similar to those for "integrity" geological sites. Management of dynamic environments, however, is more complex, and requires an understanding of geomorphological sensitivity and the capacity of the system to absorb externally imposed stresses.

The consideration of the nature of the site as an "integrity" or "exposure" site helps define the fundamental conservation objective: whether to protect the resource or maintain the exposure.

Integrity Sites - *Minimise changes and preserve integrity of sites*

Active process geomorphological site
Cave/Karst site
Static ("relict") geomorphological site
"Unique" [atypical/rare] mineral, fossil or other geological site
Mine dump
Integrity - buried

Exposure Sites - *Preserve exposure, judging changes on their merits in terms of degree and quality of exposure, and where required, enhance sites*

Exposure - buried
Mine/tunnel site
Inland outcrop or stream section
Foreshore exposure
Coastal and river cliffs
Exposure in active quarry/pit
Exposure m disused quarry, pits and cuttings

The ordering of categories in the list above indicates broadly the continuum from Integrity to Exposure sites.

Evidence available so far confirms the supposition that integrity sites are more sensitive/vulnerable in comparison with exposure sites, and generally are likely to constitute higher monitoring priority. Coastal defence works and landfill schemes pose the greatest threats to the long-term conservation of exposure sites.

EARTH SCIENCE "FEATURES"

Although our framework for devising generic conservation objectives is the ESCC (site type), our focus must be to assess the condition of conserved "Features" present within the sites. In the Earth sciences, the definition of "Features" must relate to the rationale for the selection of sites – in the GCR and ESCR – as described below.

For Earth sciences in *Britain,* the statutorily conserved sites are those localities that were identified by the Geological Conservation Review (GCR), according the criteria summarized in Ellis *et al* 1996 [Chapters 4 and 5]. In Northern Ireland, the broadly similar Earth Science Conservation Review (ESCR) now provides the rationale and methods for Earth science ASSI selection.

Since 1977, the rationale and criteria of the GCR have provided the benchmark used to identify sites of SSSI quality.

The GCR sites were selected according to about 100 geological categories, called "GCR Blocks", but original GCR workers sometimes worked on GCR Block subdivisions, derived from geological themes within a GCR Block (e.g. "beach complexes", "hard rock coasts" and "machair" among others within the "Coastal Geomorphology of Scotland" GCR Block). Suites of sites were selected to represent these themes fully, but using the minimum number of representative sites, and these themes are now referred to as "GCR Networks". There may be one or more GCR Network (theme) in any GCR Block (category). In the case of many GCR Blocks, the original GCR Networks were not recorded, and are only being elucidated now as a consequence of the GCR Publications Programme.

In the Earth sciences, the "Feature" ought to be regarded, properly, as the "GCR Network" because the Network is the underlying special reason why a site was selected for the Review. However, currently there is no list of GCR Networks available, so it is the combined list of ESCR and GCR Blocks that is used as the "Feature" list for the Earth sciences. See page 10ff.

A framework for "Attributes"- and broad levels for degree of detail

When you visit a site, it will not usually be immediately clear what the "Feature" is "Marine Permian Stratigraphy" will not spring to mind unless you are an expert. Such a "Feature" will probably be manifested by a number of key Earth science elements such as the rock type (chemical and physical composition) or range of rock types, the fossils, the relationship of the Permian rocks to older and younger ones, the sediment structures (fossil ripples, etc), the orientation of the rocks and so forth.

This leads us to a further problem for devising a framework for conservation objectives for Earth science Features: we need to consider not only the broad conservation requirements for physical types of site, but also the actual entitles ("key Earth science elements") in a site that caused it to be selected for a "Feature". Such key Earth science elements could be, for example, a Precambrian-Cambrian unconformity, *pulchra similis* biozone, pegmatitic dyke, drumlin, kidney ore, esker, greenstone, arête, ammonite fauna, shingle spit, meander cut-off, dry river valley, fossiliferous deposit etc., but these are very specific, technical entities not always easily to define for uninitiated monitors. We can group such entities into larger categories that have similar conservation needs to assist monitors who may lack detailed geological knowledge. [Besides, if we try to be too specific, we may encounter the problem of geological synonyms (e g Keuper Marl = Triassic Keuper Marl = Upper Triassic Red Marl= Mercia Mudstone Group)]. For example, we might discuss the exposure of a "junction between two important rock types", "presence of an important rock type", "relict glacial landform" etc. These contributing factors that have led to sites' selection for a "Feature" are what we mean by "Attributes"

"Attributes" - as used in monitoring language - refers to a *characteristic of a "Feature"* that provides an indication of the condition of that "Feature". In the same way that a thermometer reading of a patient's temperature tells us something about the patient's health, the number of chicks per nest and number of nests might be used to tell us something about the "health" of the Kittiwake "Feature". In the Earth sciences, "Attributes" will refer to the **"intactness" or integrity or amount** of the *key* Earth science elements [characteristics or geomorphological processes] that were the reason behind a site's selection for a "Feature".

In general terms, "Attributes" should be measurable. In a biological example, "Attributes" might be the number of nesting pairs at a site, plant diversity in grassland sward sample, number of orchid spikes and so on. But in Earth sciences, because of the way "Features" are defined, "Attributes" will not usually be measurable *quantities,* but subjectively assessable *qualities.* We will be commenting on the condition "intactness" or "naturalness" of contributing factors that led to a site being selected to represent a particular "Feature" more often than proportions of rock exposed, for example. In most cases an upper "limit of acceptable change" cannot be set. A site can never be *too* intact!

Of course, there might be interesting Earth science elements present in a site that are incidental the main reason why it became selected for a "Feature", such "hosted" or "bonus" elements may be recorded and reported at an country agency level if required, but because they are not critical to the inclusion of the site in the GCR/ ESCR their condition will not alter the assessment of the **key Earth science elements** of the Earth science "Feature" as recorded by JNCC. See also the discussion of "multiple" sites on page 17. Before devising a conservation plan for a site, or assessing a site, the monitor will need to know what the *key* Earth science elements of the "Feature" are, and which ones are incidental or "hosted" (reference to "Statements of Interest" or country agency documentation on the site should provide the necessary list, see further discussion below).

How much geological knowledge will monitors need?

It is possible to assess the condition of "an important rock body", regardless of the age or scientific definition of that rock body. Non-expert, but nevertheless effective, monitors do not need to know the precise technical definition of the "Keuper Marl". Rather, they need to record such things as the degree of exposure (lateral, and perhaps vertical, extent, degree of concealment and overall physical condition) over time of "the important rock body". They may need to check that the relationship of the rock body to surrounding rocks is still as visible – e.g. that it is not covered by scree - and so on. Of course, it will be necessary to demonstrate what the "important rock body" looks like at a site, perhaps photographically. Once this is established (probably through scrutiny of site-management briefs or similar) then the assessments of site condition can be made year-on-year without experts being called in when no obvious threats have arisen. At this lowest level, monitors will require simple question and answer sheets to assess site condition by assessing the changes in condition of the key geological Earth science elements, the generic conservation objectives included in this document are designed to act as templates for these "question and answer" assessments.

Identifying the *key* (rather than "host") Earth science elements that contribute to a "Feature" at a site may involve scrutiny of the GCR/ESCR statements of interest, publications, site management briefs, reference to scientific literature, discussion with internal or external geologist experts, or by direct observation at the site.

When *site specific* conservation objectives are drawn up, each agency will decide what level of detail is required. For example, an agency may wish to make a detailed geological survey, referring to Keuper Marl, Carboniferous Limestone unconformity, lake ripple features, desiccation cracks, dinosaur footprints, Alpine faults and various other geological entities at a Triassic site, instead of reporting on the "integrity" the important rock bodies" that yield these things. Specific conservation objectives may then need to refer to these characteristics/entities, but the level of detail may vary between agencies and terminology may be different so this will not be an issue for aggregated reporting.

Earth science Features and Earth Science Conservation Classification (ESCC) Grid – applying the framework

By combining the two systems of categorising Earth science sites - "Feature" and ESCC Site type - we can construct a grid in which we can plot every site. Some parts of this grid will be blank - there are neither foreshore exposures (ESCC) for the Caves and Karst "Feature", nor coastal geomorphology

("Feature") sites in active quarries. Many points in the grid will have similar conservation objectives (e.g. all Stratigraphy "Features" in disused quarry sites, all palaeontology "Features" on foreshore exposure sites etc.)

Before considering a specific site, a monitor will need to know what the ESCC site type is and what the "Feature" is (using site documentation such as the site management brief or by referring to the inter-agency Earth science database). Secondly, the monitor will then need to be able to identify what Earth science characteristics led to the site being selected for a "Feature", which may be deduced or inferred from the GCR statement, or publications. Is it a particular body or rock, or the junction between types of rock, the arête or the come (or both), the folding in the rock layers or the Igneous rock that has cut through the rock layers?

Thirdly, the monitor needs to consider the layout of the site. If the all-important body of rock lies at a cliff base in a quarry, the "Feature" will be in a favourable condition if the foot of the cliff is not obscured. If the important rock is halfway up the cliff, access to the "Feature" may actually be improved if sand, shingle or other materials were to be placed at the foot of the cliff.

Where a site has more than one "Feature" in it, readers should refer to the section on "Multiple Sites", page 17.

Armed with this information, the monitor can now refer to the guidelines that follow, pages 20ff, organised by ESCC site type, to help them assess the condition of the site or devise a site-specific conservation objective.

Table of Earth science "features", indicating their component GCR/ESCR Blocks and showing which ESCC site types may exhibit each Feature

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REPORTING

From an operational viewpoint, country agencies will need to know, and report on,

- which specific sites are deteriorating or not in a favourable condition;
- which "Features" (approximately equal to GCR Blocks) are deteriorating or not in a favourable condition;
- what types of Earth Science site (Earth Science Conservation Classification) are not in a favourable condition

At a UK level, JNCC will be reporting Site condition statistics according the following categories (GCR Groups):

1. Precambrian, Structural and Metamorphic Geology
2. Palaeontology
3. Igneous Petrology and Mineralogy
4. Quaternary Stratigraphy and Geomorphology
5. Palaeozoic Stratigraphy
6. Mesozoic-Cenozoic Stratigraphy
7. Geomorphology

These are the categories that are used in the GCR Publications programme and identify the background cover colour of the published volumes.

GCR≠SSSI; ESCR≠ASSI

Not all GCR/ESCR sites have been designated as SSSIs/ASSIs, although work is progressing towards this goal. For Britain as a whole, approximately 80% of GCR sites have been designated, although in England, the designation process is to be completed in 1998. Therefore, at the time of writing, it will not be possible to report on the condition of the entire GCR site series[2], but reports on the c. 80% of the GCR sites presently designated as SSSIs will be possible, and results could be projected to reflect the likely condition of the entire GCR site series. The proportion of GCR sites that have yet to be designated as SSSIs will indicate the degree of approximation of such a projection As more GCR sites are designated as SSSIs over time, the degree of error in the projections for the whole GCR will be reduced.

Multiple "Feature" sites and multiple ESCC sites

As indicated on page 7, most Earth science SSSIs/ASSIs will have a complex mix of key Earth science elements that led to a site being selected for a "Feature". For example, an SSSI might have eskers, kames, drumlins and moraine that together led to the site being selected for the Quaternary of Scotland "Feature". Moreover, some sites attain SSSI/ASSI status independently for several "Features", e.g. where a locality is selected for the GCR for more than one GCR Block. The SSSI/ASSI may also have especially important biological "Features". For example, a single SSSI might be important for Coastal Geomorphology on account of its beach/dunes and soft cliffs, it might also be selected for the Aptian-Albian Stratigraphy [Cretaceous] GCR Block and have an important colony of birds nesting in burrows in the soft sediments.

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[2] Although it is not a governmental requirement to report on GCRs, only SSSIs, it is arguably more meaningful /useful to consider the whole GCR series to measure how well UK geology is being conserved under law.

For this “multiple” site to be entirely in favourable condition, it must be in favourable condition with respect to each "Feature". It is possible for such a "multiple" site to be in favourable condition with respect to one "Feature", but not another. We need to know the condition of each individual "Feature", rather than the site as a whole. It is recognised that there may be conflicting conservation objectives for the various "Features" which will need to be carefully considered for site management activities.

In the example given above, separate assessments for coastal geomorphology, Aptian-Albian Stratigraphy and bird conservation are required. The site might be recorded as in favourable condition with regard to stratigraphy, but at the same time not in a favourable condition for geomorphology. It should be noted that for the Coastal Geomorphology "Feature" to be in a favourable condition in the given example, it would need to have *both* its beach/dunes *and* its soft cliffs in favourable condition, because these are both Earth science elements of one “Feature”.

Besides the possibility of more than "Feature" at a site, there might be more than one ESCC category present at a site (e.g. Foreshore and Coastal cliff). It may be possible to consider each ESCC type separately, but if there are conflicting conservation requirements for the ESCC types present, the monitor will need to carefully consider how to derive/combine the conservation objectives that protect all the special manifestations of the "Feature(s)" at the site.

JUDGING THE CONDITION OF SITES

These categories will be used to assess and report on site condition and will replace the old loss and damage categories previously used.

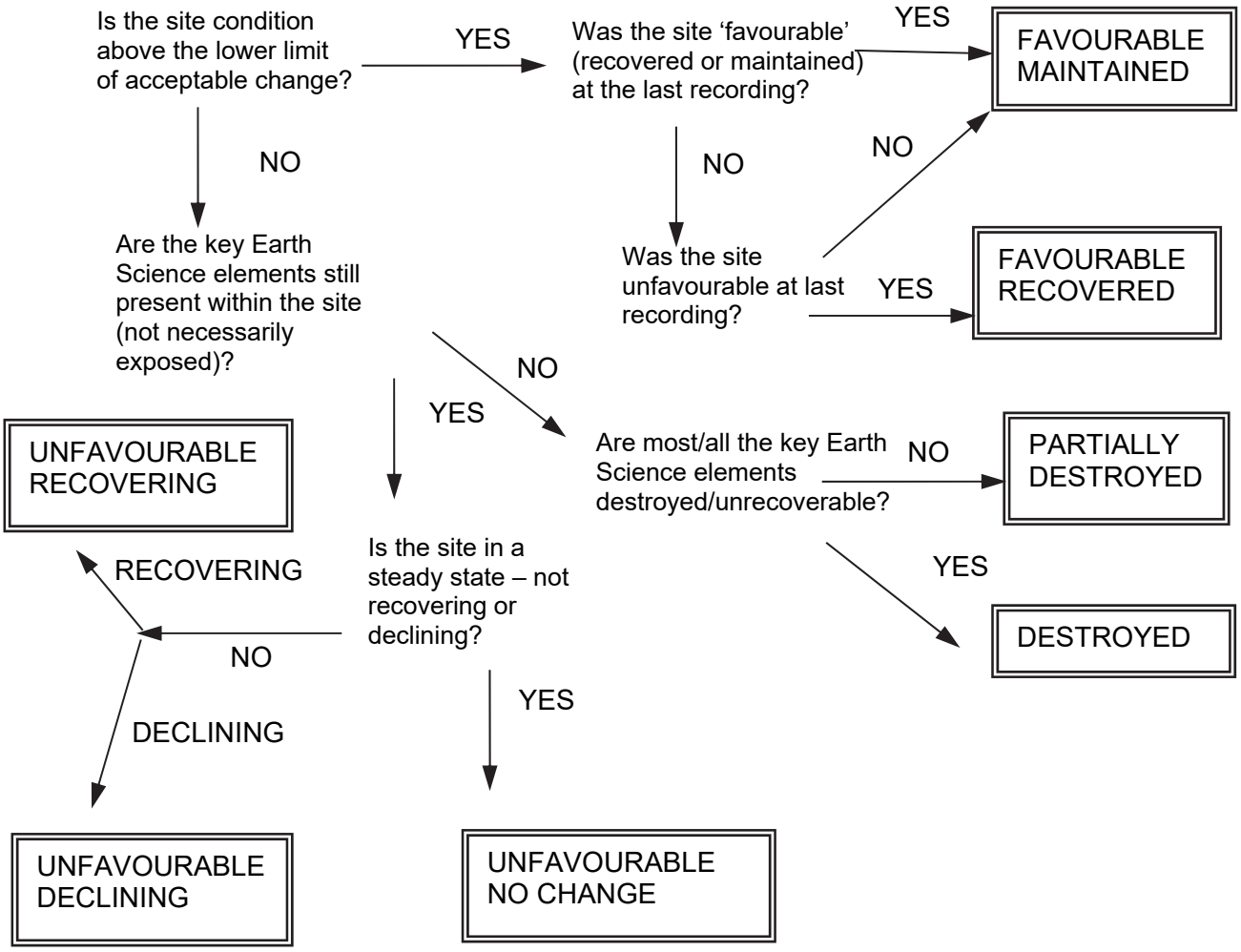
It is agreed that the common standard categories for judging and reporting on the condition of a "Feature'" will be

- *Favourable – maintained.* A Feature at a site should be recorded as *maintained* when its conservation objectives were being met at the last assessment and are still being met.
- *Favourable – recovered.* A Feature can be recorded as having *recovered* if it has regained 'favourable condition', having been recorded as 'unfavourable' on the previous assessment.
- *Unfavourable - recovering:* a Feature can be recorded as *recovering* after damage if it has begun to show, or is continuing to show, a trend towards favourable condition
- *Unfavourable - no change:* a Feature may be retained in a more-or-less steady state by repeated or continuing damage; it is unfavourable but neither declining nor recovering. In rare cases, a Feature might not be able to regain its original condition following a damaging activity, but a new, stable state might be achieved.
- *Unfavourable- declining:* Decline is another possible consequence of a damaging activity. In this case, recovery is possible and may occur either spontaneously or if suitable management input is made.
- *Partially Destroyed:* It is possible to destroy sections or areas of certain Features at a site, with no hope of reinstatement in the affected part of the Site, because the Feature itself, or habitat or processes essential to support it, has been removed or irretrievably altered.
- *Destroyed:* The recording of a Feature as *destroyed* will indicate that an entire Feature at a site has been affected to such an extent that there is no hope of recovery, perhaps because its supporting habitat or processes have been removed or irretrievably altered.

Sequence of condition states

The condition definitions given above in the box are not given in descending order – this list is not a series of states through which a deteriorating site will pass. For example, once a site has gone below the lower limit for recording "favourable – maintained" it will become recorded as "unfavourable" – and depending on the circumstances it may be "recovering", "no change" (if its condition is now in steady state in its new unfavourable condition) or "declining".

A site only becomes "favourable – recovered" after being in "unfavourable" condition previously. Thereafter it becomes "favourable-maintained" if no further deterioration occurs. Once a site is recorded as being "Destroyed", its condition cannot improve. The flow chart below indicates when each condition state applies.



INTEGRITY
SITE

RELICT GEOMORPHOLOGY[3]

Firstly, decide what are the *key* Earth science elements (one or more of the following) in the site to be monitored?

- glacial and interglacial landforms/characteristics/deposits (including moraine, drumlins, isostatic/eustatic features - raised beaches etc.);
- glacial erosion landforms/characteristics (e.g. striations, róche moutonnée, crag and tail),
- periglacial landforms/characteristics (e.g. patterned ground),
- glacial-fluvial depositional and erosional landforms/characteristics,
- glacial/ interglacial stratigraphy/sediments [i.e. lithostratigraphy and biostratigraphy exposures other than those present in landforms],
- relict fluvial landforms [not part of a currently active fluvial system: relict erosion/deposition characteristics e.g. terraces, relict river channels, river capture evidence],
- relict coastal erosion landforms (e.g. raised wave-cut notches or wave cut platforms)
- relict coastal deposition landforms (including "fossil" shingle structures, spits, beaches, machair)
- relict landslips

Site Management Issues

We will need to take into account the condition of the key Earth science elements at the time of baseline survey[4] and the extent to which we accept natural changes or trends (e.g. weathering, erosion, vegetation alteration).

Continuing agricultural use in its present form may be an important factor to maintain the site in favourable condition – e.g. grazing, which improves the visibility of the elements within the site by removing invasive vegetation. Conversely, vegetation may help stabilise sites undergoing rapid erosion. Scrub clearance may be necessary if self-sown trees begin to obscure (or cause damage by root disruption to) key parts of the site.

Where the important relict geomorphology lies exposed in a cliff (e.g. a Quaternary sediment sequence, or a cross-section through a landform like a kettle hole), unimpeded coastal or fluvial erosion may be important to remove eroded material, and maintain a good, clean "face". However, if cliff-line retreat is very rapid, the important material may be completely eroded away. Sympathetic protection may be considered in this case, such as allowing a certain degree of cover by scree, soil or vegetation, so long as the cover can be removed when the site is being studied for research. Similarly, inland, keeping a site completely uncovered by scree, soil and vegetation might not be practical or desirable for the long-term conservation of the site (e.g. if a site is not being grazed and rapid recolonisation of vegetation conceals parts of the site, but causes

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[3] Evidence of no-longer active landscape forming processes or "Fossil" landforms, e.g. esker, drumlin, river terrace, raised beach.
This category of site type **includes** relict geomorphology in: active/disused pits, inland outcrops/stream sections, river and coastal cliffs (although these types of site have their own ESCC for "Exposure" Sites, see comments in "Management Issues") but **excludes** relict (inactive/"dry") Caves and Karst, and thereby Tufa, which have their own ESCC. Bogs important for glacial/ interglacial sediments and peat (sampled by coring) are dealt with under the "Active Geomorphology" ESCC rather than here or under the "Exposure - buried" ESCC. Cross reference to the other relevant ESCC guidelines is recommended when devising conservation objectives for a particular site.
[4] The baseline might be time of selection of the site for GCR/ESCR, time of first site visit, time of site management report or SSSI/ASSI management plan, time of SSSI/ASSI notification.

no long-term damage, then a recording of "favourable condition" may still be returned so long as the site is cleared before research takes place). The reader should cross-refer to the ESCCs "Coastal and River Cliffs" and "Integrity - buried" for further information as appropriate.

There will need to be some consideration of the type of research that is permitted. To study these relict geomorphological sites, we often need to dig trench/take boreholes to study internal structures, how much of this potentially disruptive research is permitted will depend upon frequency of disruption, quantity of disruption, and likely gain in scientific knowledge. Expert advice may be needed before permission is given.

The main target is to ensure that there are no artificial developments of any kind. Very small superficial or temporary changes, such as fence laying, may be permitted.

Activities usually highly damaging if unmodified	**Damage can usually be avoided if work sensitively planned and carried out**	**Damaging only in exceptional circumstances**
Major excavations (e.g. sand and gravel extraction)/levelling. Dumping and infilling. Major afforestation. First time deep ploughing. Track/road building. Coastal reclamation/sea defence. Industrial/housing developments (buildings/ artificial structures). Some recreational pursuits (e.g. mountain biking/ scrambling) causing accelerated erosion.	Pit or small trenches. Small plantations. Fencing, including deer fencing. Handrail construction or similar non-intrusive developments in show caves.	Sites generally vulnerable and no specific operations in this box. The key consideration with small developments is the cumulative effect over time.

'Natural' changes potentially affecting relict geomorphology sites
Natural erosion and weathering; water-table changes; vegetation growth (including scrub development/self-sown trees) and dieback.

Generic Conservation Objective for Relict Geomorphology sites:

To maintain the integrity ("intactness"), diversity and extent of *all* the *key* Earth science elements of the Site and to minimise changes to the site that may damage those elements.

Targets

- Physical composition, morphology and internal structure of each of the key Earth science elements **remains entirely intact** or there has been **no deterioration** if not intact at the time of baseline survey;
- None of the key Earth science elements have **been modified or concealed** without consent (i.e. ensuring that there is no unconsented tipping or dumping, tree planting, deep ploughing or engineering works that would obscure or damage the key Earth science elements, and that there is no unconsented research excavation),
- All key Earth science elements **remain accessible through excavation** (if vulnerable and currently covered for protection),
- **Visibility** of the key **Earth science elements is unimpaired** (or there has been no deterioration since the time of baseline survey) ["visibility' relates to the context of different landforms within the site boundary; important here is ensuring that there is no scrub invasion, natural woodland development or erection of artificial structures],
- None of the key Earth science elements within the site boundary have deteriorated as a result of change within the wider setting the **context and relationships** of the key **Earth science elements** to the surroundings **have not diminished through physical damage or fragmentation** [e.g. the physical conditions (drainage/exposure to natural weathering/extent and type of vegetation, soil or scree cover [where not part of the special interest]) are not artificially altered or that there has been **no change** to them since the time

of baseline survey; [consent may be given for the protection of vulnerable Earth science elements by covering, however]; use of surrounding land does not lead to changes which might affect water levels or chemical composition within the site, nearby mineral, peat or water extraction does not threaten the integrity of the key Earth science elements];

- **Access to the site is maintained for the purposes of education and research** as appropriate (paths and gateways are not obstructed) and that the amount (extent and frequency) of permitted research which potentially damages the integrity is not exceeded; ["Access" does not relate to natural inaccessibility (sheer cliffs etc.) or restriction of general permission to visit the site].
- Agricultural use has not changed since baseline survey (if ongoing agricultural use is not harmful to the site in the long term (e.g. grazing patterns maintained)

Defining the conditions "Favourable – Maintained" and "Favourable – Recovered" for Relict Geomorphology

For a site to be recorded as "favourable - maintained", the full range of key Earth science elements must continue to be intact and unobscured with respect to their condition at time of baseline survey or with respect to the accepted lower limit of favourable condition (see below). A site in prime condition will have landform structure/morphology/volume intact, vertical and lateral extent of constituent material constant, landforms and sediments entirely undisturbed and in a natural context, physical conditions the same as at the time of baseline survey - no significant vegetative disruption, no significant build-up of soil/mud/scree [where not part of the special interest] impairing accessibility/visibility, no artificially induced changes to water levels (flooding or draining), no development on or near the site (no tipping, tree planting, engineering or building works, no contamination/pollution detected), no removal of maternal (e.g. quarrying), no deterioration caused by agricultural use change. If the site was "unfavourable- recovering" (see below) at the last assessment and the site has returned to "favourable" condition, an assessment of "Favourable - recovered" would be reported.

Very low levels of disruption that are reversible or temporary may be acceptable and permitted with consent, and the site still recorded as "favourable". Changes that may be acceptable are:

- small sympathetic excavations or removal of samples for consented research that does not disrupt the site significantly,
- small build ups of scree/soil and small increases in potentially disruptive vegetative cover if they do not obscure more than 5% of the site area and none of the key parts of the site (or no more than 5% increase compared to time of baseline survey. Greater amounts of cover may be acceptable if this is helpful to the ongoing conservation of the key elements of interest at the site and if the material built up does not unduly hinder consented research, the reader should cross refer to the "Coastal and River Cliffs" and "Integrity - buried" ESCCs),
- small superficial modifications such as fencing or tree planting in non-critically important parts of the site,
- small alterations if they are reversible and short term and do not contaminate the site and do not affect critically important parts of the site.

"Unfavourable" condition

A site will be in an "unfavourable condition" if the site condition is below the lower limit of "favourable maintained" described above. A new steady state of "unfavourable condition" may then exist and continue to be reported as such ("unfavourable – no change"). The site may be beginning to recover ("unfavourable – recovering") - for example, if on previous occasion(s) build-ups of scree/soil/vegetative disruption/flooding had significantly obscured parts of the site but the situation now is improving/being rectified. A report of "favourable – recovered" would be hoped for at the time of the next survey. The site may begin to worsen ("favourable- declining") if the key Earth science elements are becoming increasingly obscured

If the activities/changes cause further irretrievable worsening of the condition, or some key elements

are damaged permanently, then an assessment of "partially destroyed" may be made Depending on how much, if any, of the original integrity of the Earth science elements remains intact, a "destroyed" assessment may be made.

It might be that activities outside of the site boundary have negative effect within its, and a condition assessment of "unfavourable" status may need to be recorded. Further action to address such a situation will need to be initiated in consultation with National teams/offices.

INTEGRITY SITE

ACTIVE PROCESS GEOMORPHOLOGY[5]

Firstly, decide what are the *key* Earth science elements (one or more of the following) in the site to be monitored?[6]

- Fluvial landforms [erosion/deposition characteristics] (e.g. active bars, meanders, gorges, waterfalls, levees),
- fluvial process characteristics (e.g. river bed form (potholes, rocky, gravely or muddy character), river "load" type and quantity);
- river channel and floodplain change characteristics (e.g. rejuvenation evidence, storm surge deposition, ox-bow lakes),
- coastal erosion characteristics,
- coastal deposition characteristics,
- saltmarsh,
- "active" landslip characteristics,
- Quaternary "bogs"

Site Management Issues

It is very difficult to define what we mean when we say we require active geomorphology sites to be "evolving naturally". Almost every site will manifest some human-induced change. It is even more difficult to try to predict whether small scale "artificial" changes to the site will significantly affect or "damage" the integrity of the site [Readers should refer to textbooks on "Chaos theory" – if a butterfly flaps its wings in Surrey, there might be a hurricane in Japan etc. … Small differences in the "starting conditions" of a system can lead to very different conditions later]. Cumulative effects are important as well. One small change to the site, additional to other small changes that did not seem to affect the system significantly, may cumulatively reach a critical point ("the straw that broke the camel's back") that catalysis vast change to the dynamics of the system. Moreover, the variability of geomorphological processes makes it hard to decide what acceptable natural variation is and what is caused by human intervention. Incremental changes may be detectable only over long periods of time, and root causes - natural or artificial - are hard to deduce. Conversely, a site might be affected by dramatic and sudden change, yet still be "evolving naturally", e.g. if there is a storm surge that breaches a shingle spit or erodes a section of saltmarsh. Hence management of the sites will rely on complete non-intervention principles, making sure that no further artificial modifications are made to the site from the time of baseline survey.

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[5] Sites in which landforms are being actively formed by rivers [erosion/deposition], coastal processes [erosion/deposition and saltmarsh] or mass movements [landslides or gravity-driven processes]. This category excludes actively forming Caves, and Karst, and relict geomorphology landforms which have their own ESCCs to which readers should cross-refer. Quaternary bog sites - although technically a relict geomorphology Site or buried exposure- are included in this category because they are best conserved in the long term through ensuring hydrological integrity of the system.

[6] Specific conservation objectives may need to mention active meander belts, bars, regrading waterfall, shingle structures, beach complexes: spits, dunes, soft cliffs, hard-rock cliffs, structural geology controlled erosion, beach complexes, saltmarsh: machair etc.]

There will also need to be some consideration of modifications to geomorphological processes occurring *outside* of the ASSI/SSSI Site boundary, that have negative effects on the integrity/condition of the key Earth science elements *within* the boundary. Activities outside of the site may have measurable effects within the site, but cannot necessarily be reversed to restore the natural balance. Consultation with adjacent land managers, policy makers or National teams may be required to address the Issue. {A similar problem to migratory birds' nesting sites, where we may measure the attribute such as the number of nesting pairs. This may fall below the "acceptable minimum", but the condition may result from factors outwith the site boundary and no "corrective" action can be undertaken}.

We cannot easily monitor the active processes themselves, but we can consider the manifestations of the processes- the condition of the sand dunes, shingle spit, waterfall and so on. Again it is very difficult to set limits for "acceptable change" for these features, considering the natural variability as described above - the sudden erosion or burial of an interesting spit might be a perfectly natural development. Important here will be recording when significant meteorological/tidal events, take place (i.e. we need to know the regularity and degree of flooding/storm surges and likely erosion effects), so that we know what we must accept as "natural change" without recording the site as being in unfavourable condition. After a natural "catastrophic" event like erosion or deposition resulting from storm surge, the site should be visited as soon as possible to record significant "natural" changes.

With the provisos given above, and in a similar way to that applied to the relict geomorphology ESCC, we can consider the use "naturalness" of Earth science elements that arise from the processes as an approximate surrogate for monitoring the "naturalness" of the geomorphological process themselves. As before, we will need to consider the condition of the key Earth science elements at the time of baseline survey, but in active systems we also need to consider their likely variability and the capacity for the system to recreate components damaged or destroyed by any means (natural or artificial).

The main target is to ensure that there are no artificial developments of any kind. Small superficial changes may be acceptable in exceptional circumstances, so long as the predicted impact of the change is negligible.

Continuing agricultural use in its present form may be an important factor to maintain the site in favourable condition – e g. grazing, which improves the visibility of the elements within the site by removing invasive vegetation and might otherwise stabilise features such as active dunes. Conversely, vegetative development may be judged acceptable - part of the natural stabilisation of parts of a river or coastal site, or perhaps because it protects parts of the site undergoing rapid erosion by human feet.

There will need to be some consideration of how much research is permitted. If the research is potentially disruptive, the frequency of disruption, quantity of disruption, and likely gain in scientific knowledge will need to be assessed. Expert advice may be needed before permission is given.

Activities usually highly damaging if unmodified	**Damage can usually be avoided if work sensitively planned and carried out**	**Damaging only in exceptional circumstances**
As for relict geomorphological Sites. River management works (bank protection/channel straightening). Sand fencing. Slope/dune stabilisation. Dredging in active coastal 'cell'. Introduction of vegetation. Recreational and amenity developments. Changes in agricultural practice.	No specific operations although minor examples of operations in the column on the left may avoid damage. Depends on ability of system to recover. Certain recreational uses (mountain biking, water skiing)	Sites generally vulnerable and no specific operations in this box.

'Natural' changes potentially affecting active process geomorphology sites
Variability in natural processes (frequency of storms/meteorological affects/water table levels), erosion, vegetation growth and dieback [which may stabilise or de-stabilise the sites]. Climatic changes.

Generic Conservation Objective for active process geomorphology sites:

To ensure the unimpeded continuing action of natural geomorphological processes. To ensure that the key Earth science elements that result from the processes evolve in a natural way in response to the natural variability of the system.

Targets

- Physical composition, morphology and internal structure of key Earth science elements **remain intact** and are **evolving naturally** and that **natural processes are unimpeded**, or there has been **no further artificially-induced deterioration** if they were not intact/entirely unimpeded at the time of baseline survey;
- The levels of activity of the geomorphological processes and their spatial domain retain the capacity to **operate across their full range** of natural variability, or there has been **no further artificially-induced deterioration** if these were constrained by human activity at the time of baseline survey;
- The key Earth science elements are **not modified or concealed** without consent (i.e. ensuring that there is no unconsented tipping or dumping, tree planting, deep ploughing or engineering works that would interfere with the natural development of the system, and that there is no unconsented research excavation);
- The **visibility** of the key **Earth science elements is unimpaired** (or there has been **no reduction in degree of visibility** since the time of baseline survey) ["visibility" relates to context of different landforms within the site boundary - no undesirable scrub/woodland invasion and no erection of artificial structures];
- The system maintains the **capacity to recreate the Earth science elements**, where these have been lost or damaged or altered through natural processes;
- The integrity, **context and relationships** of the key **Earth science elements** to their substrate/basement have **not diminished through physical damage or fragmentation** [e.g. physical conditions (drainage/ extent and type of vegetation/soil/scree cover [where not part of the special interest]) are not artificially altered or there has been no change to them since the time of baseline survey, the use of surrounding land does not lead to changes which might affect water levels or chemical composition within the site, mineral, peat or water extraction does not threaten the integrity of the key Earth science elements; in particular, water flow must not be constrained or adversely affected by developments within, adjacent to or on land hydrologically linked to the site;
- **Access to the site is maintained for the purposes of education and research** as appropriate (paths and gateways are not obstructed) and that the amount (extent and frequency) of permitted research which potentially damages the integrity is not exceeded ["Access" does not relate to natural inaccessibility];
- **Agricultural use has not changed** since baseline survey (if ongoing agricultural use is not harmful to the site in the long term (e.g. grazing patterns maintained).

Defining the conditions "Favourable - Maintained" and "Favourable - Recovered" for Active Geomorphology sites

For a site to be recorded as "Favourable- Maintained", the geomorphological processes must be free to evolve naturally (i.e. the physical conditions that could be affected by human intervention must be the same as at the time of baseline survey). This means there must be no additional induced vegetative disruption, no artificially induced build up or removal of sand/sod/mud/scree impairing

accessibility/visibility/system functionality, no artificially induced changes to water levels (flooding or draining), no development on or near the site (no tipping, tree planting, engineering or building works, no contamination/pollution detected), no deterioration caused by agricultural use change. Monitors will not be able to judge the "naturalness" of the geomorphological processes directly. They will need to record whether there have been any artificial modifications within the site boundary and whether any changes that have occurred to the Earth science elements are outside of their normal natural range (in other words, the volume, vertical and lateral extent of Earth science elements and their structure must be within their normal natural range). If a site was "unfavourable – recovering" at the last assessment and the site has returned to a natural equilibrium, an assessment of "favourable- recovered" would be reported.

Very low levels of disruption that are reversible or temporary may be acceptable and permitted with consent in exceptional circumstances, if the system overall will not be damaged in the long term and can recover. Changes that may be acceptable:

- small sympathetic excavations or removal of samples for consented research that does not disrupt the site significantly, (i.e. acceptable if the system can re-create disrupted sampled components);
- small superficial modifications such as fencing in non-critically important parts of the site; or which do not significantly affect the functionality of the active process system,
- small alterations if they are reversible and short term and do not contaminate the site and do not affect critically important parts of the site.

"Unfavourable" condition

A site will be in an "unfavourable condition" if the site condition is below the lower limit of "favourable maintained" described above, e.g. if scree had been deliberately placed, without consent, on the external part of a meander to prevent erosion. A new steady state of "unfavourable condition" may then exist and continue to be reported as such ("unfavourable — no change"). The site may be beginning to recover ("unfavourable- recovering") - for example, If, the river had begun to rework the scree and was returning to natural baseline conditions. A report of "favourable – recovered" would be hoped for at the time of the next survey. The site may begin to worsen ("favourable – declining") if interventions have begun to cause significant, unnatural, deviation from baseline conditions.

If the activities/changes cause further irretrievable worsening of site condition, or the geomorphological processes have been permanently altered and the system is no longer evolving in a natural way, then an assessment of "partial destruction" may be made. Depending on how much, if any of the original integrity of the site remains intact, a "destroyed" assessment may be made.

It might be that activities outside of the site boundary have negative effects within it, and a condition assessment of "unfavourable" status may need to be recorded. Further action to address such a situation will need to be initiated in consultation with National teams/offices.

INTEGRITY SITE

CAVE/KARST SITE[7]

Firstly, decide what are the *key* Earth science elements (one or more of the following) in the site to be monitored?

- active carbonate precipitation;
- relict carbonate precipitation;
- cave sediments, fossiliferous cave deposit[8];
- cave mineral deposits [speleothem; tufa];
- cave passage (active/relict, phreatic/vadose pattern and amount);
- cave chamber, choking/collapse feature;
- karst landform [doline, karst valley, dry valley, gorge, limestone pavement, scar];
- chalk/limestone drainage feature; active solution processes, relict solution processes]

Site Management Issues

We will need to take into account the condition of the key Earth science elements (see list above) at the time of baseline survey, the natural variability of the system (changes in extent/composition/morphology of key elements in active systems), the capacity for the key processes to recreate components damaged or destroyed in active cave systems, and the extent to which we accept natural changes or trends (e g caused by regularity of flooding, weathering, erosion, cave passage collapse, vegetation changes). Uninduced cave collapse and natural flooding will cause a reduction in the quality or extent of the key features in the site, but this is a consequence of natural cave development and should not therefore be viewed necessarily as "unfavourable". Readers should cross-refer to "active geomorphology" ESCC for further consideration of actively developing caves, and "relict geomorphology" ESCC for consideration of relict karst, such as limestone pavement.

There will also need to be some consideration of modifications made *outside* of the ASSI/SSSI Site boundary, that have negative effects on the integrity/condition of the key Earth science elements *within* the boundary, e.g. changes in adjacent areas hydrologically linked to a cave, such as water extraction. The effects of activities outside of the site may be measurable within the site, but cannot necessarily be reversed to restore the natural balance. Consultation with adjacent land managers, policy makers or National teams may be required to address the issue. {A similar problem to migratory birds' nesting sites, where we may measure the attribute such as the number of nesting pairs. This may fall below the "acceptable minimum", but the condition may result from factors outwith the site boundary and no "corrective" action can be undertaken}

It is not uncommon to have highly vulnerable/sensitive components within a cave system to which monitoring activities can pose a threat - some Earth science elements in caves will not therefore be monitored.

Natural, or deliberate concealment / passage blocking may be a useful conservation mechanism where Earth science elements (e.g. fossils) are vulnerable or limited m extent and may be subject to unconsented collecting or damage from recreational caving.

Fencing off dangerous areas or handrail construction may be necessary in the interests of safety.

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[7] Sites at which limestone scenery/landforms are being actively formed, or where have been formed previously ("relict" caves/karst). Note that this is a separate category to "Relict" and "Active" geomorphology sites which have dedicated ESCCs to which readers should cross-refer.

[8] "Bone Caves" and important localised fossiliferous resources. Readers should cross refer to the "Unique
Fossil /Mineral site" ESCC as well as consider appropriate sections of the Cave/Karst ESCC given here.

Activities usually highly damaging if unmodified	Damage can usually be avoided if work sensitively planned and carried out	Damaging only in exceptional circumstances
Effluent disposal and dumping. Quarrying/removal of "pavement". Entrance closure. Collecting. Catchment developments influencing hydrological and sedimentological characteristics	Changes in agricultural practice Water abstraction from boreholes Entrance control Recreational caving	Minor developments above cave passages

'Natural' changes potentially affecting Karst/Cave sites

Increase in instability, chamber/passage collapse, flooding (water table changes), weathering/erosion.

Generic Conservation Objectives for Cave and Karst sites:

To maintain the integrity ("intactness"), diversity and extent of the key Earth science elements and the processes which form them by minimising any changes to the site.

Targets

- Physical composition, morphology and internal structure of the Earth science elements **remain intact** and are evolving **naturally** and that **natural processes are unimpeded**, or there has been **no artificially induced deterioration**. If they were not intact/entirely unimpeded at the time of baseline survey;
- Levels of activity of the geomorphological processes and their spatial domain **retain the capacity to operate across their full range** of natural variability, or there has been **no deterioration**. If these were constrained by human activity at the time of baseline survey;
- Key Earth science elements remain **unmodified and unconcealed**, unless there has been consent to modify or conceal (i.e. the target is to ensure that there is no unconsented tipping or dumping, tree planting, or engineering works that would obscure or damage the key Earth science elements, and that there is no unconsented excavation or quarrying);
- **Visibility** of the key **Earth science elements is unimpaired** (or there has been **no deterioration** since the site was notified) ["visibility" relates to context of different landforms within the site boundary – no undesirable visual obstructions];
- The geomorphological system maintains the **capacity to recreate the Earth science elements** for which the site was notified, where these have been lost or damaged or deteriorated naturally (active systems);
- The integrity, **context and relationships** of the key **Earth science elements** to their substrate/basement have **not diminished through physical damage or fragmentation**, [e.g. physical conditions (drainage/exposure to natural weathering/extent and type of vegetation/soil/scree cover [where not part of the special interest]) are not artificially altered or there has been **no change** to them since the time of baseline survey [consent may be given for the protection of vulnerable interests by covering, however], the use of surrounding land does not lead to changes which might affect water levels or chemical composition within the site, mineral, peat or water extraction does not threaten the integrity of the key Earth science elements, in particular, water flow must not be constrained or adversely affected by developments within, adjacent to or on land hydrologically linked to the site;
- **Access to the site is maintained for the purposes of education and research** as appropriate, and that the amount (extent and frequency) of permitted research which potentially damages the integrity is not exceeded ["Access" does not relate to natural inaccessibility or deliberate prevention of access in order to protect vulnerable areas].

Defining the conditions "Favourable - Maintained" and "Favourable - Recovered" for Cave/Karst sites

For a site to be recorded as "Favourable – Maintained", the cave/ karst processes must be free to evolve naturally (i.e. the physical conditions that could be affected by human intervention must be the same as at the time of baseline survey). This will mean that the full range of Earth science elements

continues to be intact or evolve in a natural unimpeded fashion, (e g vertical and lateral extent of relict Earth science elements constant, cave sediments remain intact, active processes continue unabated, no additional induced vegetation cover, no artificially induced build-up of soil/mud /scree impairing accessibility/visibility/system functionality; no artificially induced changes to water levels (flooding or draining), no development on or near the site (no tipping, tree planting, engineering or building works, no contamination/pollution of cave waters detected), no removal of limestone (e.g. quarrying), no wastes (fixings or other wastes) left by cavers, no contamination/pollution detected, no deterioration caused by agricultural use change.

Monitors will not be able to Judge the "naturalness" of the geomorphological processes directly They will need to record whether there have been any artificial modifications within the site boundary and whether any changes that have occurred to the Earth science elements are outside of their normal natural range (I e volume, vertical and lateral extent of Earth science elements and their structure must be within their normal natural range) If a site was "unfavourable-recovering" at the last assessment and the site has returned to a natural equilibrium, an assessment of "favourable -recovered" would be reported.

Very low levels of disruption that are reversible or temporary may be acceptable and permitted with consent, if the system overall will not be damaged in the long term and can recover Changes that may be acceptable

- small sympathetic excavations or removal of samples for consented research that does not disrupt the site (i.e. acceptable if the system can re-create disrupted sampled components, movement of vulnerable material to suitable repository (e.g. bone cave excavation and recording) may in fact be preferable if likely to deteriorate rapidly in-situ);
- small build ups of scree/soil and small increases in potentially disruptive vegetative cover, or by minor engineering works (e g minor "show cave" developments that do not affect the integrity of the cave system), the implied partial loss may be acceptable and permitted with consent in exceptional circumstances, if, for example, they do not obscure more than 5% of the site area and none of the key Earth science elements (or no more than 5% increase compared to time of baseline survey) Greater amounts of cover may be acceptable if this is helpful to the ongoing conservation of the key elements of interest at the site and if the material built up does not unduly hinder consented research, the reader should cross refer to the "Integrity – buried" ESCC);
- deliberate cave passage blockage where Earth science elements are highly vulnerable;
- small superficial modifications such as small developments or agricultural land-use change above caves, fencing on non-critically important parts of a karst site, handrail or similar safety constructions, or minor modifications which do not significantly affect the functionality of the cave system if sensitively carried out;
- small alterations if they are reversible and short term and do not contaminate the site and do not affect critically important parts of the site.

"Unfavourable" condition

A site will be in an "unfavourable condition". If the site condition is below the lower limit of "favourable maintained" described above, e.g. if cave deposits have been removed without consent, or damage caused by cavers. A new steady state of "unfavourable condition" may then exist and continue to be reported as such ("unfavourable – no change"). The site may be beginning to recover ("unfavourable – reconvening") - for example, if, damaged stalactites begin to show signs of regeneration and were now adequately protected or a partially obscured limestone pavement was being cleared, or water extraction was reduced. A report of "favourable – recovered" would be hoped for eventually. The site may begin to worsen ("favourable – declining") if interventions have begun to cause significant, worsening, deviation from baseline conditions

If the activities/changes cause further irretrievable damage or worsening of condition, or the geomorphological processes or cave/karst features have been permanently and artificially altered and the system is no longer evolving in a natural way, then an assessment of "partial destruction" may be made depending on how much, if any of the original integrity of the site remains intact, a "destroyed" assessment may be made.

It might be that activities outside of the site boundary have negative effects within it, and a condition

assessment of "unfavourable" status may need to be recorded. Further action to address such a situation will need to be initiated in consultation with National teams/offices.

INTEGRITY
SITE

"UNIQUE" [ATYPICAL/RARE] MINERAL, FOSSIL OR OTHER GEOLOGICAL[9]

Firstly, decide what are the *key* Earth science elements (one or more of the following) in the site to be monitored?

- rare/unusual mineral occurrence,
- rare/ unusual fossil bearing material,
- rock body/sediments potentially containing rare/ unusual fossils or minerals,
- visible fossils (e g tree stumps, footprints)
- rare/ unusual geological feature of limited extent

Site Management Issues

We will need to take into account the condition of the key Earth science elements at the time of baseline survey, the extent to which we accept natural changes or trends (e.g. weathering, erosion, vegetation alteration), the extent of the resource, and how damaging unconsented collecting may be. The main target is to ensure that there are no new artificial developments of any kind or irresponsible collecting or total removal of the important geological materials.

The site may attract amateur and professional collectors and researchers who may wish to collect /remove rock/take boreholes. How much of these activities is permitted before the site reaches a critical condition will depend upon frequency of disruption, quantity of disruption, availability of the total resource and "gain in scientific knowledge. However, it is not possible to "police" the sites, so signboards advocating responsible use of the site "no hammering" etc. may be advisable. Opportunities to raise awareness about responsible collecting through leafleting and reference to policy statements should be exploited, and a sense of local "ownership" should be fostered among geological groups (e g. RIGs groups and universities) to help safeguard the site.

Where the important Earth science elements he in a cliff, unimpeded coastal or fluvial erosion may be important to remove eroded material, and maintain a fresh, clean "face". However, if cliff-line retreat is very rapid, and the important material of very limited extent, the important material may be completely eroded away. Sympathetic protection may be considered in this case, such as a certain degree of cover by scree, soil or vegetation, so long as the cover can be removed when the site is being studied for research. Similarly, inland, keeping a site completely uncovered by scree and soil might not be practical or desirable for the long-term conservation of the site. Further, if a site is not being grazed and rapid recolonisation of vegetation conceals the site, but causes no long-term damage, then a recording of "favourable condition" may still be returned so long as the site is cleared before research takes place. The reader should cross-refer to the ESCCs "Coastal and River Cliffs" and "Integrity-buried" for further information as appropriate.

Physical protection of the resource may be required for the most vulnerable sites. For example, steps may need to be taken to stop the removal of material by collectors by deliberate burial, fencing, or allowing natural concealment to develop. Protection of the resource from the effects of weathering (e.g. construction of a roof or shelter) as well as from over-zealous collectors may be considered necessary to protect exposed fossils. Removal of the important material to a suitable repository such as a museum may become necessary ultimately.

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[9] Sites at which there are finite and irreplaceable resources. This includes "unique" materials that could be in a quarry/foreshore/cliff/mine/cave and also includes 'Integrity Buried' ESCC site types, the reader should cross refer to the appropriate ESCC for further guidance.

Activities highly damaging if unmodified	Damage can usually be avoided if work sensitively planned and carries out	Damaging only in exceptional circumstance
Industrial/housing developments. Waste disposal and infilling. Reprofiling and excavation. Removal of material. Commercial and educational Collecting.	Research and small-scale amateur collecting (losses need to be offset by agreed benefits to research). Stabilisation of faces	Sites generally vulnerable and no specific operations in this box.

'Natural' changes potentially affecting "Unique" mineral, fossil or other geological sites
See under quarries (active and disused), foreshores, cliffs mine dumps caves ESCCs, as appropriate to the physical type of site in which the "Unique" material is present.

Generic Conservation Objective for "unique" mineral, fossil or other geological sites:

To maintain the integrity ("intactness" - quality and quantity) of the key Earth science elements and minimise changes to the site, but protecting vulnerable materials from weathering and over collecting if necessary.

Targets

- Quantity of the key Earth science elements **remains constant** and that there has been **no deterioration** in the physical condition of them compared to the time of baseline survey;
- The key Earth science elements are **not modified or concealed (i.e. visibility unimpaired**, or there has been **no deterioration** since the time of baseline survey) without consent (i.e. ensuring that there is no unconsented tipping or dumping, tree planting, or engineering works that would obscure or damage the key Earth science elements, and that there is no unconsented research excavation), or
- The key **Earth science elements remain accessible through excavation** (if vulnerable and currently covered for protection);
- The physical condition of the site has not deteriorated, and the **context and relationships** of the key **Earth science elements** to the **surroundings have not diminished through physical damage or fragmentation** [e g the physical conditions (drainage/exposure to natural weathering/extent and type of vegetation, soil or scree cover) are not artificially altered or that there has been no change to them since the time of baseline survey, [consent may be given for the protection of vulnerable attributes by covering or burial, however], use of surrounding land does not lead to changes which might flood the site or change its chemical composition, nearby mineral, peat or water extraction does not threaten the integrity of the key Earth science elements];
- **Access to the site is maintained for the purposes of education and research, regulated or restricted to protect vulnerable materials**, as appropriate, and that the amount (extent and frequency) of permitted research/ collecting which potentially damages the integrity is not exceeded.

Defining the conditions "Favourable- Maintained" and "Favourable- Recovered" for "Unique" mineral, fossil, or other geological sites

For a site to be recorded as "Favourable maintained", the quantity and range of key Earth science elements will be constant (no loss of material) They will continue to be intact and unobscured by natural soil/vegetation/scree build-up, or by consented dumping/engineering works, the physical conditions will be the same as at the time of baseline survey - no vegetation cover, no build -up of soil/mud impairing accessibility, no flooding, no development on or near the Site (no tipping, tree planting, engineering or building works). If vulnerable material is, or has been, deliberately covered to protect it, the site will still be in favourable condition if the cover is entirely intact and undisturbed, and is arranged in such a way that authorised excavations are still possible

Some disruptions/ changes to the site may be tolerated within the "favourable- maintained" condition

- small scale removal of samples for consented research that does not disrupt the Earth science elements significantly, (i.e. acceptable if regulated or if movement of vulnerable material (e g rare fossils) to suitable repository may in fact be preferable),

- natural build-ups of scree/soil, or increase in vegetative cover is acceptable if the "unique" material is very limited in extent and if the cover is removed before the site is due to be studied,
- deliberate burial, or construction of fencing to protect highly vulnerable materials,
- responsible collecting [monitors should refer to the JNCC position statement on fossil collecting, as well as guidelines produced by the Geologists' Association], i.e. removal of small amounts of material. If the resource is sufficiently extensive and if collecting seems to be sustainable at present levels without entirely removing it in the foreseeable future. [A point may be reached when collecting is no longer sustainable and the remaining resource needs to be physically protected against any collecting].
- small superficial modifications such as fencing, tree planting or face stabisation on non-crtically important parts of a site,
- small alterations if they are reversible and short term and do not contaminate the site and do not affect critically important parts of the site.

"Unfavourable" condition

A site will be in an "unfavourable condition" if its condition is below the lower limit of "favourable maintained" described above, e.g. if irresponsible collecting had led to removal of a significant amount of the important material or left the site littered with rock debris, or perhaps the amount of soil/ scree vegetative cover had reached an unacceptably high level that was going to make any use of the site very difficult. A new steady state of "unfavourable condition" may then exist and continue to be reported as such ("unfavourable- no change"). The site may be beginning to recover ("unfavourable- recovering") – in the first example, if the remaining material was now being protected, or the debris was being cleared. A report of "favourable - recovered" would be hoped for at the time of the next survey. The Site condition may begin to worsen ("favourable- declining").

If the activities/changes cause further irretrievable worsening of condition, or the important material have been permanently altered or removed without consent, then an assessment of "partial destruction" may be made. Depending on how much, if any, of the original integrity of the site remains intact, a "destroyed" assessment may be made. Consented removal of vulnerable material will not be reported as "destruction" if it is placed in a suitable repository. A decision will then need to be made as to whether the site still warrants GCR/ESCR status.

INTEGRITY SITE

MINE DUMP

Firstly, decide what are the *key* Earth science elements (one or more of the following) in the site to be monitored?

- mineral/fossil specimens,
- secondary mineral growth
- potentially fossil-bearing rock,
- potentially mineral-bearing rock

Site Management Issues

We will need to take into account the condition of the dump at the time of baseline survey, the extent to which we accept natural changes or trends (e.g. weathering, erosion, build-up of soil, vegetation growth/die back), the extent to which we allow modification to the dump to allow research/collecting (e.g. turning over the material for new potential finds), whether the dump is being periodically replenished, the extent of the dump, and the extent to which we allow removal of material.

How much collecting/ site disruption is permitted will depend upon frequency of disruption, quantity of disruption, and "gain in scientific knowledge". There may need to special attention to the non-disturbance of the site if the growth of secondary minerals in the dump is an important feature. Similarly, protection of rare metallophyte lichens from the biological conservation viewpoint may modify conservation activities and site use.

A degree of natural concealment may help to deter collectors or site misuse, if such misuse or collecting poses a threat; however, the greatest threats will be large-scale removal of the dump material (e.g. for aggregate) or "reclamation" schemes. Fly tipping may be a problem, and "No tipping" signs might be erected, or barriers to vehicles (e.g. gates/ boulders) placed at site access points.

Activities usually highly damaging if unmodified	Damage can usually be avoided if work sensitively planned and earned out	Damaging only m exceptional circumstances
Major afforestation and introduction of vegetation Major excavations (major removal of spoil). Reprofiling ("reclamation", "landscaping" or levelling) Industrial/housing developments	Minor excavations Minor afforestation	Collecting

'Natural' changes potentially affecting Mine Dumps

Mass movement (slumping); accumulation of sediment/vegetative cover; flooding; weathering.

Generic Conservation Objectives for mine dump Sites:

To maintain the integrity ("intactness" - quality and quantity) and accessibility of the key Earth science elements.

Targets

- The mine dump is **not modified or concealed** without consent (i.e. ensuring that there is no unconsented

tipping or dumping, tree planting, "landscaping" or engineering works that would obscure or damage the important mine dump material).

- the physical conditions (drainage/exposure to natural weathering/extent of soli or vegetation cover) me not artificially altered or that there has been **no change** to them since the time of baseline survey, [consent may be given for the protection of vulnerable interests by covering, or for rotation of the dump to expose new material, however], ensuring that the use of surrounding land does not lead to water level or other changes which would chemically alter the mine-dump,
- the fossil/mineral bearing rock **remains accessible** through excavation (if currently covered to protect vulnerable interests)
- **the quantity of available material in the dump remains constant** (if the dump is not being replenished), or ensuring that the dump is being replenished with similar material (from the same source) to that already present,
- **access to the site is maintained for the purposes of education and research**, or restricted, as appropriate, and that the amount (extent and frequency) of permitted research and collecting that potentially damages the integrity (through excessive removal of material) is not exceeded.

Defining the conditions "Favourable- Maintained" and "Favourable- Recovered"

For a mine dump site to be recorded as "Favourable - maintained", the quantity of material in the key dumps must be constant (no loss), or increasing (with similar material from the same mine source), or consented removal of material is small scale and seems to be sustainable at present levels without entirely removing it in the foreseeable future. [A point may be reached when collecting is no longer sustainable and the remaining resource needs to be physically protected against any collecting]. For the dump to be in favourable condition, it must continue to be intact and unobscured by natural small/mud/vegetation build-up, or by consented dumping/engineering works, and the physical conditions will be the same as at the time of baseline survey - no vegetation cover, no build-up of soil/mud impairing accessibility, no flooding, no development on or near the site (no tipping, tree planting, engineering or building works). If vulnerable material is, or has been, deliberately covered to protect it, the site will still be in favourable condition if the cover is entirely intact and undisturbed, and such that authorised excavations are still possible.

Some disruptions/ changes to the site may be tolerated within the "favourable- maintained" condition

- small scale removal of samples for consented research that does not disrupt the Earth science elements significantly, (i.e. acceptable if regulated or if movement of vulnerable material (e g rare fossils) to suitable repository may in fact be preferable),
- consented dump "rotation",
- natural build-ups of scree/soil, or increase in vegetative cover is acceptable If It does not obscure more than 5% of the site (5% compared to the extent of cover at the time of baseline survey). Greater amounts of cover may be acceptable if this is helpful to the ongoing conservation of the key elements of interest at this site and if the material built up does not unduly hinder consented research,
- deliberate burial or construction of fencing to protect highly vulnerable materials,
- responsible collecting [monitors should refer to the JNCC position statement on fossil collecting, as well as guidelines produced by the Geologists' Association], i.e. removal of small amounts of material if the resource is sufficiently extensive and if collecting seems to be sustainable at present levels without entirely removing it in the next few years. [A point may be reached when collecting is no longer sustainable and the remaining resource needs to be physically protected]
- small superficial modifications such as fencing, tree planting or stabilisation on non-critically important parts of a site,
- small alterations if they are reversible and short term and do not contaminate the site and do not affect critically important parts of the site.

"Unfavourable"
condition

A site will be in an "unfavourable condition" if its condition is below the lower limit of "favourable maintained"' described above, e.g. if a significant amount of the important material had been removed without consent, or perhaps the amount of soil/ scree vegetative cover had reached an unacceptably high level that was going

to make any use of the site very difficult. A new steady state of "unfavourable condition" may then exist and continue to be reported as such ("unfavourable - no change"). The site may be beginning to recover ("unfavourable - recovering") - for example, if the remaining material was now being protected against removal, or undesirable debris cover was being cleared. A report of "favourable - recovered" would be hoped for at the time of the next survey. The site condition may begin to worsen ("favourable- declining").

If the activities/changes cause further irretrievable worsening of condition, or the important material have been permanently altered or removed without consent, then an assessment of "partial destruction" may be made. Depending on how much, if any, of the original integrity of the site remains intact, a "destroyed" assessment may be made. Consented removal of vulnerable material will not be reported as "destruction" if it is placed in a suitable repository.

INTEGRITY SITE

INTEGRITY - BURIED

These sites may have important geological characteristics of limited extent ("integrity"), but which are buried, e.g. under soil or scree. The category does not include sites that are to all intents and purposes permanently buried and inaccessible (e.g. buried beneath concrete or building or engineering works (such burial cannot be "favourable").

"Integrity – buried" sites are purposefully buried, or are allowed to remain buried under natural accumulations, because burial can be a useful protection measure that preserves the vulnerable Earth sciences material (e.g. rare fossils). "Burial" under water might be considered in this category, e.g. in a flooded dis-used quarry, depending on whether the important geological features can be accessed periodically, e.g. by draining/ natural dry-up. Retaining the potential for access is the key requirement for favourable status.

Generic conservation objectives can be accounted for elsewhere – particularly the "Unique" mineral, fossil or other geological sites ESCC. Primary targets for sites to be m favourable condition are that the material remains accessible through excavation, and that the cover is not removed without consent. "Unfavourable" conditions might include unconsented excavation of the material, failure to re-bury the site after excavation, excess accumulation of natural cover to the point where re-excavation is virtually impossible (e.g. covered by a slump or rockfall); permanent developments above the buried material.

EXPOSURE SITE

EXPOSURE - BURIED[10]

Firstly, decide what are the *key* Earth science elements (one or more of the following) in the site to be monitored?

- rock body (lithological unit),
- rock type,
- junction/boundary between lithological units,
- band within lithological unit,
- contact between rock types (unconformity; igneous contact, contact metamorphism);
- sequence of rock units (continuity and extent);
- dyke/ vein,
- sedimentary structures (cross bedding; ripples etc.);
- deformation (folding, faulting, cleavage);
- fossiliferous layer;
- rock body potentially bearing fossils or minerals,
- visible fossils (e g tree stumps, footprints);
- rock body actually or potentially containing minerals;
- ore body,
- glacial and interglacial stratigraphy (lithostratigraphy and biostratigraphy- not landforms),

Site Management Issues

Generally, the situation is that a buried exposure (as opposed to a buried "integrity" site) is not in favourable condition because the presumption is that the important rock body is laterally extensive and could be excavated without there being a risk to loss of key features. Management objectives should include the development of permanent exposures wherever possible, and should certainly ensure that the buried exposure retains the potential for re-exposure (i.e. no development on the site).

Quaternary exposure buried sites (e.g. bogs) which can be sampled by bore-holes might be considered to be in favourable condition only if they remain naturally "buried", but this type of site might be better regarded under the "Active Geomorphology" ESCC, because they are best conserved in the long term through ensuring hydrological integrity of the system.

Activities usually highly damaging if unmodified	**Damage can usually be Avoided if work sensitively planned and earned out**	**Damaging only in exceptional circumstances**
Major afforestation Major excavations (major removal of cover) Industrial/housing developments	Excavation Minor afforestation Changes in agricultural practice Road and track construction	Collecting

'Natural' changes potentially affecting buried exposures

Development of scrub or woodland.

[10] Sites in this category could be any geological types ("Feature") except the Caves, Karst, and active geomorphology

EXPOSURE SITE

MINE/TUNNEL SITE[11],[12]

Firstly, decide what are the *key* Earth science elements (one or more of the following) in the site to be monitored?

- rock body (lithological unit), rock type,
- junction/boundary between lithological units,
- band within lithological unit,
- contact between rock types (unconformity, igneous contact, contact metamorphism),
- sequence of rock units (continuity and extent);
- dyke/ vein,
- sedimentary structures (cross bedding, ripples etc.),
- deformation (folding; faulting, cleavage),
- fossiliferous layer,
- rock body potentially bearing fossils or minerals,
- visible fossils (e.g. tree stumps, footprints],
- rock body actually or potentially containing minerals,
- ore body

Site Management Issues

We will need to take into account the condition of the key Earth science elements at the time of baseline survey, whether the mine is no longer being worked, whether there is any capacity for the key Earth science elements to be found elsewhere in the mine (if being actively worked), and the extent to which we accept natural changes or trends (e.g. weathering, erosion, and the extent to which we accept necessary engineering works which secure the ongoing safety or working the mine (e.g. roof supports). How much consented research collecting/rock coring/ site disruption is permitted will depend upon frequency of disruption, quantity of disruption, and "gain in scientific knowledge".

The target is to ensure that the all the key Earth science elements present at the time of baseline survey continue to be exposed, and are in good "clean" physical condition, any developments have been consented and no new underground hazards are introduced without consent.

Fencing off shafts, open stopes and adits may be necessary in the interest of safety or protection of vulnerable materials and this should not be regarded as decline m favourable condition.

Some decrease in the level of exposure through collapse may be regarded as acceptable, particularly if the tunnel instability is an ongoing problem or if it helps to protect more vulnerable parts of the site from over-collecting Clearance and stabilisation may then only be required prior to consented research.

[11] excluding 'integrity' sites occurring in mines/tunnels - these are covered in the "Unique" mineral/fossil/other geological ESCC, although readers should consider the guidance given in this section on mines and tunnels and adapt it for use as necessary.

[12] Mines and tunnels potentially contain any geological "Features" except Caves, Karst and Quaternary, relict or active geomorphology.

Activities usually highly damaging if unmodified	Damage can usually be avoided if work sensitively planned and carried out	Damaging only in exceptional circumstances
Adit or shaft closure (this can be acceptable if desirable/reversible) Infilling Surface subsidence or flooding Effluent or waste disposal Commercial and educational collecting	Show mine developments (e.g. lighting, flood-water pumping and strengthening works which do not obscure important parts of the site) Research collecting	Demolitions above mines Normal agricultural operations

'Natural' changes potentially affecting mine/ tunnels

Increase in instability, tunnel/mine collapse/blockage, surface subsidence,

flooding, **Generic Conservation Objectives for mine/tunnel sites:**

To maintain the degree and quality of exposure and safe accessibility of the key Earth science elements

Targets

- Key Earth science elements **remain exposed** or that there has been no reduction in degree of exposure since the time of baseline survey (i.e. there is no unconsented tipping or dumping, or no unconsented engineering works or underground hazards that would obscure or damage the key Earth science elements). If the mine is being actively worked, then the scope for re-exposure of **Earth science elements** is important [detailed geological assessment required], ensuring that there is no unconsented collecting;
- The context and relationships of the key Earth science elements **have not diminished through physical damage**;
- The **visibility of the key Earth Science elements is unimpaired (or there has been no deterioration** since the time of baseline survey) or the key exposures of rock remain accessible through excavation (if currently covered to protect vulnerable materials or currently the subject of continuing mining),
- The key Earth science elements are **not modified or concealed** without consent (if the mine is inactive),
- **Safe access to the site is maintained for the purposes of education and research** as appropriate, (flooding, scree/waste materials must not impede access) and that the amount (extent and frequency) of permitted research which potentially damages the site through excessive removal of material is not exceeded.

Defining the conditions "Favourable - Maintained" and "Favourable - Recovered

The site will be in "favourable" condition if the quantity and quality of key Earth science elements is constant or increasing, (e.g. vertical and lateral extent of Earth science elements constant or increasing and that they are not concealed or damaged) and if the physical conditions the same as at the time of baseline survey (no build-up of soil/mud impairing accessibility, no flooding, no collapse, no development on or near the site, no dumping and no engineering works).

If vulnerable material is deliberately covered or access to it deliberately blocked, or blocked by collapse, the site will still be in favourable condition if the cover/ blockage is entirely intact and undisturbed, and arranged in such a way that authorised research is still possible after necessary clearance.

Some disruptions/ changes to the site may be tolerated within the "favourable- maintained" condition

- small scale removal of samples for consented research that does not disrupt the Earth science elements significantly, (i.e. acceptable if regulated or if movement of vulnerable material (e.g. rare minerals) to suitable repository may in fact be preferable) [A point may be reached when collecting is no longer sustainable and the remaining resource needs to be physically protected against any collecting];

- natural build ups of scree/soil/rock are acceptable if they do not obscure more than 5% of the exposure (5% compared to the extent of cover at the time of baseline survey). Greater amounts of cover may be acceptable if this is helpful to the ongoing conservation of the key elements of interest at this site and if the material built up does not unduly hinder consented research,
- deliberate burial, or access restriction, to vulnerable or unsafe parts of the site,
- consented collecting [monitors should refer to the JNCC position statement on fossil collecting, as well as guidelines produced by the Geologists' Association], i.e. removal of small amounts of material if the resource is sufficiently extensive and if collecting seems to be sustainable at present levels and is carried out safely. [A point may be reached when collecting is no longer sustainable and the remaining resource needs to be physically protected],
- modifications such as roof supports or face stabilisation on non-critically important parts of a site,
- small alterations if they are reversible and short term and do not contaminate the site and do not affect critically important parts of the site, e.g. sympathetic show-mine developments (lighting, handrail construction or fencing off dangerous parts of the site)

"Unfavourable" condition

A site will be in an "unfavourable condition" if its condition is below the lower limit of "favourable maintained" described above, e.g. if a significant amount of a protected characteristic ore body had been removed without consent, or perhaps the amount if soil/ scree/rock cover had reached an unacceptably high level that was going to make any use of the site very difficult. A new steady state of "unfavourable condition" may then exist and continue to be reported as such ("unfavourable - no change"). The site may be beginning to recover ("unfavourable - recovering") - for example, if the remaining ore was now being protected against removal, or undesirable debris cover was being cleared. A report of "favourable- recovered" would be hoped for at the time of the next survey. The site condition may begin to worsen ("favourable- declining").

If the activities/changes cause further irretrievable worsening of condition, or the important material have been permanently altered or removed without consent, then an assessment of "partial destruction" may be made. Depending on how much, if any, of the original integrity of the site remains intact, a "destroyed" assessment may be made. Consented removal of vulnerable material will not be reported as "destruction" if it is placed in a suitable repository.

EXPOSURE SITE

INLAND OUTCROP[13] OR STREAM SECTION[14]

Firstly, decide what are the *key* Earth science elements (one or more of the following) in the site to be monitored?

- rock body (lithological unit), rock type;
- junction/boundary between lithological units;
- band within lithological unit;
- contact between rock types (unconformity, igneous contact, contact metamorphism);
- sequence of rock units (continuity and extent);
- dyke/ vein;
- sedimentary structures (cross bedding, ripples etc.),
- deformation (folding, faulting, cleavage);
- fossiliferous layer;
- rock body potentially bearing fossils or minerals,
- visible fossils (e g tree stumps, footprints],
- rock body actually or potentially containing minerals, ore body
- glacial/interglacial deposition landforms/characteristics (including isostatic/eustatic features - raised beaches etc.);
- glacial/interglacial erosion landforms/characteristics,
- periglacial landforms/characteristics,
- glacio-fluvial depositional and erosional landforms/characteristics,
- glacial and interglacial stratigraphy/sediments (lithostratigraphy and biostratigraphy - not landforms)

Site Management Issues

We will need to take into account the condition of the key Earth science elements at the time of baseline survey, the extent of the key Earth science elements not yet exposed (i.e. the total extent of the resource, not just the exposed parts, and the capacity for exposing new material if elsewhere it becomes covered or damaged) and the extent to which we accept natural changes or trends (e.g. weathering, erosion, vegetation alteration).

The mam target is to ensure that the all the key Earth science elements present at the time of baseline survey continue to be exposed, and are in good "clean" physical cond1tion. However, some decrease in the level of exposure may be regarded as acceptable, particularly if it helps to protect more vulnerable parts of the site. For example, if rapid recolonisation of vegetation conceals the exposure, but causes no long-term damage, then a recording of "favourable condition" may still be returned so long as the site is cleared before research takes place. A certain amount of natural concealment (by soil/scree/vegetation) may be helpful in deterring collectors if over-collecting or site misuse is a problem (e.g. site becomes littered with collecting debris). If the exposure is of soft or unstable material that tends to weather or disintegrate quickly, 100% exposure of clean fresh faces all the time will not be practical or desirable, but the site should be cleaned in advance of known research activities and clearance at regular intervals of invasive scrub, woodland development may be necessary to prevent the structure of the sediments becoming disturbed by roots.

Continuing agricultural use in its present form may be an important factor to maintain the site in favourable condition – e.g. grazing, which improves the visibility of the elements within the site by removing invasive

[13] Includes railway and road cuttings.

[14] Excluding "integrity" sites occurring as outcrops/stream sections - these are covered in relict geomorphology, Karst/Caves, Unique mineral/fossil/other geological site ESCCs as appropriate.

vegetation. Woodland or scrub development above soft sediment exposures can be damaging, because of disturbance by roots. Conversely, vegetation may help stabilise soft exposure sites undergoing rapid erosion. Cutting a lower angle of face may be helpful for soft sediment exposures to slow up erosion through slumping. Where partial concealment is permitted the site can be recorded "favourable" if the site is cleared prior to consented research.

Stream sections may occasionally become obscured by natural build-up of sediment/scree/rock fall material. If this occurs through natural processes (i.e. not artificially induced through land-use changes), then the site will not necessarily be recorded as unfavourable condition, so long as the stream has the natural capacity to remove the cover and re-expose the important rock.

Where the exposures lie in railway or road cuttings, it may be important to remove build ups of eroded material from the base of the cutting periodically. However, if stability of the cutting is a problem, sympathetic protection in the interests of safety may be considered, so that the accumulated material may be helpful, similarly a certain degree of cover by scree, soil or vegetation may be acceptable, so long as the cover can be removed when the site is being studied for research. Protection of unstable faces by artificial means such as chicken wire covering, rock bolts etc. may be necessary in the interest of safety but would need to be positioned so that the key Earth science elements can still be accessed. See also "Disused Quarry" ESCC where further guidance can be found If the key Earth science elements are exposed in higher parts of the face, build-ups of scree or soil at the base, or cutting a "stepped" face, may actually be helpful by allowing better access.

Activities usually highly damaging if unmodified	**Damage can usually be avoided if work sensitively planned and carried out**	**Damaging only in exceptional circumstances**
Major afforestation Industrial/housing developments River management works Quarrying, including scree removal	Small plantations Isolated developments Roads/tracks Fencing, including deer fencing Collecting	Changes in agricultural practice Drainage and buried services

'Natural' changes potentially affecting inland outcrops/stream sections

Increase in instability, bank collapse, vegetative cover including scrub and woodland development.

Generic Conservation Objectives for inland outcrop/stream section sites:

To maintain the degree and quality of exposure of the key Earth science elements

Targets

- The key Earth science elements **remain exposed/unobscured** or that there has been an increase or **no reduction in degree of exposure** since the time of baseline survey, (i.e. ensuring that there is no unconsented tipping or dumping, tree planting or unconsented engineering works that would obscure or damage the key Earth science elements). If a stream section periodically displays the key Earth science elements, then the scope for re-exposure of **Earth science elements** is important [detailed geological assessment required], there must be no unconsented or unsustainable collecting,
- The **visibility of the key Earth Science features are unimpaired (or there has been no deterioration** since the site was notified) or the key Earth Science features remain accessible through excavation (if currently covered to protect vulnerable interests) ["Visibility" relates to context of different features within the site boundary - no undesirable visual obstructions],
- The context and relationships of the key Earth Science features to the surroundings **have not diminished through physical damage,**
- **Access to the site is maintained for the purposes of education and research** as appropriate (flooding, scree/waste materials must not impede access to the key exposures) and that the amount (extent and frequency) of permitted research and collecting which potentially damages the site through excessive removal of material is not exceeded.

Defining the conditions "Favourable- Maintained" and "Favourable - Recovered"

The site will be in "favourable" condition if the quantity and quality of key Earth science elements is constant or increasing, (i.e. vertical and lateral extent of the key Earth science elements constant or increasing and that they are not concealed or damaged) and if the physical conditions are the same as at the time of baseline survey (no build -up of soil/mud/vegetation impairing accessibility, no flooding, no afforestation, no development on or near the site, no tipping, no engineering or building works).

If parts of the site are vulnerable and are deliberately or naturally covered, the site will still be in favourable condtion if the cover is entirely intact and undisturbed, and arranged in such a way that authorised research is still possible after necessary clearance. The cover must not exceed levels that would severely restrict access to the important material.

Some disruptions/ changes to the site may be tolerated within the "favourable - maintained" condition

- small scale removal of samples for consented research that does not disrupt the Earth science elements significantly, (i.e. acceptable if regulated or if movement of vulnerable material (e.g. rare minerals) to suitable repository may in fact be preferable,
- small scale collecting [monitors should refer to the JNCC position statement on fossil collecting, as well as guidelines produced by the Geologists' Association], i.e. removal of small amounts of material if the resource is sufficiently extensive and if collecting seems to be sustainable at present levels and is carried out safely and with owner permission [A point may be reached when collecting is no longer sustainable and the remaining resource needs to be physically protected]
- temporary build-ups of channel deposits that entirely or partially cover up an exposed stream section, If they are deemed to be "natural" and likely to be eroded away eventually,
- natural build-ups of scree/soil/rock are acceptable If they do not obscure more than 5% of the exposure (5% compared to the extent of cover at the time of baseline survey). Greater amounts of cover may be acceptable if this is helpful to the ongoing conservation of the key elements of interest at this site, or in the interests of safety, and if the material built up does not unduly hinder consented research,
- deliberate burial, or access restriction, to vulnerable or unsafe parts of the site,
- modifications such as face stabilisation on non-critically important parts of a site,
- small alterations if they are reversible and short term and do not contaminate the site and do not affect critically important parts of the site, e.g. sympathetic drainage works (to prevent face collapse) or fencing off dangerous parts of the site.

"Unfavourable" condition

A site will be in an "unfavourable condition" if its condition is below the lower limit of "favourable maintained" described above, e.g. if the amount of soil/ scree/rock cover or scrub development had reached an unacceptably high level that was going to severely restrict access for research or make clearance very difficult. A new steady state of "unfavourable condition" may then exist and continue to be reported as such ("unfavourable - no change"). The site may be beginning to recover ("unfavourable - recovering") - for example, if the undesirable debris/disruptive scrub cover was being cleared. A report of "favourable- recovered" would be hoped for at the time of the next survey. The site condition may begin to worsen ("favourable- declining").

If the activities/changes cause further irretrievable worsening of condition, or the important material has been permanently altered or removed without consent, then an assessment of "partial destruction" may be made. Depending on how much, if any, of the original exposure remains intact, a "destroyed" assessment may be made. Consented removal of vulnerable material will not be reported as "destruction" if it is placed in a suitable repository.

EXPOSURE SITE

FORESHORE EXPOSURE[15]

Firstly, decide what are the *key* Earth science elements (one or more of the following) in the site to be monitored?

Potentially any except the Caves, Karst, Quaternary and geomorphological "Features"

- rock body (lithological unit), rock type;
- junction/boundary between lithological units, band within lithological unit;
- contact between rock types (unconformity, igneous contact, contact metamorphism);
- sequence of rock units (continuity and extent);
- dyke/ vein;
- sedimentary structures (cross bedding, ripples etc.),;
- deformation (folding, faulting; cleavage),
- fossiliferous layer;
- rock body potentially bearing fossils or minerals, visible fossils (e g tree stumps, footprints);
- rock body actually or potentially containing minerals;
- ore body.

Site Management Issues

We will need to take into account the condition of the key Earth science elements at the time of baseline survey, the extent of the key Earth science elements not yet exposed (i.e. the total extent of the resource, not just the exposed parts, and the capacity for exposing new material if elsewhere it becomes covered or damaged) and the extent to which we accept natural changes or trends (e.g. weathering, erosion, sedimentation/ natural development of cover (including seaweed)).

The main target is to, ensure that the all the key Earth science elements present at the time of baseline survey continue to be exposed, and are in good "clean" physical condition. However, the exposure may occasionally become obscured by natural build-up of sediment/scree/rock fall material. If this occurs through natural processes (i.e. not artificially induced through land-use changes), then the site will not necessarily be recorded as unfavourable condition, so long as erosion has the natural capacity to remove the cover and re-expose the important rock.

Similarly, some decrease in the level of exposure may be regarded as acceptable, particularly if it helps to protect more vulnerable parts of the site. For example, if erosion might cause significant reduction in the degree of exposure, natural build-ups of rock or sediment might be tolerated if they cause no long-term damage to the key Earth science elements and if the site can still be excavated prior to consented research. Similarly, a certain amount of natural concealment by rock or sediment may be helpful in deterring collectors if over-collecting or site misuse is a problem (e.g. if vulnerable materials are being removed without consent

Where partial concealment is tolerated the site can be recorded "favourable" if the site is cleared prior to consented research and re-covered after research if necessary to protect remaining vulnerable material.

[15] Excludes integrity sites occurring on foreshores - these are covered in Unique fossil/mineral/geological site ESCC.

Activities usually highly damaging if unmodified	Damage can usually be avoided if work sensitively planned and carried out	Damaging only m exceptional circumstances
Reclamation schemes. Marinas, barrages and similar major developments. Coastal protection works. Beach re-nourishment.	Pipelines. Small jetties. Collecting.	Small-scale sand removal.

'Natural' changes potentially affecting foreshore exposures

Accumulation of sediment cover, rise in sea level.

Generic Conservation Objectives for foreshore exposure sites:

To maintain the degree and quality of exposure of the key Earth science elements.

Targets

- Key Earth science elements **remain exposed/unobscured** or that there has been **no reduction in degree of exposure** since the time of baseline survey, (i.e. ensuring that there is no unconsented tipping or dumping, or unconsented engineering works that would obscure or damage the key Earth science elements). If the exposure is only uncovered periodically because of natural sediment accumulation and erosion, then the scope for re-exposure of Earth science elements is important [detailed geological assessment required], there must be no unconsented or unsustainable collecting.
- **Visibility of the key Earth Science features are unimpaired (or there has been no deterioration** since the site was notified) or the key Earth Science features remain accessible through excavation (if currently covered to protect vulnerable interests) ["Visibility" relates to context of different features within the site boundary - no undesirable visual obstructions],
- **Access to the site is maintained for the purposes of education and research** as appropriate [this does not relate to natural inaccessibility or unrestricted access to visit, it relates to maintaining the level of access to the key exposures that was achievable at the time of baseline survey - no new unconsented physical obstructions],
- The context and relationships of the key Earth Science features to the surroundings **have not diminished through physical damage**.

Defining the conditions "Favourable- Maintained" and "Favourable- Recovered"

The site will be in "favourable" condition if the quantity and quality of key Earth science elements is constant or increasing, (i.e. area extent of the key Earth science elements constant or increasing and that they are not concealed or damaged) and if the physical conditions the same as at the time of baseline survey (no build-up of sand/shingle/mud/seaweed impairing accessibility, no development on or near the site, no tipping, no engineering or building works).

If parts of the site are vulnerable and are deliberately or naturally covered, the site will still be in favourable condition if the cover is arranged in such a way that authorised research is still possible after any necessary clearance – i.e. artificial cover does not exceed levels that would severely restrict access to the important material or temporary natural build-up of sediments is within the normal variability of the system.

Some disruptions/ changes to the site may be tolerated within the "favourable - maintained" condition

- small scale removal of samples for consented research that does not disrupt the Earth science elements significantly, (i.e. acceptable if regulated or if movement of vulnerable material (e.g. rare minerals) to suitable repository may in fact be preferable,
- small scale collecting [monitors should refer to the JNCC position statement on fossil collecting, as well as guidelines produced by the Geologists' Association], i.e. removal of small amounts of material if the resource is sufficiently extensive and if collecting seems to be sustainable at present levels and is carried out safely and with owner permission [A point may be reached when collecting is no longer sustainable and the remaining resource needs to be physically protected].

- temporary build-ups of sediment/shingle/rock that entirely or partially covers up the exposure, if they are deemed to be "natural" and likely to be eroded away eventually,
- longer term natural build-ups of scree/soil/rock are acceptable if they do not obscure more than 5% of the exposure (5% compared to the extent of cover at the time of baseline survey). Greater amounts of cover may be acceptable if this is helpful to the ongoing conservation of vulnerable key elements of the site, and if the material built up does not unduly hinder consented research;
- deliberate burial, or access restriction, to vulnerable or unsafe parts of the site,
- small modifications such as pipeline laying on non-critically important parts of a site,
- small alterations if they are reversible and short term and do not contaminate the site and do not affect critically important parts of the site, e g jetty construction.

"Unfavourable" condition

A site will be in an "unfavourable condition" if its condition is below the lower limit of "favourable maintained" described above, e.g. if rock cover through slumping had reached an unacceptably high level that was going to severely restrict access for research or make clearance very difficult. A new steady state of "unfavourable condition" may then exist and continue to be reported as such ("unfavourable - no change"). The site may be beginning to recover ("unfavourable - recovering") - for example, if the undesirable debris was being cleared through coastal erosion. A report of "favourable - recovered" would be hoped for eventually. The site condition may begin to worsen ("favourable - declining"), e.g. if the rock cover was encroaching further over the site.

If the activities/changes cause further irretrievable worsening of condition, or the important material have been permanently altered or removed without consent, then an assessment of "partial destruction" may be made. Depending on how much, if any, of the original exposure remains intact, a "destroyed" assessment may be made. Consented removal of vulnerable material will not be reported as "destruction" if it is placed in a suitable repository.

EXPOSURE SITE

COASTAL AND RIVER CLIFFS[16]

Firstly, decide what are the *key* Earth science elements (one or more of the following) in the site to be monitored?[17]

- rock body (lithological unit);
- rock type;
- junction/boundary between lithological units;
- band within lithological unit;
- contact between rock types (unconformity, igneous contact, contact metamorphism);
- sequence of rock units (continuity and extent),
- dyke/vein,
- sedimentary structures (cross bedding, ripples etc.);
- deformation (folding, faulting, cleavage);
- fossiliferous layer,
- rock body potentially bearing fossils or minerals;
- visible fossils (e g tree stumps, footprints],
- rock body actually or potentially containing minerals;
- ore body
- glacial/interglacial deposition landforms/characteristics (including isostatic/eustatic features - raised beaches etc.);
- glacial/interglacial erosion landforms/characteristics, periglacial landforms/characteristics;
- glacio-fluvial depositional and erosional landforms/characteristics;
- glacial and interglacial stratigraphy/sediments (lithostratigraphy and biostratigraphy - not landforms)

Site Management Issues

We will need to take into account the condition of the key Earth science elements at the time of baseline survey, the extent of the key Earth science elements not yet exposed (i.e. the total extent of the resource, not just the exposed parts, and the capacity for exposing new material if elsewhere it becomes eroded, covered or damaged) and the extent to which we accept natural changes or trends (e.g. weathering, erosion, build-up of sediment, vegetation alteration).

The main target is to ensure that the all the key Earth science elements present at the time of baseline survey continue to be exposed, and are in good "clean" physical condition.

Unimpeded coastal or fluvial erosion will be important to remove cliff-foot accumulations, and to maintain a good, clean "face". However, if cliff-line retreat is very rapid, the important material may be completely eroded away or there may be pressure for coastal protection to protect capital assets. Sympathetic protection may be considered in these cases, such as allowing a certain degree of cover with loose material like scree. or allowing coastal protection of a type that does not obscure the important exposures totally [offshore or "soft" engineering solutions might be considered] Coastal engineering works that protect capital assets may be acceptable if carefully carried out in consultation with specialists. Ideally, any permitted cliff foot accumulations should be removable (and if necessary replaceable) when the site is being studied for research.

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[16] Excludes integrity sites occurring in coastal cliffs and river cliffs - these are covered in relict geomorphology, Caves/Karst/, Unique mineral/fossil/other geological ESCCs as appropriate.

[17] Potentially any except those that may occur in Cave/Karst and active geomorphology ESCCs. Active river and coastal geomorphology sites are accounted for under the active geomorphology ESCC.

Build-ups of sediments that allow access to higher parts of the section can sometimes improve research potential - where no key Earth science elements occur at the cliff-foot.

Some decrease in the level of exposure may be regarded as acceptable, particularly if it helps to protect more vulnerable parts of the site. For example, if rapid recolonisation of vegetation or soil build-up conceals the exposure, but causes no long-term damage, then a recording of "favourable condition" may still be returned so long as the site is cleared before research takes place. A certain amount of natural concealment (by soil/scree/vegetation) may be helpful if site misuse is a problem (e.g. site becomes littered with collecting debris or cliffs are being artificially undermined). If the exposure is a cliff made of soft or unstable material that tends to weather away or disintegrate quickly, 100% exposure of clean fresh faces all the time will not be practical or desirable, but the site should be cleaned in advance of known research activities and clearance at regular intervals of invasive scrub, woodland development may be necessary to prevent the structure of the sediments becoming disturbed by roots.

Cliffs may occasionally become obscured by slump/rock fall. If this occurs through natural processes (i.e. not artificially induced through land-use changes), then the site will not necessarily be recorded as unfavourable condition, so long as there is a natural capacity to remove the cover and re-expose the important rock. [For example, for cliffs above the MHWM, only storms or very high tides may begin to remove scree etc. for cliffs below MHWM, material will be more likely to be reworked/ eroded. [If the site is a mass movement site, where actively slumping is the Feature of interest, the site will be considered under the active geomorphology ESCC].

Activities usually highly damaging if unmodified	**Damage can usually be avoided if work sensitively planned and carried out**	**Damaging only in exceptional circumstances**
'Hard' coast protection schemes, e.g. concrete structures Developments above cliff undergoing erosion Dumping at cliff foot Flooding	Beach replenishment 'Soft' coast protection schemes, e.g. offshore berms Chalets/beach huts Commercial and educational collecting	Signs, paths and fencing Tree and scrub clearance Research collecting

'Natural' changes potentially affecting Coastal and River Cliffs

Cliff instability, cliff collapse/slumping, cliff erosion ('retreat'), accumulation of sed1ment at cliff foot (and its removal during storms), rise in sea level/storm frequency.

Generic Conservation Objectives for coastal and river cliff sites:

To maintain the degree and quality of exposure of the key Earth science elements

Targets

- Physical Earth science elements **remain exposed/unobscured** or that there has been **no reduction in degree of exposure** since the time of baseline survey, (i.e. ensuring that there is no unconsented tipping or dumping, tree planting or unconsented engineering works that would obscure or damage the key Earth science elements, active processes (causing erosion) not constrained within or adjacent to the site). If the section periodically displays the key **Earth science elements**, then the scope for re-exposure of Earth science elements is important [detailed geological assessment required], there must be no unsustainable collecting;
- **The visibility of the key Earth Science elements are unimpaired (or there has been no deterioration** since the site was notified) or the key Earth Science elements remain accessible through excavation (if currently covered to protect vulnerable interests) ["Visibility" relates to context of different features within the site boundary - no undesirable visual obstructions];
- **Access to the site is maintained for the purposes of education and research** as appropriate, along the whole extent of the exposure [this does not relate to natural inaccessibility or freedom to visit the site, it

relates to maintaining the level of access that was achievable at the tune of baseline survey - no new unconsented physical obstructions],

- The context and relationships of the key Earth Science features to the surroundings **have not diminished through physical damage**.

Defining the conditions "Favourable- Maintained" and "Favourable- Recovered

The site will be in "favourable" condition if the quantity and quality of key Earth science elements is constant or increasing, (i.e. vertical and lateral extent of the key Earth science elements constant or increasing and that they are not concealed or damaged) and if the physical conditions are the same as at the time of baseline survey (no build -up of sand/shingle/mud/seaweed impairing accessibility, no development on or near the site, no tipping, no engineering or building works).

If parts of the site are vulnerable and are deliberately or naturally covered, the site will still be in favourable condition if the cover is arranged in such a way that authorised research is still possible after any necessary clearance – i.e. artificial cover does not exceed levels that would severely restrict access to the important material or temporary natural build-up of sediments is within the normal variability of the system.

Some disruptions/ changes to the site may be tolerated within the "favourable - maintained" condition:

- small scale removal of samples for consented research that does not disrupt the Earth science elements significantly, (i.e. acceptable if regulated or if movement of vulnerable material (e.g. rare minerals) to suitable repository may in fact be preferable;
- small scale collecting [monitors should refer to the JNCC position statement on fossil collecting, as well as guidelines produced by the Geologists' Association], i.e. removal of small amounts of material if the resource is sufficiently extensive and if collecting seems to be sustainable at present levels and is carried out safely and with owner permission. [A point may be reached when collecting is no longer sustainable and the remaining resource needs to be physically protected];
- temporary build-ups of sediment/shingle/rock that entirely or partially covers up the exposure, if they are deemed to be "natural" and likely to be eroded away eventually,
- longer term natural build -ups of scree/soil/rock are acceptable if they do not obscure more than 5% of the exposure (5% compared to the extent of cover at the time of baseline survey). Greater amounts of cover may be acceptable if this is helpful to the ongoing conservation of vulnerable key elements of the site, or of the build-up allows desirable access to higher parts of the exposure, i.e. if the material built up does not unduly hinder consented research;
- deliberate burial, or access restriction, to vulnerable or unsafe parts of the site,
- small modifications such as drainage on non-critically important parts of a site,
- small alterations if they are reversible and short term and do not contaminate the site and do not affect critically important parts of the site, e.g. fence construction at the clifftop.

"Unfavourable" condition

A site will be in an "unfavourable condition" if its condition is below the lower limit of "favourable maintained" described above, e.g. if rock cover through slumping had reached an unacceptably high level that was going to severely restrict access for research or make clearance very difficult. A new steady state of "unfavourable condition" may then exist and continue to be reported as such ("unfavourable - no change"). The site may be beginning to recover ("unfavourable - recovering") - for example, if the undesirable debris was being cleared through coastal erosion. A report of "favourable - recovered" would be hoped for eventually. The site condition may begin to worsen ("favourable- declining"), e.g. if the rock cover was encroaching further over the site.

If the activities/changes cause further irretrievable worsening of condition, or the important material have been permanently altered or removed without consent, then an assessment of "partial destruction may be made. Depending on how much, if any, of the original exposure remains intact, a "destroyed" assessment may be made. Consented removal of vulnerable material will not be reported as "destruction" if it is placed in a suitable repository.

EXPOSURE SITE

ACTIVE QUARRY/PIT[18]

Firstly, decide which (one or more of the following) key Earth science elements are present in the site to be monitored? in active quarries/pits[19]

- rock body (lithological unit), rock type;
- junction/boundary between lithological units;
- band within lithological unit;
- contact between rock types (unconformity, igneous contact, contact metamorphism);
- sequence of rock units (continuity and extent);
- dyke/ vein;
- sedimentary structures (cross bedding, ripples etc.);
- deformation (folding, faulting, cleavage);
- fossiliferous layer;
- rock body potentially bearing fossils or minerals;
- visible fossils (e.g. tree stumps, footprints];
- rock body actually or potentially containing minerals;
- ore body;
- glacial/interglacial deposition landforms/characteristics (including isostatic/eustatic features - raised beaches etc.);
- glacial/interglacial erosion landforms/characteristics;
- periglacial landforms/characteristics;
- glacio-fluvial depositional and erosional landforms/characteristics;
- glacial and interglacial stratigraphy/sediments (lithostratigraphy and biostratigraphy - not landforms).

Site Management Issues

We will need to take into account the extent and condition of the key Earth science elements at the, time of baseline survey, the expected amount of quarrying that will occur, the extent of the key Earth science elements not yet exposed (i.e. the total extent of the resource, not just the exposed parts, and the capacity for exposing important new "finds", or rock faces, by normal quarrying operations if elsewhere it is being removed, eroded, or covered) and the extent to which we accept natural changes or trends (e.g. weathering, erosion, build-up of sediment, vegetation alteration).

The main target is to ensure that the all the key Earth science elements present at the time of baseline survey continue to be exposed, or are likely to be exposed during normal quarrying operations. Any "final" faces left for study must be in good "clean" physical condition, i.e. safety and solidity of remaining face will be important. [Ideally the face should be smooth blasted rather than shattered, or left at 50 degree angle for soft sediments. There should be a reasonable resource of the important material behind the ultimately conserved face]. It will be important to ensure that key exposures can be accessed for research without becoming permanently obscured or damaged by waste material build-up/ reclamation schemes/ building or engineering developments.

It may be important to ensure that there is agreement/provision for the removal of build -ups of talus/scree/sediment from the base of exposures in readiness for consented research.

If stability of quarry/ pit sides is a problem, sympathetic protection in the interests of safety may be considered

[18] Excluding 'integrity' sites co-incidentally present in active workings - these are covered in relict geomorphology, Karst/Caves, Unique mineral/fossil/other geological ESCCs as appropriate.
[19] Potentially any geological types except those that may occur in Cave/Karst and active geomorphology ESCCs.

without reducing the conservation status of the site, e.g. accumulated waste material or a slump may stabilise a pit side - important here is whether the cover can be removed when the site is being studied for research. Protection of unstable faces by artificial means such as chicken wire covering, rock bolts etc. may be necessary in the interest of safety in parts of the site not being worked, the positioning of such structures should wherever possible take into account the scientific importance of the protected faces and allow research access to key parts of the face.

If the key Earth science elements are exposed in higher parts of the face, build-ups of waste/ talus/ scree or soil at the base, or cutting a "stepped" face, may actually be helpful by allowing better access.

Activities usually highly Damaging if unmodified	**Damage can usually be avoided if work sensitively planned and carried out**	**Damaging only in exceptional circumstances**
Landfill/disposal of quarry Waste; Reclamation schemes	Quarry extensions	Normal quarrying operations; Collecting

'Natural' changes potentially affecting active quarries/pits

Disused face instability, face collapse, face degradation (slumping), accumulation of sediment/talus at base of face, vegetative cover, flooding.

Generic Conservation Objectives for active quarry/pit sites:

To maintain the degree and quality of exposure of the key Earth science elements

Targets

- Key Earth science elements **remain exposed/unobscured** or that there has been **no reduction in degree of exposure** since the time of baseline survey, (i.e. ensuring that there is no unconsented tipping or dumping and no storage of materials against key quarry faces, no unconsented engineering works (including inappropriate restoration works) that would obscure or damage the key Earth science elements. If the section periodically displays the key Earth science elements, then the scope for re- exposure of Earth science elements is important [detailed geological assessment required]. Planning conditions and working/restoration agreements/plans are being observed on site, no inappropriate specimen removal or theft, buildings and other structures do not impair access, build-up of scree, talus and overburden does not unacceptably impair access, flooding does not impair access,
- **Visibility of the key Earth Science features are unimpaired (or there has been no deterioration** since the site was notified) or the key Earth Science features remain accessible through excavation ["Visibility" relates to context of d1fferent features within the site boundary - no undesirable visual obstructions];
- **Access to the site is maintained for the purposes of education and research** as appropriate [this does not relate to natural inaccessibility or frequency of access permitted by owners, it relates to maintaining the level of access that was achievable at the time of baseline survey - no new unconsented physical obstructions];
- The context and relationships of the key Earth Science features to the surroundings have not diminished through physical damage.

Defining the conditions "Favourable- Maintained" and “Favourable - Recovered"

The site will be in "favourable" condition if the quantity and quality of key Earth science elements is constant or increasing, (i.e. area extent of the key Earth science elements constant or increasing and that they are not concealed or damaged) and if the physical conditions are the same as, or better than, the baseline survey conditions (no build-up of talus/ soil impairing accessibility to key faces when research is consented, no permanent development on or near the key faces of the site, no tipping, no engineering or building works).

If parts of the site are temporarily covered through normal quarrying operations the site will still be in favourable condition if the cover is arranged in such a way that authorised research is still possible after any necessary clearance, i.e. artificial cover does not exceed levels that would severely restrict access to the important material in the long term.

Artificially modified water levels or consented dumping/engineering works must not impair access to full range of key Earth science elements.

The site is likely to change significantly over time. The sorts of changes that will be tolerated within the "favourable - maintained" condition will be:

- removal of material through normal quarrying operations, so long as any "final" faces are agreed and conservable upon cessation of quarrying;
- removal of samples for consented research (i.e. acceptable if regulated or if movement of vulnerable material (e.g. rare minerals) to suitable repository may in fact be preferable;
- collecting consented by quarry owners [monitors should refer to the JNCC position statement on fossil collecting, as well as guidelines produced by the Geologists' Association], i.e. removal of fossil/ mineral specimens if the specimen resource is sufficiently extensive and if collecting seems to be sustainable at present levels and is carried out safely and with owner permission. [A point may be reached when collecting of localised material is no longer sustainable and the remaining resource needs to be physically protected];
- temporary build-ups of sediment/shingle/rock that entirely or partially covers up the exposure, if they are deemed to be "natural" or part of normal quarrying and likely to be eroded away/ removed through normal operations eventually;
- longer term natural build-ups of scree/soil/rock are acceptable if they do not obscure more than 5% of the exposure (5% compared to the extent of cover at the time of baseline survey). Greater amounts of cover may be acceptable if this is helpful to the ongoing conservation of vulnerable key elements of the site, and if the material built up does not unduly hinder consented research;
- deliberate burial, or access restriction, to vulnerable or unsafe parts of the site;
- modifications such as pipeline laying or engineering works normal to the operation of the quarry which do not permanently damage critically important parts of a site.

"Unfavourable" condition

A Site will be m an "unfavourable condition" if its condition is below the lower limit of "favourable maintained" described above, e.g. if rock cover through slumping/ dumping/ blasting had reached an unacceptably high level that was going to severely restrict access in the long term for research or make clearance very difficult, or if engineering works or dumping of waste had severely (long term) impeded visibility of the best exposures. A new steady state of "unfavourable condition" may then exist and continue to be reported as such ("unfavourable - no change"). The site may be beginning to recover ("unfavourable - recovering") - for example, if the undesirable debris was being cleared. A report of "favourable - recovered" would be hoped for eventually. The site condition may begin to worsen ("favourable - declining"), e.g. if the quarry was nearly worked out and the resource of important material was nearly entirely removed.

If the activities/changes cause further irretrievable worsening of condition, or the important material have been permanently altered or removed, then an assessment of "partial destruction" may be made. Depending on how much, if any, of the original exposure remains intact, a "destroyed" assessment may be made. Consented removal of vulnerable material will not be reported as "destruction" if it is placed in a suitable repository.

EXPOSURE SITE

DISUSED QUARRY, PITS AND CUTTINGS[20]

Firstly, decide what are the *key* Earth science elements (one or more of the following) in the site to be monitored?

[The potential list is the same as given in the Active Quarries/Pits ESCC]

Site Management Issues

We will need to take into account the condition of the key Earth Science elements at the time of baseline survey, the extent of the key Earth science elements not yet exposed within the Site boundary (i.e. the total extent of the resource, not just the exposed parts, and the capacity (if any) for exposing new material if elsewhere it becomes covered or damaged) and the extent to which we accept natural changes or trends (e.g. weathering, erosion, vegetation alteration).

The main target is to ensure that the all the key Earth science elements present at the time of baseline survey continue to be exposed, and are in good "clean" physical condition. However, some decrease in the level of exposure may be regarded as acceptable, particularly if it helps to protect more vulnerable parts of the site. For example, if rapid recolonisation of vegetation conceals the exposure, but causes no long-term damage, then a recording of "favourable condition" may still be returned so long as the site is cleared before research takes place. A certain amount of natural concealment (by soil/scree/vegetation) may be helpful in determining collectors if over-collecting or site misuse is a problem (e.g. site becomes littered with collecting debris). If the exposure is of soft or unstable material that tends to weather or disintegrate quickly, 100% exposure of clean fresh faces all the time will not be practical or desirable, but the site should be cleaned in advance of known research activities and clearance at regular intervals of invasive scrub, woodland development may be necessary to prevent the structure of the sediments becoming disturbed by roots.

Continuing agricultural use in its present form may be an important factor to maintain the site in favourable condition – e.g. grazing, which improves the visibility of the elements within the site by removing invasive vegetation. Woodland or scrub development above soft sediment exposures can be damaging, because of disturbance by roots. Conversely, vegetation may help stabilise soft exposure sites undergoing rapid erosion. Cutting a lower angle or "stepped" of face may be helpful for soft sediment exposures to slow up erosion through slumping. Where partial concealment is permitted the site can be recorded "favourable" if the site is cleared prior to consented research.

It may be important to remove build-ups of eroded material from the base of the quarry faces periodically. However, if stability of the exposure is a problem, sympathetic protection in the interests of safety may be considered, so that the accumulated material may be helpful, similarly a certain degree of cover by scree, soil or vegetation may be acceptable, so long as the cover can be removed when the site is being studied for research. Protection of unstable faces by artificial means such as chicken wire covering, rock bolts etc. may be necessary in the interest of safety but would need to be positioned so that the key Earth science elements can still be accessed. If the key Earth science elements are exposed in higher parts of the face, build-ups of scree or soil at the base, or cutting a "stepped" face, may actually be helpful by allowing better access.

Tipping, land reclamation, flooding and landfilling pose the greatest threats. It may be helpful to deter unconsented activities by "No tipping" signs or prevention of vehicular access with barriers or gateways.

[20] Excluding 'integrity' sites in disused workings - these are covered in the relict geomorphology, Karst/Caves, "Unique" mineral/fossil/other geological site ESCCs as appropriate.

Activities usually highly damaging if unmodified	Damage can usually be avoided if work sensitively planned and carried out	Damaging only in exceptional Circumstances
Landfill; Tipping; Face reprofiling/stabilisation; Liquid storage/reservoirs; Deliberate flooding.	Quarry floor developments; Forestry ; Minor restoration and landscaping; Recreational developments; Cleaning down of faces; Commercial and educational collecting.	Tree and scrub clearance; Fencing; Drainage and buried services Research collecting (including coring); Rock climbing developments/debris.

'Natural' changes potentially affecting disused quarries/pits/cuttings

Face instability, face collapse, face degradation (slumping), accumulation of sediment/talus at base of face, vegetative cover, flooding, accumulation of leachate/landfill gas, where site is partially landfilled.

Generic Conservation Objective for disused quarries/pits/cuttings:

To maintain the degree and quality of exposure of the key Earth science elements and where necessary enhance their exposure.

Targets

- Key Earth science elements **remain exposed/unobscured** or that there has been **no reduction in degree of exposure** since the time of baseline survey, (i.e. ensuring that there is no unconsented tipping or dumping against key faces, no unconsented tree planting or engineering works (including inappropriate "restoration"/ “reclamation” works, no damage caused by recreational rock climbing) that would obscure or damage the key Earth science elements). If the exposure is in soft sediments and periodically displays the key Earth science elements through natural erosion, then the scope for re- exposure of Earth science elements is important [detailed geological assessment required], there must be no unconsented or unsustainable collecting; buildings and other structures do not impair access, build-up of scree/vegetation, does not unacceptably impair access, flooding does not impair access;
- **Visibility of the key Earth Science features are unimpaired (or here has been no deterioration** since the site was notified) or the key Earth Science features remain accessible through excavation (if currently covered to protect vulnerable interests) ["Visibility” relates to context of different features within the site boundary- no undesirable visual obstructions],
- **Access to the site is maintained for the purposes of education and research** as appropriate, (flooding, scree/waste materials must not impede access to the key exposures) and that the amount (extent and frequency) of permitted research and collecting which potentially damages the site through excessive removal of maternal is not exceeded.
- The context and relationships of the key Earth Science features to the surroundings **have not diminished through physical damage.**

Defining the conditions "Favourable- Maintained" and "Favourable - Recovered"

The site will be in “favourable" condition if the quantity and quality of key Earth science elements is constant or increasing, (i.e. vertical and lateral extent of the key Earth science elements constant or increasing and that they are not concealed or damaged) and if the physical conditions are the same as at the time of baseline survey (no build-up of soil/mud/vegetation impairing accessibility, no flooding no afforestation, no development on or near the site, no tipping, no engineering or building works).

If parts of the site are vulnerable and are deliberately or naturally covered, the site will still be in favourable condition if the cover is entirely intact and undisturbed, and arranged in such a way that authorised research is still possible after necessary clearance. The cover must not exceed levels that would severely restrict access to the important material.

Some disruptions/ changes to the site may be tolerated within the "favourable- maintained" condition

- small scale removal of samples for consented research that does not disrupt the Earth science elements significantly, (i.e. acceptable if regulated or If movement of vulnerable material (e.g. rare minerals) to suitable repository may in fact be preferable), damage by clusters of rock core samples may lead to decrease in "favourable" condition through removal of important material or destabilisation;
- small scale collecting [monitors should refer to the JNCC position statement on fossil collecting, as well as guidelines produced by the Geologists' Association], i.e. removal of small amounts of material if the resource is sufficiently extensive and if collecting seems to be sustainable at present levels and is carried out safely and with owner permission. [A point may be reached when collecting is no longer sustainable and the remaining resource needs to be physically protected].
- natural build -ups of scree/soil/rock/water levels are acceptable if they do not obscure more than 5% of the exposure (5% compared to the extent of cover at the time of baseline survey). Greater amounts of cover may be acceptable if this is helpful to the ongoing conservation of the key elements of interest at this site, or in the interests of safety, and if the material built up does not unduly hinder consented research;
- deliberate burial, or access restriction, to vulnerable or unsafe parts of the site,
- modifications such as face stabilisation on non-critically important parts of a site,
- small alterations if they are reversible and short term and do not contaminate the site and do not affect critically important parts of the site, e.g. sympathetic drainage works (to prevent face collapse), consented afforestation/landfilling or fencing off dangerous parts of the site.

"Unfavourable" condition

A site will be in an "unfavourable condition" if its condition is below the lower limit of "favourable maintained" described above, e.g. if the amount of soil/ scree/rock cover or scrub development had reached an unacceptably high level that was going to severely restrict access for research or make clearance very difficult. A new steady state of "unfavourable condition" may then exist and continue to be reported as such ("unfavourable - no change"). The site may be beginning to recover ("unfavourable - recovering") - for example, if the undesirable debris/disruptive scrub cover was being cleared. A report of "favourable- recovered" would be hoped for at the time of the next survey. The site condition may begin to worsen ("favourable- declining")

If the activities/changes cause further irretrievable worsening of condition, or the important material have been permanently altered or removed without consent, then an assessment of "partial destruction" may be made. Depending on how much, if any, of the original exposure remains intact, a "destroyed" assessment may be made. Consented removal of vulnerable material will not be reported as "destruction" if it is placed m a suitable repository.

Appendix 2: Old SNH Earth science Site Condition Monitoring Guidance from 1999

Contents

Scottish Natural Heritage, 1999. Earth Sciences *in* Guidance - Site Condition Monitoring Guidance Folder

(N.B. section 15.7 has been recreated from draft notes as no copy of the final version of this section appears to have survived)

guidance

SCOTTISH NATURAL HERITAGE

SITE CONDITION MONITORING

GUIDANCE FOLDER

Including Project Plan for
1 April 2000 to 31 March 2001

15. EARTH SCIENCES

15. INTRODUCTION TO EARTH SCIENCES

This chapter provides guidance for the identification of attributes, targets and monitoring methods to assess the condition of Earth science sites These sites vary considerably in their nature and scale, and the approach required will vary accordingly. A detailed methodology and definition of terms for monitoring Earth science sites has been produced by JNCC - N. Ellis (1998) *Earth Science Site Monitoring. A Framework and Guidelines for Earth Science SSSIs and ASSIs* - referred to hereafter as the JNCC Guide Reference should be made to this document for further information A supplementary document deals with conservation objectives and monitoring questions - N Ellis (1999) *Earth Science Site Monitoring. Conservation Objectives and Site Monitoring Questions.*

Earth science sites can vary from a few square metres of exposed rock (outcrop) to lengths of river channel and coastline or areas of hillside. In the following sections the types of site are considered according to the reason for their designation and their broad generic type which is reflected in the Earth Science Reporting Categories for Site Condition Monitoring (Table 15.0) The Geological Conservation Review (GCR) site networks or blocks included in each type are listed in the tables on pages 10-17 of the JNCC Guide. **Note, however, that the reporting categories listed on page 18 of the JNCC Guide have been re-grouped as in table 15.0.**

Table 15.0 Reporting categories for Earth science site

Section and Reporting Category	
15.1	Stratigraphy sites
15.2	Structural and metamorphic geology sites
15.3	Igneous petrology sites
15.4	Mineralogy sites
15.5	Palaeontology sites
15.6	Quaternary geology and geomorphology sites
15.7	Geomorphology sites

The Earth Science Conservation Classification (ESCC) defines the following two main types of site, which helps to determine the essential conservation objectives.

Integrity Sites contain finite deposits or landforms which are irreplaceable if destroyed. Types of site include: active process geomorphological sites, static (relict) geomorphological sites, cave/karst sites, rare or atypical mineral, fossil or other geological sites, mine dumps and integrity buried sites. The conservation aim at these sites is to minimise changes and to preserve site integrity.

Exposure Sites provide exposures of rock that are extensive or also present below the ground surface. These include: foreshore exposures, coastal and river cliffs, active quarries and pits, disused quarries, pits and cuttings, inland outcrops or stream sections,

exposure buried sites and mines/tunnels Exposure sites include rock units which are spatially extensive and for which a number of potentially representative sites exist or could be created by excavation. The conservation aim is to preserve exposure, judging changes on their merits in terms of degree and quality of exposure. For example, quarrying may be welcome where it creates new exposures, or coastal erosion where it maintains fresh exposures.

The assessment of Earth science features will require some knowledge of landforms and basic rock types. Indications of what to look for at each type of site are provided in the relevant section of this guidance. For each site visit it will be necessary to familiarise yourself with the SSSI citation and the Earth Science Site Documentation Reports and, in some cases, to consult reference books or the staff of the Earth Science Group to be sure you understand the nature of the site and the conservation objectives. Normally, however, the Site Documentation Reports should contain all the information needed.

The **Earth Science Site Documentation Reports** describe the features of Interest and highlight the main concerns for each site. Normally they contain annotated photographs of the key features and a section on site management. The Potentially Damaging Operations list for each site indicates the types of operation that are most likely to be detrimental in each case.

Further information

Further information about Earth science sites and issues can be obtained from Earth Science Group, SNH.

Useful Earth science references

The GCR volumes provide technical descriptions of the scientific interest of each site.

Craig, G.Y. 1991 (ed.). *Geology of Scotland.* The Geological Society, London.
Ellis, N. 1998. Earth science site monitoring A framework and guidelines for Earth science SSSIs and ASSIs. JNCC, Peterborough.
Ellis, N. 1999 Earth science site monitoring: conservation objectives and site monitoring questions. JNCC, Peterborough.
Gordon, J.E. 1997 (ed.). *Reflections on the Ice Age in Scotland.* Scottish Association of Geography Teachers and Scottish Natural Heritage, Glasgow.
Pellant, C. 1990. *Rocks, Minerals* & *Fossils of the World.* Pan Books
Sissons, J.B. 1976. *Geomorphology of the British Isles – Scotland.* Methuen, London
Werritty, A., Duck, R. W. and Kirkbride, M. P. 1998. Development of a conceptual and methodological framework for monitoring site condition in geomorphological systems. *SNH Research Survey and Monitoring Report* No. 105.
Whitten, D.G.A & Brooks, J.RV. 1972. *Dictionary of Geology.* Penguin Books.

V1.0 15.2

15.1 STRATIGRAPHY SITES

1 Introduction

From the early days of geological science, geologists have attempted to set up a series of divisions and sub-divisions of rock layer sequences (both sedimentary and volcanic) and to sub-divide geological time into convenient portions. There is also the need to relate (correlate) rock layers (or beds) and rock layer sequences of an area to other beds and sequences, regionally, nationally and internationally.

Relating stratified rocks, especially their sequence in time, the character of the rocks and the correlation of beds in different localities, is the basis for ***stratigraphy***. This fundamental aspect of geology is important, for example, in determining the occurrence and extent of an economic coal seam across the Midland Valley, or understanding oil-bearing sequences in the North Sea.

The scale of stratigraphy sites could range from a relatively small outcrop (a few square metres) to a contact running across a valley side. They may comprise one or more relatively small exposures, or they may Include exposures over a wide area (such as a valley side), which demonstrate the relationships between different strata.

Stratigraphy sites will generally be exposure sites. Most commonly these will be foreshore exposures, coastal and river cliffs, active quarries and pits, disused quarries, pits and cuttings, inland outcrops or stream sections. A few, however, may be integrity sites; for example, type sites for particular rock layers or the contacts between different rock layers, where a specific exposure or section is formally adopted as a standard reference.

2 Skill requirements

Descriptions of the rocks at each site and the key features can be found in the Site Documentation Reports. At the most basic level, you should be able with the assistance of these reports to identify the location and extent of the key rock exposures. You do not necessarily need to be able to identify the individual rock types, but it would be an advantage to be able to recognise some of the key features and the horizons in which they occur.

3 Factors likely to influence the status of sites

The factors most likely to influence the status of stratigraphy sites are the physical attributes (extent, composition and structure) and clarity of the main features and a means for gaining safe access to view them. The biggest threats are construction, excavation (including quarrying), tipping (including landfill) and land restoration schemes. Sites comprising natural cliffs may be prone to instability as may sites in disused quarries, tunnels, mines or excavations which could also become flooded. Sites may also be adversely affected by coast protection and river bank protection. Stratigraphic sites containing interesting or attractive rock types or fossils may be damaged by irresponsible collecting.

Some of these sites may be prone to the activity of natural processes such as weathering and erosion which could reduce the definition of some features, and in extreme cases could destroy a site. However, these processes may also produce new exposures.

Reference should be made to the JNCC Guide for further information on defining favourable and unfavourable condition. This is provided for each category of integrity and exposure site in the Earth Science Conservation Classification.

4 What Attributes do you need to assess?

The following attributes should always be reported for all sites.

4.1. Physical Attributes

Physical attributes relate to the degree to which the site continues to display the key interests that it was selected to represent. Extent refers to the extent of rock outcrop and its degree or clarity of exposure. Composition refers to the presence of the key features for which the site is notified. Structure refers to the relationships between key features (e.g. the junction between two rock layers) and the relationships between the key features and their wider geological context (e g the position of a fossil- bearing bed in a sequence of rocks).

A note should be made of changes such as coastal or river erosion, soil erosion, gully formation, slope failures and of weathering of exposed rock such as discolouration, softening or textural alteration. Roots entering cracks in rock may break the rock, and lichen and moss, as well as obscuring the detail of the rock, may cause chemical damage to the surface.

4.2 Visibility

The features of the site should be visible. In exceptional circumstances burial may be a conservation requirement to protect vulnerable key elements, such as a rich fossil horizon.

In some cases more than one view of a site may be required; for example, a close up view of a rock type and one or more distant views of contacts or large exposures, such as natural cliffs or quarry faces. It is acceptable for limited amounts of work to be necessary, such as clearance of vegetation or scree deposits, for a site to be viewed.

Construction, vegetation, tipping and afforestation outside at some distance from the site may affect its visibility.

4.3 Access

The site should be accessible to the extent practicable. Unlike some other types of site, Earth science sites may be referred to in research work and may have to be visited for comparative purposes. The features of the site must be accessible for study but they need not be readily accessible to everyone all of the time. For example, it is acceptable for limited amounts of work to be necessary, such as clearance of vegetation or scree deposits, for a site to be accessed, and some coastal sites may only be visited at low tide.

Accessibility could be prejudiced by new construction, significant changes in vegetation, afforestation, agricultural use, slope instability and by coast defences or river bank protection measures. In some cases excessive easement of access could reduce the value of the site, for example by path widening. Removal of scree could enhance the

rate of degradation of a slope which is stabilised by the build-up of material at the toe, but the presence of scree or overgrown vegetation may provide some protection against opportunist sample collectors.

A note should be made of any difficulties in gaining access to the site and an estimate of the time and resources needed to gain access.

4.4 Safety

Processes such as the opening of joints and fissures in rock, formation of gullies in soils and soft rocks, rockfalls and collapse of rock cliffs or soil slopes can pose a risk to visitors. Safety may also be compromised by the undermining of coastal or river- side paths by erosion or by the formation of marshy areas due to flooding.

4.5 Negative Indicators

This attribute refers to changes in, near or even distant from the site that may be affecting the site indirectly, or may affect it in the future. Examples could include the construction of new weirs, dams, roads, changes to the way natural vegetation is controlled, stream and flood management, quarrying processes and changes in land use. Detrimental effects to the site should be reported and a note made of any changes that might affect the site in the future, so that they can be monitored.

5 Defining targets for each attribute

Guidance on targets for each attribute is presented in the following table. Mandatory targets define the levels which a feature must achieve in order for its condition to be considered favourable. These must be assessed at all sites where the attribute is present and are highlighted in bold text in the table. Indicative targets provide additional information about the site. Failure to meet these targets does not mean that the site should necessarily be considered unfavourable, but does indicate that it may be undergoing undesirable changes.

6 Measuring whether the targets have been met

6.1 Preparation

A field visit is required to gather most of the information necessary to determine whether the targets have been met. Preparation for field visits should always include reading the previous visit notes to make sure you know what features are important at the site. Before making the first visit it will be necessary to refer to the Site Documentation Reports. A member of the Earth Science Group should be consulted if you need further explanation of the features and how to assess them. The record notes for the first visit should include any information obtained in this way with annotated maps showing the features, so that this knowledge is available for future visits.

Table 15.1.1 Generic guidance on targets for stratigraphy sites

Attribute	Target
Physical Attributes	**A site will be favourable if it continues to display the essential features on which the citation is based. Any decrease in extent, composition and structure of the features will affect the status.** Large scale exposures may be necessary to demonstrate the nature of contacts between stratigraphic units Sites will tend to be in a favourable condition unless affected by construction, roads, tree-planting, quarrying, excavation, tipping, permanent industrial or building development, build-up of scree, encroachment of vegetation, storage of materials, river bank protection, coast defence works, landfill and restoration, large scale erosion or landsliding. Some disruption/changes to the site may be tolerated within the 'favourable-maintained' condition. These are detailed in the JNCC Guide under the appropriate Earth Science Conservation Classification for the site. Individual exposures showing rock detail may also be affected by weathering, erosion and breaking up by roots.
Visibility	**A site will be favourable if it affords appropriate views of the key features. It will also be favourable if partially obscured by scree or vegetation to the extent that no more than a few hours work with hand tools or an excavator is needed to clear the obstructions.** Close-up views (probably less than 10m) will usually be required to view a rock type while a distant view, possibly from more than one angle, may be needed to appreciate a stratigraphic contact or relationship A site may be unfavourable is obscured by excessive build-up of scree, encroachment of vegetation, tipping, river bank or cliff protection work or coastal defences. In exceptional circumstances, burial may be a conservation requirement to protect vulnerable key elements.
Access	**A site will be favourable if it affords appropriate access for study groups or researchers to the extent described under Visibility above.** As described above, access may be necessary either close up and/or from one or more distant vantage points in order to appreciate all the features. The status may be affected by construction, vegetation, land-use changes or flooding.
Safety	**A site should be safe to visit for people acting in a responsible manner.** A site will be considered to be unfavourable if it is unsafe for people taking reasonable care and without the need for any specialist safety equipment or skills. Safety may be affected by rockfalls, flooding or deterioration in paths or footbridges.
Negative Indicators	Any changes in the vicinity of the site that might in the future affect one Indicators of more of the above attributes should be reported.

Key· Mandatory targets are highlighted in bold text

If possible, take copies of relevant documents with you to the site. For complex areas that have been cited for more than one reason, it will be necessary to determine whether there are any likely conflicts between, for example, the requirements of vegetation/habitat and Earth science features.

6.1.1 Maps

Maps of a suitable scale to show the location and access routes to the site (probably not smaller than 1:50,000) and also the location of features within the sites (not smaller than about 1:5,000 or 1:10,000 depending of the size of the site) will always be needed. Refer to the Site Documentation Reports.

6.2 Field Surveys

6.2.1 When to survey

The best time to survey Earth science sites is generally in the early spring before summer vegetation cover begins and in bright weather, preferably lightly overcast to reduce shadows in photographs. Forward planning is required to ensure that sites prone to shadows, tides or other constraints are visited at appropriate times. Once the monitoring is established, there is a benefit in re-visiting sites at the same season, and during similar weather conditions and times of day.

6.2.2 Things to Take With You

You will need the following items on site:

- the Site Documentation Report;
- a map, marked with the location or boundaries of the site and salient features;
- a camera with a reasonably wide angle lens (35 mm). If the camera has a flash, then it must be possible to switch off the flash; photographs should be taken in natural light (see section 1.8 for further advice on photographs);
- a compass to check the direction of views in sketches and photographs;
- a ruler to place in close-up photographs as a scale, and a board identifying the site, date and time of day and direction of view;
- blank field recording forms and checklist of monitoring questions - refer to the JNCC Guide (1999 Supplement) for the appropriate proforma and the instructions for completion;
- forms from the previous monitoring visit to ensure photographs are taken from the same viewpoints and in the same directions on each occasion;
- this manual.

6.2.3 Field Procedures

1 In considering the following generalised approach, special attention should be paid to the crucial areas identified in the Site Documentation Report.

2. You should check that the location or boundaries previously recorded are correct. For large sites it is Important that the whole of the feature of Interest is seen by walking over the site or viewing from suitable vantage points, as appropriate. The details of the inspection should be recorded and repeated in future Inspections.

3 A dimensioned site layout sketch should be produced to show the features of the site, access routes, points from which the features of Interest can be seen and any changes to the physical attributes, access or safety of the site. On future visits, sketches should be made from the same viewpoint to illustrate any changes. A photograph should be taken from the same viewpoint. Locations of additional photographs and detailed sketches (see below) should be shown on the layout sketch.

4. Where necessary, further dimensioned detail sketches should be made of the main features of the site, for example prominent outcrops, showing the size and shape of the exposure and any salient details. Records should be taken at the same location on subsequent monitoring visits and, where relevant, at the same state of tide.

5 When visiting the site, you should refer to the Site Monitoring Question Checklist- (refer to the JNCC Guide, 1999 Supplement). You may also find it helpful to ask yourself the following general questions

- Has the site changed in any way from the description on the citation?
- Has the site changed in any way since the last inspection?
- Try to describe and sketch any changes.
- Do these changes make the site more of less favourable with respect to any of the attributes or do they have no effect?
- If changes are on-going, is the value of the site being increased or reduced?

6.3 Evaluation, Analysis and Record Keeping

The data should be transferred from your field notes to a Site Condition Monitoring Form and compared with the targets for each attribute. The field recording forms should be placed on file for future reference. A note should be kept on file of the length of time taken to carry out the monitoring for planning future visits.

15.2 STRUCTURAL AND METAMORPHIC GEOLOGY SITES

1. Introduction

Structural and metamorphic are terms used to describe rocks that have been subjected to some form of temperature and/or pressure induced changes since they were first formed Structural changes refer to deformations of the layered structure of the rock which may include shearing or folding of the original layering (bedding) of the rock, ranging from gentle to highly contorted. Metamorphic changes occur when the minerals making up the rock become unstable under the changed conditions and are chemically replaced by minerals that are stable at higher temperatures and/or pressures

Structural and metamorphic geology sites will generally be exposure sites. Most commonly these will be foreshore exposures, coastal and river cliffs, active quarries and pits, disused quarries, pits and cuttings, inland outcrops or stream sections. A few, however, may be integrity sites; for example type sites for mountain-building events, such as the Lewisian Gniesses at Scourie or key historical localities, such as Knockan Crag.

2 Skill requirement

Descriptions of the rocks at each site and the key features can be found in the Site Documentation Reports. At the most basic level, you should be able with the assistance of these reports to Identify the location and extent of the key rock exposures. You do not necessarily need to be able to identify the individual rock types, but it would be an advantage to be able to recognise some of the key features and the horizons m which they occur.

3 Factors likely to influence the status of sites

The factors most likely to influence the status of structural and metamorphic geology sites are the physical attributes (extent, composition and structure) and clarity of the main features and a means for gaming safe access to view them The biggest threats are construction, excavation (including quarrying), tipping (including landfill) and land restoration schemes. Sites comprising natural cliffs may be prone to instability as may sites in disused quarries, tunnels, mines or excavations which could also become flooded. Sites may also be adversely affected by coast protection and river bank protection. Metamorphic geology sites containing interesting rock types may be damaged by irresponsible collecting.

Some of these sites are also prone to the activity of natural processes such as weathering, erosion and slope failures which could reduce the definition of some features, and in extreme cases could destroy a site. However, such activity might also produce new exposures.

Reference should be made to the JNCC Guide for further information on defining favourable and unfavourable condition. This is provided for each category of Integrity and exposure site in the Earth Science Conservation Classification.

4 What Attributes do you need to assess?

The following attributes should always be reported for all sites

4.1 Physical Attributes

Physical attributes relate to the degree to which the site continues to display the key Interests that it was selected to represent. Extent refers to the extent of rock outcrop and its degree or clarity of exposure. Composition refers to the presence of the key features for which the site is notified. Structure refers to the relationships between key features (e.g. the contact between two rock units) and the relationships between the key features and their wider geological context.

A note should be made of changes such as coastal or river erosion, soil erosion, gully formation, slope failures and of weathering of exposed rock such as discolouration, softening or textural alteration. Roots entering cracks in rock may break the rock, and lichen and moss, as well as obscuring the detail of the rock, may cause chemical damage to the surface.

4.2 Visibility

The features of the site should be visible. In exceptional circumstances burial may be a conservation requirement to protect vulnerable key elements, such as a rich mineral horizon.

In some cases more than one view of a site may be required; for example, a close up view of a rock type and one or more distant views of contacts or large exposures, such as natural cliffs or quarry faces. It is acceptable for limited amounts of work to be necessary, such as clearance of vegetation or scree deposits, for a site to be viewed.

This attribute may be affected by construction, vegetation, tipping, afforestation and remedial and protective measures to slopes and water courses, both at the site and outside at some distance from the site.

4.3 Access

The site should be accessible to the extent practicable. Unlike some other types of site, earth science sites may be referred to in research work and may have to be visited for comparative purposes. The essential features of the site must be accessible for study but they need not be readily accessible to everyone all of the time. For example, it is acceptable for limited amounts of work to be necessary, such as clearance of vegetation or scree deposits, for a site to be accessed, and some coastal sites may only be visited at low tide.

Accessibility could be affected by new construction, significant changes in vegetation, afforestation, agriculture, slope instability and by coast defences and river bank protection measures. It should be noted that excessive easement of access could reduce the value of the main scientific attributes, for example by path widening. Removal of scree could enhance the rate of degradation of a slope which is stabilised by the build-up of material at

the toe. Scree build-up and overgrown vegetation may provide some protection against opportunist sample collectors.

A note should be made of any difficulties in gaining access to the site and an estimate of the time and resources needed to gain access.

4.4 Safety

Processes such as the opening of Joints and fissures in rock, rockfalls and collapse of rock cliffs can pose a risk to visitors. Safety may also be compromised by the undermining of coastal or river-side paths by erosion or by the formation of marshy areas due to flooding.

4.5 Negative Indicators

This attribute refers to changes in, near or even distant from the site that may be affecting the site indirectly, or may affect it in the future. Examples could include the construction of new weirs, dams, roads, changes to the way natural vegetation is controlled, stream and flood management, quarrying processes and changes in land use. Detrimental effects to the site should be reported and a note made of any changes that might affect the site in the future, so that they can be monitored.

5 Defining targets for each attribute

Guidance on targets for each attribute is presented in the following table. Mandatory targets define the levels which a feature must achieve in order for its condition to be considered favourable. These are shown in bold text in the table. These must be assessed at all sites where the attribute is present Indicative targets provide additional information about the site, and do not have to be met for the site to be assessed as favourable However, they provide an indication of changes which may need to be addressed if the site is to remain in favourable condition.

6 Measuring whether the targets have been met

6.1 Preparation

A field visit is required to gather most of the information necessary to determine whether the targets have been met. Preparation for field visits should always include reading the previous visit notes to make sure you know what rock types or features are present at the site and how to recognise them. Before making the first visit it will be necessary to refer to the Site Documentation Reports. A member of the Earth Science Group should be consulted if you need further explanation of the features and how to assess them Information collected during the first visit should include annotated maps showing the features so that this knowledge is available for future visits.

Table 15.2.1 Generic guidance on mandatory targets for structural and metamorphic geology sites

Attribute	Target
Physical Attributes	**A site will be favourable if it continues to display the essential features on which the citation is based. Any decrease in extent, composition and structure of the features will affect the status.** Large scale exposures may be necessary to demonstrate features of structural geology. Stes will tend to be in a favourable condition unless affected by construction, roads, tree-planting, quarrying, excavation, tipping, permanent industrial or building development, build-up of scree, encroachment of vegetation, storage of materials, river bank protection, coast defence works, landfill and restoration, large scale erosion or landsliding. Some disruptions/changes to the site may be tolerated within the 'favourable - maintained' condition. These are detailed in the JNCC Guide under the appropriate Earth Science Conservation Classification for the site. Individual exposures showing rock details may also be affected by weathering, erosion and breaking up by roots
Visibility	**A site will be favourable if it affords appropriate views of the key features. It will also be favourable if partially obscured by scree or vegetation to the extent that no more than a few hours work with hand tools or an excavator is needed to clear the obstructions.** Close-up views (probably less than 10m) will usually be required to view a rock type while a distant view, possibly from more than one angle, may be needed to appreciate a large structural feature or relationship. A site may be unfavourable if obscured by build-up of scree, encroachment of vegetation, tipping, river bank or cliff protection work or coastal defences. In exceptional circumstances, burial may be a conservation requirement to protect vulnerable key elements.
Access	**A site will be favourable if it affords appropriate access by study groups or researchers to the extent described under Visibility above.** As described above, access may be necessary either close up and/or from one of more distant vantage points in order to appreciate all the features. The status may be affected by construction, vegetation and land use changes or flooding.
Safety	**The site should be safe to visit for people acting in a responsible manner.** The site will be considered to be unfavourable if it is unsafe for people taking reasonable care and without the need for any specialist safety equipment or skills. Safety may be affected by landsliding, flooding or deterioration in paths or footbridges.
Negative Indicators	Any changes in the vicinity of the site, that might in the future affect one of more of the above attributes, should be reported.

Key: Mandatory targets are highlighted in bold text

If possible take copies of relevant documents with you to the site. For complex areas that have been cited for more than one reason, it will be necessary to determine whether there are any likely conflicts between, for example, the requirements of vegetation/habitat and earth science features.

6.1.1 Maps

Maps of a su1table scale to show the location and access routes to the s1te (probably not smaller than 1:50,000) and also the location of features w1th1n the s1tes (not smaller than about 1 5,000 or 1 10,000 depending of the s1ze of the s1te) will always be needed Refer to the Site Documentation Reports.

6.2 Field Surveys

6.2.1 When to survey

The best time to survey Earth science sites is generally in the early spring before summer vegetation cover begins, in bright weather, preferably lightly overcast to reduce shadows in photographs. Forward planning is required to ensure that sites prone to shadows, tides or other constraints are visited at appropriate times. Once the monitoring is established there is a benefit in re-visiting sites at the same season, and during similar weather conditions and times of day.

6.2.2 Things to Take With You

You will need the following items on site:

- the Site Documentation Report;
- a map, marked with the location or boundaries of the site and salient features,
- a camera with a reasonably wide angle lens (35 mm). If the camera has a flash then it must be possible to switch off the flash; photographs should be taken in natural light (Section 1.8 contains more advice on taking photographs);
- a compass to check the direction of views in sketches and photographs,
- a ruler to place in close-up photographs as a scale, and a board identifying the site, date and time of day and direction of view;
- blank field recording forms and checklist of monitoring questions - refer to the JNCC Guide (1999 Supplement) for the appropriate proforma and the instructions for completion,
- forms from the previous monitoring to ensure photographs are taken from the same view points and in the same directions on each occasion;
- this manual.

6.2.3 Field Procedures

1. In considering the following generalised approach, special attention should be paid to the crucial areas identified in the Site Documentation Report.

2 You should check that locations or boundaries previously recorded are correct. For large sites it is important that the whole of the feature of interest is seen by walking over the site or viewing from suitable vantage points, as appropriate. The details of the inspection should be recorded and repeated in future inspection.

3 A dimensioned site layout sketch should be produced to show the features of the site, access routes, points from which the items of interest can be seen and any changes to the extent, access or safety of the site. On future visits, sketches should be made from the same viewpoint to illustrate any changes. A photograph should be taken from the same viewpoint Locations of additional photographs and detailed sketches (see below) should be shown on the layout sketch.

4 Where necessary, further dimensioned detail sketches should be made of the main features of the site, for example prominent outcrops, showing the size and shape of the exposure and any salient details. Records should be taken at the same location on subsequent monitoring visits and, where relevant, at the same state of tide.

5 When visiting the site, you should refer to the Site Monitoring Question Checklist- (refer to the JNCC Guide, 1999 Supplement). You may also find it helpful to ask yourself the following general questions:

- Has the site changed in any way from the description on the citation?
- Has the site changed in any way since the last inspection?
- Try to describe and sketch any changes.
- Do these changes make the site more of less favourable with respect to any of the attributes or do they have no effect?
- If changes are on-going, is the value of the site being increased or reduced?

6.3 Evaluation, Analysis and Record Keeping

The field data should be transferred from the individual site recording forms to a Site Condition Monitoring Form and compared with the targets for each attribute. The field recording forms should be placed on file for future reference. A note should be kept on file of the length of time taken to carry out the monitoring for planning future visits.

SITE ATTRIBUTE TABLE FOR GEOLOGICAL SITES – EXAMPLE 1 (revised 20 April 2000)

SITE NAME:	**BRORA GORGE SSSI**
REPORTING CATEGORY:	**Structural and Metamorphic Geology**
ESCC:	**Intergrity site – 'unique' geological site**

Site	Reporting category	Interest Feature	Irt Lvl	Status	Attributes	Targets	Monitoring Prescription	98/99 £	98/99 T	99/00 £	99/00 T	00/01 £	00/01 T	01/02 £	01/02 T
BRORA GORGE SSSI	Structural and Metamorphic Geology	1.Moine rocks of the Rogart igneous complex (tonalities with cross-cutting veins)	SSSI	Not.	1.1 Extent	2.1.1 To maintain the extent of exposures of the key rocks in their current form, i.e. the rocks along the banks/bed/gorge of the river over a distance of 300m NW from the SE edge of the site (see Site Doc Report Fig 6).	Field visit. Complete monitoring question checklist for "unique" geological site Fixed point photography.								
BRORA GORGE SSSI	Structural and Metamorphic Geology	1.Moine rocks of the Rogart igneous complex (tonalities with cross-cutting veins)	SSSI	Not.	1.2 Composition	2.2.1 To maintain exposures of all the key rock types within the site.	Field visit. Complete monitoring question checklist for "unique" geological site Fixed point photography.								
BRORA GORGE SSSI	Structural and Metamorphic Geology	1.Moine rocks of the Rogart igneous complex (tonalities with cross-cutting veins)	SSSI	Not.	1.3 Structure	2.3.1 To maintain the relationships between the different rock types.	Field visit. Complete monitoring question checklist for "unique" geological site Fixed point photography.								
BRORA GORGE SSSI	Structural and Metamorphic Geology	1.Moine rocks of the Rogart igneous complex (tonalities with cross-cutting veins)	SSSI	Not.	1.4 Visibility	2.4.1 To maintain the visibility of the key rocks.	Field visit. Complete monitoring question checklist for "unique" geological site Fixed point photography.								
BRORA GORGE SSSI	Structural and Metamorphic Geology	1.Moine rocks of the Rogart igneous complex (tonalities with cross-cutting veins)	SSSI	Not.	1.5 Accessibility	2.5.1 To maintain access to the key sections and rocks to facilitate education & research if required.	Field visit. Complete monitoring question checklist for "unique" geological site Fixed point photography.								
BRORA GORGE SSSI	Structural and Metamorphic Geology	1.Moine rocks of the Rogart igneous complex (tonalities with cross-cutting veins)	SSSI	Not.	1.6 Negative indicators	2.6.1 There should be no construction, roads, tree-planting, quarrying, permanent industrial or building development, build-up of scree, encroachment of	Field visit. Complete monitoring question checklist for "unique" geological site Fixed point photography.								
BRORA GORGE SSSI	Structural and Metamorphic Geology	1.Moine rocks of the Rogart igneous complex (tonalities with cross-cutting veins)	SSSI	Not.		vegetation, storage of materials or river bank protection affecting the rocks along the banks/bed/gorge of the river over a distance of 300m NW from the SE edge of the site (see Site Doc Report Fig. 6).									

BRORA GORGE SSSI	Structural and Metamorphic Geology	2.Migmatised (altered) Moine rocks (psammites and pelites)	SSSI	Not.	2.1 Extent	2.1.1 To maintain the extent of exposures of the key rocks in their current form, i.e. the rocks along the banks/bed/gorge of the river over a distance between 300 and 600m NW from the SE edge of the site (see Site Doc Report Fig 6).	Field visit. Complete monitoring question checklist for "unique" geological site Fixed point photography.				
BRORA GORGE SSSI	Structural and Metamorphic Geology	2.Migmatised (altered) Moine rocks (psammites and pelites)	SSSI	Not.	2.2 Composition	2.2.1 To maintain exposures of all the key rock types within the site.	Field visit. Complete monitoring question checklist for "unique" geological site Fixed point photography.				
BRORA GORGE SSSI	Structural and Metamorphic Geology	2.Migmatised (altered) Moine rocks (psammites and pelites)	SSSI	Not.	2.3 Structure	2.3.1 To maintain the relationships between the different rock types.	Field visit. Complete monitoring question checklist for "unique" geological site Fixed point photography.				
BRORA GORGE SSSI	Structural and Metamorphic Geology	2.Migmatised (altered) Moine rocks (psammites and pelites)	SSSI	Not.	2.4 Visibility	2.4.1 To maintain the visibility of the key rocks.	Field visit. Complete monitoring question checklist for "unique" geological site Fixed point photography.				
BRORA GORGE SSSI	Structural and Metamorphic Geology	2.Migmatised (altered) Moine rocks (psammites and pelites)	SSSI	Not.	2.5 Accessibility	2.5.1 To maintain access to the key sections and rocks to facilitate education & research if required.	Field visit. Complete monitoring question checklist for "unique" geological site Fixed point photography.				
BRORA GORGE SSSI	Structural and Metamorphic Geology	2.Migmatised (altered) Moine rocks (psammites and pelites)	SSSI	Not.	2.6 Negative indicators	2.6.1 There should be no construction, roads, tree-planting, quarrying, permanent industrial or building development, build-up of scree, encroachment of	Field visit. Complete monitoring question checklist for "unique" geological site Fixed point photography.				
BRORA GORGE SSSI	Structural and Metamorphic Geology	2.Migmatised (altered) Moine rocks (psammites and pelites)	SSSI	Not.		vegetation, storage of materials or river bank protection affecting the rocks along the banks/bed/gorge of the river over a distance between 300 and 600m NW from the SE edge of the site (see Site Doc Report Fig. 6).					

BRORA GORGE SSSI	Structural and Metamorphic Geology	3. Unaltered Moine metamorphic rocks (psammites)	SSSI	Not.	3.1 Extent	3.1.1 To maintain the extent of exposures of the key rocks in their current form, i.e. the rocks along the banks/bed/gorge of the river over a distance between 600 and 1500m NW from the SE edge of the site (see Site Doc Report Fig 6).	Field visit. Complete monitoring question checklist for "unique" geological site Fixed point photography.				
BRORA GORGE SSSI	Structural and Metamorphic Geology	3. Unaltered Moine metamorphic rocks (psammites)	SSSI	Not.	3.2 Composition	3.2.1 To maintain exposures of all the key rock types within the site.	Field visit. Complete monitoring question checklist for "unique" geological site Fixed point photography.				
BRORA GORGE SSSI	Structural and Metamorphic Geology	3. Unaltered Moine metamorphic rocks (psammites)	SSSI	Not.	3.3 Structure	3.3.1 To maintain the relationships between the different rock types.	Field visit. Complete monitoring question checklist for "unique" geological site Fixed point photography.				
BRORA GORGE SSSI	Structural and Metamorphic Geology	3. Unaltered Moine metamorphic rocks (psammites)	SSSI	Not.	3.4 Visibility	3.4.1 To maintain the visibility of the key rocks.	Field visit. Complete monitoring question checklist for "unique" geological site Fixed point photography.				
BRORA GORGE SSSI	Structural and Metamorphic Geology	3. Unaltered Moine metamorphic rocks (psammites)	SSSI	Not.	3.5 Accessibility	3.5.1 To maintain access to the key sections and rocks to facilitate education & research if required.	Field visit. Complete monitoring question checklist for "unique" geological site Fixed point photography.				
BRORA GORGE SSSI	Structural and Metamorphic Geology	3. Unaltered Moine metamorphic rocks (psammites)	SSSI	Not.	3.6 Negative indicators	3.6.1 There should be no construction, roads, tree-planting, quarrying, permanent industrial or building development, build-up of scree, encroachment of	Field visit. Complete monitoring question checklist for "unique" geological site Fixed point photography.				
BRORA GORGE SSSI	Structural and Metamorphic Geology	3. Unaltered Moine metamorphic rocks (psammites)	SSSI	Not.		vegetation, storage of materials or river bank protection affecting the rocks along the banks/bed/gorge of the river over a distance between 600 and 1500m NW from the SE edge of the site (see Site Doc Report Fig. 6).					

15.3 IGNEOUS PETROLOGY SITES

1 Introduction

Petrology simply means the study of rocks and in this case of rocks formed from molten magma. These rocks range from light coloured coarse crystalline rocks such as granite to dense, dark coloured, fine grained rock such as basalt or dolente. They commonly contain large prominent crystals called phenocrysts and may exhibit alignment of mineral as a result of flow as a magma or lava. Types associated with volcanic activity may have small (up to about 0.5 cm diameter) bubble holes or tracks either open or subsequently filled with glassy minerals. Exposures of contacts between igneous rocks and those they have intruded into (country rocks) are often important sites. They may show signs of mixing of rock types in a plastic state, inclusions of one rock type in another or the growth of new minerals in either rock type and/or in the mix zone. As well as the rock types, themselves importance may be attached to the shape of an igneous intrusion such as a volcanic pipe or 'plug' (Castle Rock, Edinburgh) or a dyke or sill (1 e a wall or sheet of igneous rock) which may be tens of metres wide.

Igneous petrology sites will generally be exposure sites. Most commonly these will be foreshore exposures, coastal and river cliffs, active quarries and pits, disused quarries, pits and cuttings, inland outcrops or stream sections.

2 Skill required

Descriptions of the rocks at each site and the key features can be found in the Site Documentation Reports. At the most basic level, you should be able with the assistance of these reports to identify the location and extent of the key rock exposures. You do not necessarily need to be able to identify the individual rock types, but it would be an advantage to be able to recognise some of the key features and the horizons in which they occur.

In the field you will need to recognise igneous rocks and their contacts with the country rock. Igneous rocks are crystalline in texture, rather than comprising individual grains like sedimentary rocks. As described above, their broad appearance may vary considerably, but in most cases it should be possible to identify the key features from the descriptions m the Site Documentation Reports.

3 Factors likely to influence the status of sites

The factors most likely to influence the status of igneous petrology sites are the physical attributes (extent, composition and structure) and clarity of the key features and a means for gaining safe access to view them. The biggest threats are construction, excavation (including quarrying), tipping (including landfill) and land restoration schemes. Sites comprising natural cliffs may be prone to instability as may sites in disused quarries, tunnels, mines or excavations which could also become flooded. Sites may also be adversely affected by coast protection and river bank protection. Igneous petrology sites containing interesting or attractive rock types may be damaged by irresponsible collecting.

Some of these sites may be are prone to weathering, which may discolour and soften the rock, or to erosion and slope failures, which could reduce the definition of some features, and in extreme cases could destroy a site. However, such activity might also produce new exposures.

Reference should be made to the JNCC Guide for further information on defining favourable and unfavourable condition. This is provided for each category of integrity and exposure site in the Earth Science Conservation Classification.

4 What Attributes do you need to assess?

The following attributes should always be reported for all sites:

4.1 Physical Attributes

Physical attributes relate to the degree to which the site continues to display the key interests that it was selected to represent. Extent refers to the extent of rock outcrop and its degree or clarity of exposure. Composition refers to the presence of the key features for which the site is notified. Structure refers to the relationships between key features (e.g. the junction between two rock layers) and the relationships between the key features and their wider geological context.

A note should be made of changes such as coastal or river erosion, soil erosion, gully formation, slope failures and of weathering of exposed rock such as discolouration, softening or textural alteration. Roots entering cracks in rock may break the rock, and lichen and moss, as well as obscuring the detail of the rock, may cause chemical damage to the surface.

4.2 Visibility

The features of the site should be visible. In exceptional circumstances, burial may be a conservation requirement to protect vulnerable key elements such as a rare mineral horizon.

Close up views of the rock type(s) will generally be required, and in the sites containing contact zones, one or more distant views may be required, for example of natural cliffs or quarry faces. This attribute may be affected by construction (including slope and cliff protection), vegetation, tipping and afforestation both at the site and outside at some distance from the site. It is acceptable for limited amounts of work, to be necessary, such as clearance of vegetation or scree deposits, for a site to be viewed.

4.3 Access

The site should be accessible to the extent practicable. Unlike some other types of site, Earth science sites may be referred to in research work and may have to be visited for comparative purposes. The essential features of the site must be accessible for study but they need not be readily accessible to everyone all of the time. For example, it is acceptable for limited amounts of work to be necessary, such as clearance of vegetation or scree deposits, for a site to be accessed, and some coastal sites may only be visited at low tide.

Accessibility could be affected by new construction, significant changes in vegetation, afforestation or agricultural use, slope instability and by coast defences and river bank protection measures. In some cases excessive easement of access could reduce the value of the site, for example by path widening. Removal of scree could enhance the rate of degradation of a slope which is stabilised by the build-up of material at the toe. Scree build-up and overgrown vegetation may provide some protection against opportunist sample collectors.

A note should be made of any difficulties in gaining access to the site and an estimate of the time and resources needed to gain access.

4.4 Safety

Processes such as the opening of joints and fissures in rock, rockfalls and collapse of cliffs can and pose a risk to visitors. Safety may also be compromised by the undermining of coastal or river-side paths by erosion or by the formation of marshy areas due to flooding.

4.5 Negative Indicators

This attribute refers to changes in, near or even distant from the site that may be affecting the site indirectly, or may affect it in the future. Examples could include the construction of new weirs, dams, roads, changes to the way natural vegetation is controlled, stream and flood management, quarrying processes and changes in land use. Detrimental effects to the site should be reported and a note made of any changes that might affect the site in the future, so that they can be monitored.

5 Defining targets for each attribute

Guidance on targets for each attribute is presented in the following table. Mandatory targets define the levels which a feature must achieve in order for its condition to be considered favourable. These are shown in bold type in the table. These must be assessed at all sites where the attribute is present. Indicative targets provide extra information about the features present at a site. Failure of these does not necessarily mean that the site is unfavourable However, it does provide an indication of factors which may lead to the site becoming unfavourable in the future.

6 Measuring whether the targets have been met

6.1 Preparation

A field visit is required to gather most of the Information necessary to determine whether the targets have been met. Preparation for field visits should always include reading existing notes for the site to make sure you know what features are important. Before making the first visit it will be necessary to refer to the Site Documentation Reports. A member of the Earth Science Group should be consulted if you need further explanation of the features and how to assess them. You should make a note of any information which you use to help with subsequent visits. This may include the production of annotated maps showing the features so that this knowledge is available for future visits.

Table 15.3 1 Generic guidance on targets for igneous petrology sites

Attribute	Target
Physical Attributes	**A site will be favourable if it continues to display the essential features on which the citation is based. Any decrease in extent, composition and structure of the features will affect the status. Large scale exposures or a series of exposures may be necessary to demonstrate the nature of contact between an igneous rock and the adjacent country rock.** Sites will tend to be in a favourable condition unless affected by construction, roads, tree-planting, quarrying, excavation, tipping, permanent industrial or building development, build-up of scree, encroachment of vegetation, storage of materials, river bank protection, coast defence works, landfill and restoration, large scale erosion or landsliding. Some disruptions/changes to the site may be tolerated within the 'favourable - maintained' condition. These are detailed in the JNCC Guide under the appropriate Earth Science Conservation Classification for the site. Individual exposures showing rock details may also be affected by weathering, erosion and breaking up by roots.
Visibility	**A site will be favourable if it affords appropriate views of the key features. It will also be favourable if partially obscured by scree or vegetation to the extent that no more than a few hours work with hand tools or an excavator is needed to clear the obstructions.** Close-up views (probably less than 10m) will usually be required to view a rock type while a distant view, possibly from more than one angle, may be needed to appreciate a rock contact or large structural feature. A site may be unfavourable if obscured by build-up of scree, encroachment of vegetation, tipping, river bank or cliff protection work or coastal defences. In exceptional circumstances, burial may be a conservation requirement to protect vulnerable key elements.
Access	**A site will be favourable if it affords appropriate access by study groups or researchers to the extent described under Visibility above.** As described above, access may be necessary either close up and/or from one of more remote vantage points in order to appreciate the features. The status may be affected by construction, vegetation and land use changes, or flooding.
Safety	**The site should be safe to visit for people acting in a responsible manner.** The site will be considered to be unfavourable if it is unsafe for people taking reasonable care and without the need for any specialist safety equipment or skills. Safety may be affected by landsliding, flooding or deterioration in paths or footbridges.
Negative Indicators	Any changes in the vicinity of the site that might in the future affect one Indicators of more of the above attributes should be reported.

Key: Mandatory targets are shown in bold type

If possible take copies of relevant documents with you to the site. For complex areas that have been cited for more than one reason, it will be necessary to determine whether there are any likely conflicts between, for example, the requirements of vegetation/habitat and earth science features.

6.1.1 Maps

Maps of a suitable scale to show the location and access routes to the site (probably not smaller than 1:50,000) and also the location of features within the sites (not smaller than about 1.5,000 or 1·10,000 depending of the size of the site) will always be needed. Refer to the Site Documentation Reports.

6.2 Field Surveys

6.2.1 When to survey

The best time to survey Earth science sites is generally in the early spring before summer vegetation cover begins, in bright weather, preferably lightly overcast to reduce shadows in photographs. Forward planning is required to ensure that sites prone to shadows, tides or other constraints are visited at appropriate times. Once the monitoring is established there is a benefit in re-visiting sites at the same season, and during similar weather conditions and times of day.

6.2.1 Things to Take With You

You will need the following items on site:

- the Site Documentation Report;
- a map, marked with the location or boundaries of the site and salient features,
- a camera with a reasonably wide angle lens (35 mm). If the camera has a flash then it must be possible to switch off the flash; photographs should be taken in natural light (further advice is provided in section 1.8);
- a compass to check the direction of views in sketches and photographs;
- a ruler to place in close-up photographs as a scale, and a board identifying the site, date and time of day and direction of view;
- blank field recording forms and checklist of monitoring questions - refer to the JNCC Guide (1999 Supplement) for the appropriate proforma and the instructions for completion;
- forms from the previous monitoring to ensure photographs are taken from the same view points and in the same directions on each occasion
- this manual.

6.2.3 Field Procedures

1. In considering the following generalised approach, special attention should be paid to the crucial areas identified in the Site Documentation Report.

2. You should check that location or boundaries previously recorded are correct. For large sites it is important that the whole of the feature of interest is seen by walking over the site or viewing from suitable vantage points, as appropriate. The details of the inspection should be recorded and repeated in future inspections.

3. A dimensioned site layout sketch should be produced to show the features of the site, access routes, points from which the items of interest can be seen and any changes to the extent, access or safety of the site On future visits sketches should be made from the same viewpoint to illustrate any changes. A photograph should be taken from the same viewpoint. Locations of additional photographs and detailed sketches (see below) should be shown on the layout sketch

4. Where necessary, further dimensioned detail sketches should be made of the mam features of the site, for example prominent outcrops, showing the size and shape of the exposure and any salient details. Records should be taken at the same location on subsequent monitoring visits and, where relevant, at the same state of tide.

5. When visiting the site, you should refer to the Site Monitoring Question Checklist- (refer to the JNCC Guide, 1999 Supplement). You may also find it helpful to ask yourself the following general questions:
   - Has the site changed m any way from the description on the citation?
   - Has the site changed m any way since the last inspection?
   - Try to describe and sketch any changes
   - Do these changes make the site more of less favourable with respect to any of the attributes or do they have no effect?
   - If changes are on-going, is the value of the site being increased or reduced?

6.3 Evaluation, Analysis and Record Keeping

Field data should be transferred from the individual site recording forms to a Site Condition Monitoring Form and compared with the targets for each attribute. The field recording forms should be placed on file for future reference. A note should be kept on file of the length of time taken to carry out the monitoring for planning future visits.

15.4 MINERALOGY SITES

1 Introduction

Mineralogy refers to the study of minerals. These sites are likely to comprise exposures of rock, either natural or in quarries, mines, shallow workings, or spoil heaps. It should be possible to identify the specified minerals with the help of a good text containing colour pictures.

Mineralogy sites can be either exposure or integrity sites. Most commonly exposure sites will be foreshore exposures, coastal and river cliffs, active quarries and pits, disused quarries, pits and cuttings, inland outcrops or stream sections. Mine dumps or spoil heaps of limited extent are normally considered to be integrity sites, as the resource is localised and of limited extent. In some cases, a site may be formally adopted as a standard reference or "type locality" for a particular mineral species, such as Strontian Mines SSSI, the type locality for strontianite.

2 Skill requirement

Descriptions of the rocks at each site and the key features can be found in the Site Documentation Reports. At the most basic level, you should be able with the assistance of these reports to identify the locations and extent of the key rock exposures. You do not necessarily need to be able to identify the individual mineral types, but it would be an advantage to be able to recognise some of the key features and the horizons in which they occur.

It is desirable to be able to recognise the minerals featured from their description and photographs in the Site Documentation Report. This should prove to be relatively straightforward for large examples of the 'gem-stone' type but additional assistance may be needed for more obscure minerals.

3 Factors likely to influence the status of sites

The factors most likely to Influence the status of mineralogical sites are the physical attributes (extent, composition and structure) and clarity of the key mineral exposures and a means for gaining safe access to view them. The biggest threats to are construction, excavation (including quarrying), tipping (including landfill) and land restoration schemes. Sites associated with old workings may be subject to flooding, landscaping and 'improvements'. Some sites may also be adversely affected by coast protection and river bank protection. Removal of specimens by irresponsible collecting is a major threat to mineralogical sites.

Mineralogy sites also are prone to the activity of natural processes such as weathering and erosion. Roots entering cracks in rock may break the rock and lichen and moss, as well as obscuring the detail of the rock may cause chemical damage to the surface. Instability of natural or man-made rock faces could destroy the exposures, but might also create new exposures.

Activities related to stream diversions, flood defence, building of dams, and field drainage measures may also affect the sites.

Reference should be made to the JNCC Guide for further information on defining favourable and unfavourable condition. This is provided for each category of integrity and exposure site in the Earth Science Conservation Classification.

4 What Attributes do you need to assess?

The following attributes should always be reported for all sites:

4.1 Physical Attributes

Physical attributes relate to the degree to which the site continues to display the key interests that it was selected to represent. Extent refers to the extent of rock outcrop and its degree or clarity of exposure. Composition refers to the presence of the key features for which the site is notified. Structure refers to the relationships between key features (e.g. the junction between two rock layers) and the relationships between the key features and their wider geological context (e.g. the position of a mineral-bearing horizon in a sequence of rocks).

A note should be made of changes such as coastal or river erosion, soil erosion, gully formation, slope failures and of weathering of exposed rock such as discolouration, softening or textural alteration. Roots entering cracks in rock may break the rock, and lichen and moss, as well as obscuring the detail of the rock, may cause chemical damage to the surface.

4.2 Visibility

The featured minerals present at the site should be visible. In exceptional circumstances, burial may be a conservation requirement to protect vulnerable key minerals.

A close up view of the rock type or spoil heap is required for inspection. This attribute may be affected by construction, vegetation, tipping and afforestation. It is acceptable for limited amounts of work to be necessary, such as clearance of vegetation or scree deposits, for a site to be viewed.

4.3. Access

The site should be accessible to the extent practicable. Unlike some other types of site, earth science sites may be referred to in research work and may have to be visited for comparative purposes. The essential features of the site must be accessible for study but they need not be readily accessible to everyone all of the time For example, it is acceptable for limited amounts of work to be necessary, such as clearance of vegetation or scree deposits, for a site to be accessed, and some coastal sites may only be visited at low tide.

Accessibility could be prejudiced by new construction, significant changes in vegetation, afforestation, agricultural use, slope instability and by coast defences or river bank protection measures. In some cases excessive easement of access could reduce the value of the site, for example by path widening. Removal of scree could enhance the rate of, degradation of a slope which is stabilised by the build-up of material at the toe, but the presence of scree or overgrown vegetation may provide some protection against opportunist sample collectors.

A note should be made of any difficulties in gaining access to the site and an estimate of the time and resources needed to gain access.

4.4 Safety

Processes such as the opening of joints and fissures in rock, formation of gullies in soils and soft rocks, rockfalls and collapse of rock cliffs or soil slopes can pose a risk to visitors Safety may also be compromised by the undermining of coastal or river- side paths by erosion or by the formation of marshy areas due to flooding.

4.5 Negative Indicators

This attribute refers to changes in, near or even distant from the site that may be affecting the site indirectly, or may affect it in the future. Examples could include the construction of new weirs, dams, roads, changes to the way natural vegetation is controlled, stream and flood management, quarrying processes and changes in land use. Detrimental effects to the site should be reported and a note made of any changes that might affect the site in the future, so that they can be monitored.

5 Defining targets for each attribute

Guidance on targets for each attribute is presented in the following table. Mandatory targets define the levels which a feature must achieve in order for its condition to be considered favourable. These are shown in bold type in the table and must be assessed at all sites where the attribute is present. Indicative targets provide extra Information about a site.

6 Measuring whether the targets have been met

6.1 Preparation

A field visit is required to gather most of the information necessary to determine whether the targets have been met. Preparation for field visits should always include reading the previous visit notes to make sure you know what features are Important at the site. Before making the first visit it will be necessary to refer to the Site Documentation Reports. A member of the Earth Science Group should be consulted if you need further explanation of the features and how to assess them. A note of this type of information should be kept for future monitoring visits, together with annotated maps showing the features so that this knowledge is available for future visits.

If possible take copies of relevant documents with you to the site. For complex areas that have been cited for more than one reason, it will be necessary to determine whether there are any likely conflicts between, for example, the requirements of vegetation/habitat and Earth science features.

Table 15.4.1 Generic guidance on targets for mineralogy sites

Attribute	Target
Physical Attributes	**The site will be favourable if it continues to display the essential features on which the citation is based. This will usually require at least one good quality exposure or one area of spoil heap. Any decrease in extent, composition and structure of the features will affect the status.** Sites will tend to be in a favourable condition unless affected by construction, roads, tree-planting, quarrying, excavation (including collector quarrying), tipping, permanent industrial or building development, build-up of scree, encroachment of vegetation, storage of materials, river bank protection, coast defence works, landfill and restoration, landscaping of old excavations, large scale erosion or landsliding. Some disruptions/changes to the site may be tolerated within the 'favourable-maintained' condition. These are detailed in the JNCC Guide under the appropriate Earth Science Conservation Classification for the site. Individual exposures may also be affected by weathering, erosion and breaking up by roots.
Visibility	**A site will be favourable if it affords appropriate views of the key features. It will also be favourable if partially obscured by scree or vegetation to the extent that no more than a few hours work with hand tools or an excavator is needed to clear the obstructions.** Close-up views (probably less than 10m) will usually be required to view mineralogical sites. A site may be unfavourable if obscured by build-up of scree, encroachment of vegetation, tipping or works such as cliff protection or coastal defence. In exceptional circumstances, burial may be a conservation requirement to protect vulnerable key minerals.
Access	**A site will be favourable if it affords appropriate access for study groups or researchers to the extent described under Visibility above.** Close-up access (probably less than 10m) will usually be required to inspect mineral specimens
Safety	**The site should be safe to visit for people acting in a responsible manner.** The site will be considered to be unfavourable if it is unsafe for people taking reasonable care and without the need for any specialist safety equipment or skills. Safety may be affected by landsliding, flooding or deterioration in paths or footbridges.
Negative Indicators	Any changes in the vicinity of the site that might in the future affect one or more of the above attributes should be reported.

Key: Mandatory targets are highlighted in bold text

6.1.1 Maps

Maps of a suitable scale to show the locations and access routes to the site (probably not smaller than 1 50,000) and also the locations of features within the sites (not smaller than about 1 5,000 or 1 10,000 depending of the size of the site) will always be needed. Refer to the Site Documentation Reports.

6.2 Field Surveys

6.2.1 When to survey

The best time to survey Earth science sites is generally in the early spring before summer vegetation cover begins, in bright weather, preferably lightly overcast to reduce shadows in photographs Forward planning is required to ensure that sites prone to shadows, tides or other constraints are visited at appropriate times. Once the monitoring is established there is a benefit in re-visiting sites at the same season, and during similar weather conditions and times of day.

6.2.2 Things to Take With You

You will need the following items on site

- the Site Documentation Report;
- a map, marked with the locations or boundaries of the site and salient features,
- a camera with a reasonably wide angle lens (35 mm) If the camera has a flash then it must be possible to switch off the flash, photographs should be taken in natural light (See section 1 8);
- a compass to check the direction of views in sketches and photographs;
- a ruler to place in the photograph as a scale, and a board identifying the site, date and time of day and direction of view;
- blank field recording forms and checklist of monitoring questions - refer to the JNCC Guide (1999 Supplement) for the appropriate proforma and the instructions for completion,
- forms from the previous monitoring to ensure photographs are taken from the same view points and in the same directions on each occasion,
- this manual.

6.2.3 Field Procedures

1 In considering the following generalised approach, special attention should be paid to the crucial areas identified in the Site Documentation Report.

2 You should check that locations or boundaries previously recorded are correct. For large sites it is important that the whole of the feature of Interest is seen by walking over the site or viewing from suitable vantage points, as appropriate. The details of the inspection should be recorded and repeated in future inspections.

3. A dimensioned site layout sketch should be produced to show the features of the site, access routes, points from which the items of interest can be seen and any

changes to the extent, access or safety of the site. On future visits sketches should be made from the same viewpoint to illustrate any changes. A photograph should be taken from the same viewpoint. Locations of additional photographs and detailed sketches (see below) should be shown on the layout sketch.

4 Where necessary, further dimensioned detail sketches should be made of the mam features of the site, for example prominent outcrops, showing the size and shape of the exposure and any salient details. Records should be taken at the same location on subsequent monitoring visits and, where relevant, at the same state of tide.

5 When visiting the site, you should refer to the Site Monitoring Question Checklist- (refer to the JNCC Guide, 1999 Supplement). You may also find it helpful to ask yourself the following general questions·

- Has the site changed in any way from the description on the citation?
- Has the site changed in any way since the last inspection?
- Try to describe and sketch any changes
- Do these changes make the site more of less favourable with respect to any of the attributes or do they have no effect?
- If changes are on-going, is the value of the site being increased or reduced?

6.3 Evaluation, Analysis and Record Keeping

Field data should be transferred from the individual site recording forms to a Site Condition Monitoring Form and compared with the targets for each attribute. The field recording forms should be placed on file for future reference. A note should be kept on file of the length of time taken to carry out the monitoring for planning future visits.

15.5 Palaeontology Sites

1 Introduction

Palaeontology is the study of fossil remains. These sites are likely to be similar to the mineralogy sites except that the rock will contain fossil remains rather than particular minerals. The site will probably be an area of exposed sedimentary rock (commonly siltstone, mudstone or sandstone). The fossils could consist of the remains of any living organism, Including corals, marine shells, plant matter and the skeletal remains of animals as well as tracks and traces or organisms including footprints and burrows. The Site Documentation Reports normally feature illustrations of key fossils; alternatively a good text book with photographs and sketches will assist in recognising the presence of fossils and will enable many common fossils to be identified.

Fossil sites can be either exposure or integrity sites. Exposure sites are foreshore exposures, coastal and river cliffs, active quarries and pits, disused quarries, pits and cuttings, inland outcrops or stream sections. However, where unique fossil assemblages occur or where a specific exposure or section is formally adopted as a standard reference, the site will be described as an integrity site. The Site Documentation Report will indicate where this status exists.

2 Skill requirement

Descriptions of the rocks at each site and the key features can be found in the Site Documentation Reports. At the most basic level, you should be able with the assistance of these reports to identify the location and extent of the key rock exposures. You do not need to be able to identify the individual fossils, but it would be an advantage to be able to recognise the key horizons in which they occur.

In the field you will need to recognise the presence of fossils, but not individual species.

3 Factors likely to influence the status of sites

The factors most likely to influence the status of palaeontology sites are the physical attributes (extent, composition and structure) and clarity of the fossiliferous rock exposures and a means for gaming safe access to view them. Palaeontology sites are at high risk from irresponsible collecting. Other threats include construction, excavation (including quarrying), tipping (including landfill) and land restoration schemes. Sites comprising natural cliffs may be prone to instability as may sites in disused quarries, tunnels, mines or excavations which could also become flooded. Sites may be adversely affected by coast protection and river bank protection. Exposures may be damaged or reduced in value by the excessive action of fossil collectors, including minor quarrying.

Fossiliferous rock exposure sites also are prone to the activity of natural processes such as weathering, erosion and slope failures which could reduce the definition of some features, and in extreme cases could destroy a site. However, such activity might also produce new exposures. Weathering may change the nature of exposed rock (discolouration, softening) and alter or destroy the fossils. Roots entering cracks

in rock may break the rock and lichen and moss, as well as obscuring the detail of the rock may cause chemical damage to the surface.

Activities related to stream diversions, flood defence, sinking of wells, building of dams, and field drainage measures may also affect the site either directly or indirectly.

Reference should be made to the JNCC Guide for further information on defining favourable and unfavourable condition. This is provided for each category of integrity and exposure site in the Earth Science Conservation Classification

4 What Attributes do you need to assess?

The following attributes should always be reported for all sites:

4.1 Physical Attributes

Physical attributes relate to the degree to which the site continues to display the key interests that it was selected to represent. Extent refers to the extent of rock outcrop and its degree or clarity of exposure. Composition refers to the presence of the key features for which the site is notified. Structure refers to the relationships between key features (e.g. the junction between two rock layers) and the relationships between the key features and their wider geological context (e.g. the position of a fossil-bearing bed in a sequence of rocks)

A note should be made of changes such as coastal or river erosion, soil erosion, gully formation, slope failures and of weathering of exposed rock such as discolouration, softening or textural alteration. Roots entering cracks in rock may break the rock, and lichen and moss, as well as obscuring the detail of the rock, may cause chemical damage to the surface.

4.2 Visibility

The features of the site should be visible. In exceptional circumstances, burial may be a conservation requirement to protect vulnerable fossil bearing horizons.

For palaeontology sites a close up view to enable detailed Inspection of the fossils will normally be required. This attribute may be affected by construction, vegetation, tipping and afforestation. It is acceptable for limited amounts of work to be necessary, such as clearance of vegetation or scree deposits, for a site to be viewed.

4.3 Access

The site should be accessible to the extent practicable. Unlike some other types of site, earth science sites may be referred to in research work and may have to be visited for comparative purposes. The site must be accessible for study but it need not be readily accessible to everyone all of the time. For example, it is acceptable for limited amounts of work to be necessary, such as clearance of vegetation or scree deposits, for a site to be accessed, and some coastal sites may only be visited at low tide.

Accessibility could be affected by new construction, significant changes in vegetation, afforestation or agricultural use, slope instability and by coast defences or river bank protection measures. In some cases excessive easement of access could reduce the value of the main scientific attributes, for example by path widening. Removal of scree could enhance the rate of degradation of a slope which is stabilised by the build-up of material at the toe. The presence of scree and overgrown vegetation may provide some protection against opportunist fossil collectors.

A note should be made of any difficulties in gaining access to the site and an estimate of the time and resources needed to gain access.

4.4 Safety

Processes such as the opening of joints and fissures in rock, formation of gullies in soils and soft rocks, rockfalls and collapse of rock cliffs or soil slopes can pose a risk to visitors. Safety may also be compromised by the undermining of coastal or river- side paths by erosion or by the formation of marshy areas due to flooding.

4.5 Negative Indicators

This attribute refers to changes in, near or even distant from the site that may be affecting the site indirectly, or may affect it in the future. Examples could include the construction of new weirs, dams, roads, changes to the way natural vegetation 1s controlled, stream and flood management, quarrying processes and changes in land use. Detrimental effect to the site should be reported and a note made of any changes that might affect the site m the future, so that they can be monitored.

5 Defining targets for each attribute

Guidance on targets for each attribute is presented in the following table. Mandatory targets define the levels which a feature must achieve in order for its condition to be considered favourable. These are shown in bold in the table and must be assessed at every site. Indicative targets provide additional information about the condition of the site.

6 Measuring whether the targets have been met

6.1 Preparation

A field visit is required to gather most of the information necessary to determine whether the targets have been met. Preparation for field visits should always include reading the previous visit notes to make sure you know what fossils are important at the site and how to identify them. Before making the first visit it will be necessary to refer to the Site Documentation Reports. A member of the Earth Science Group should be consulted if you need further explanation of the features and how to assess them. A record should be kept of any information used, together with annotated maps showing the features so that this knowledge is available for future visits.

Table 15.5.1 Generic guidance on targets for palaeontology sites

Attribute	Target
Physical Attributes	**The site will be favourable if it continues to display the essential features on which the citation is based. This will usually require at least one exposure of good quality. Any decrease in extent, composition and structure of the key features will affect the status.** Sites will tend to be in a favourable condition unless affected by construction, roads, tree-planting, quarrying, excavation, tipping, permanent industrial or building development, build-up of scree, encroachment of vegetation, storage of materials, river bank protection, coast defence works, landfill and restoration, large scale erosion or landsliding Some disruptions/changes to the site may be tolerated within the 'favourable-maintained' condition. These are detailed in the JNCC Guide under the appropriate Earth Science Conservation Classification for the site. Individual exposures showing rock detail may also be affected by weathering, erosion and breaking up by roots.
Visibility	**A site will be favourable if it affords appropriate views of the rock exposures. It will also be favourable if partially obscured by scree or vegetation to the extent that no more than a few hours work with hand tools or an excavator is needed to clear the obstructions.** Close-up views (probably less than 10m) will usually be required to view palaeontology sites. A site may be unfavourable if obscured by excessive build-up of scree, encroachment of vegetation, tipping, river bank or cliff protection work or coastal defences. In exceptional circumstances, burial may be a conservation requirement to protect vulnerable fossil bearing horizons.
Access	**A site will be favourable if it affords appropriate access by study groups or researchers to the extent described under Visibility above.** Close-up access (probably less than 10m) will be required. The status may be affected by construction, vegetation and land use changes, or flooding.
Safety	**The site should be safe to visit for people acting in a responsible manner.** The site will be considered to be unfavourable if it is unsafe for people taking reasonable care and without the need for any specialist safety equipment or skills. Safety may be affected by landsliding, flooding or deterioration in paths or footbridges
Negative Indicators	Any changes in the vicinity of the site that might in the future affect one of more of the above attributes should be reported.

Key: Mandatory targets are highlighted in bold text

If possible take copies of relevant documents with you to the site For complex areas that have been cited for more than one reason, it will be necessary to determine whether there are any likely conflicts between, for example, the requirements for vegetation/habitat and earth science features.

6.1.1 Maps

Maps of a suitable scale to show the locations and access routes to the site (probably not smaller than 1 50,000) and also the location of features within the sites (not smaller than about 1:5,000 or 1 10,000 depending of the size of the site) will always be needed. Refer to the Site Documentation Reports.

6.2 Field Surveys

6.2.1 When to survey

The best time to survey Earth science sites is generally in the early spring before summer vegetation cover begins, in bright weather, preferably lightly overcast to reduce shadows in photographs. Forward planning is required to ensure that sites prone to shadows, tides or other constraints are visited at appropriate times. Once the monitoring is established there is a benefit in re-visiting sites at the same season, and during similar weather conditions and times of day.

6.2.2 Things to Take With You

You will need the following items on site.

- the Site Documentation Report;
- a map, marked with the location or boundaries of the site and salient features,
- a camera with a reasonably wide angle lens (35 mm). If the camera has a flash then it must be possible to switch off the flash; photographs should be taken in natural light (See section 1.8);
- a compass to check the direction of views m sketches and photographs
- a ruler to place in close-up photographs as a scale, and a board identifying the site, date and time of day and direction of view;
- blank field recording forms and checklist of monitoring questions - refer to the JNCC Guide (1999 Supplement) for the appropriate proforma and the instructions for completion,
- forms from the previous monitoring to ensure photographs are taken from the same view points and in the same directions on each occasion;
- this manual.

6.2.3 Field Procedures

1. In considering the following generalised approach, special attention should be paid to the crucial areas identified m the Site Documentation Report.

2 You should check that location, or boundaries, previously recorded are correct. For large sites it is important that the whole of the feature of interest is seen by walking over the site or viewing from suitable vantage points, as

appropriate. The details of the inspection should be recorded and repeated in future Inspections

3. A dimensioned site layout sketch should be produced to show the features of the site, access routes, points from which the items of interest can be seen and any changes to the extent, access or safety of the site. On future visits sketches should be made from the same viewpoint to illustrate any changes. A photograph should be taken from the same viewpoint. Locations of additional photographs and detailed sketches (see below) should be shown on the layout sketch.

4 Where necessary, further dimensioned detail sketches should be made of the main features of the site, for example prominent outcrops, showing the size and shape of the exposure and any salient details. Records should be taken at the same location on subsequent monitoring visits and, where relevant, at the same state of tide

5 When visiting the site, you should refer to the Site Monitoring Question Checklist- (refer to the JNCC Guide, 1999 Supplement). You may also find it helpful to ask yourself the following general questions:

- Has the site changed in any way from the description on the citation?
- Has the site changed in any way since the last inspection?
- Try to describe and sketch any changes.
- Do these changes make the site more of less favourable with respect to any of the attributes or do they have no effect?
- If changes are on-going, is the value of the site being increased or reduced?

6.3 Evaluation, Analysis and Record Keeping

The data should be transferred to a site Condition Monitoring Form and compared with the targets for each attribute. The field recording forms should be placed on file for future reference. A note should be kept on file of the length of time taken to carry out the monitoring for planning future visits.

15.6 QUATERNARY GEOLOGY AND GEOMORPHOLOGY SITES

1 Introduction

The Quaternary Period covers approximately the last 2.5 million years of geological time and is continuing today. It therefore encompasses the landscape modifications produced during and since the ice age, as well as the records of associated climate and environmental changes Quaternary sites may Include glacial landforms such as drumlins and eskers, sedimentary exposures of glacial and Interglacial deposits, periglacial landforms and lochs and bogs with detailed palaeoenvironmental records These sites range in size from small stratigraphic exposures to extensive landform assemblages (such as the Cairngorms).

Quaternary sites will generally be integrity sites. Most commonly these will be static (relict) geomorphological sites or unique/rare deposits (e g. interglacial deposits) in foreshore exposures, coastal and river cliffs, active quarries and pits, disused quarries, pits and cuttings, inland outcrops or stream sections. Some, however, will be exposure sites (e.g. for glacial deposits) in the form of foreshore exposures, coastal and river cliffs, active quarries and pits, disused quarries, pits and cuttings, inland outcrops or stream sections.

2 Skill requirement

Descriptions of the landforms and/or deposits at each site and the key features can be found in the Site Documentation Reports. At the most basic level, you should be able with the assistance of these reports to identify the locations and extent of the main landform types or sedimentary exposures. You do not necessarily need to be able to identify the sedimentary details, but it would be an advantage to be able to recognise some of the key features and the horizons in which they occur.

3 Factors likely to influence the status of sites

The factors most likely to influence the status of Quaternary Geology and Geomorphology Sites are the physical attributes (morphology, extent, composition and structure) and clarity of the main features and a means for gaining safe access to view them. These sites are most at threat from planning developments and land use activities related to construction, mineral extraction, agricultural and forestry activities. They may also be affected by natural processes such as changes in vegetation, erosion, and slope instability. Stratigraphic sites may be adversely affected by coast protection and river bank protection.

Quaternary Geology and Geomorphology Sites are likely to vary widely in size and nature, and reference should be made to the Site Documentation Report and the list of Potentially Damaging Operations (PDOs) for the particular site for an indication of the high risk activities.

In general, threats to physical attributes are likely to include: construction, excavation (including quarrying), and tipping (including landfill), drainage works, stream diversions or any actions affecting the groundwater table, coast defences and river bank protection works. The activity might damage the site directly or indirectly by obscuring one of more views of the site. Changes in crop type, or cessation of grazing, might lead to masking of subtle features, while afforestation could obscure an entire site.

A feature such as a raised beach or river terrace may be prejudiced if new construction or afforestation masks the comparison of its elevation and morphology with that of the adjacent land. This means that a site could be severely affected by off-site changes, either natural or man-made, even at some distance from the SSSI.

Geomorphology sites also are prone to the activity of natural processes such as erosion, slope failures and flooding. In some cases these will reduce the definition of features, and in extreme cases could destroy a site, although they may also provide new exposures. A note should be made of changes resulting from these processes. Soft ground sites may be damaged by animal tracks and excessive grazing or burrowing by rabbits and badgers.

Activities related to stream diversions, flood defence, sinking of wells, building of dams, and field drainage measures may affect the site. The water table may be raised or lowered by planting or clearing trees. Such changes should be recorded and possible effects checked during subsequent monitoring.

Reference should be made to the JNCC Guide for further information on defining favourable and unfavourable condition. This is provided for each category of integrity and exposure site in the Earth Science Conservation Classification.

4 What Attributes do you need to assess?

The following attributes should always be reported for all sites:

4.1 Physical Attributes

Physical attributes relate to the degree to which the site continues to display the key interests that it was selected to represent. **Morphology** refers to the surface forms of the features of interest (landforms) and the degree to which they are intact. **Extent** refers to the extent of the key features and the degree or clarity of their expression or exposure. **Composition** refers to the presence of the key features for which the site is notified, including the presence of stratigraphic sections as well as landforms. **Structure** refers to the relationships between key features (e.g. between different landforms such as an esker and a meltwater channel) and the relationships between the key features and their wider geomorphological context (e g. the position of an esker in a wider assemblage of glaciofluvial landforms).

4.2 Visibility

The features of the site should be visible. In exceptional circumstances, burial may be a conservation requirement to protect vulnerable key elements. Also, for many stratigraphic sites, it will not be practical to maintain clear sections in unconsolidated sediments, and it is acceptable for limited amounts of work to be necessary, such as clearance of vegetation or scree deposits, for a site to be viewed.

In some cases more than one view of a site may be required, for example, close up of a material type (stratigraphic exposure) and one or more distant views of large landforms such as small hills, ridges or valleys. This attribute may be affected by construction, vegetation, tipping and afforestation both at the site and outside at some distance from the SSSI.

4.3 Access

The site should be accessible to the extent practicable. Unlike some other types of site, Earth science sites may be referred to in research work and may have to be visited for comparative purposes. The essential features of the site must be accessible to students and research groups but they need not be readily accessible to everyone all of the time. For example, it is acceptable for limited amounts of work to be necessary, such as clearance of vegetation or scree deposits, for a stratigraphic site to be accessed, and some coastal sites may only be visited at low tide.

Accessibility could be affected by new construction, significant changes in vegetation, agriculture or tree growth or by coast defences and river bank protection Obstruction of paths due to vegetation should be noted, as well as any effect on access from activities such as construction or farming.

4.4 Safety

Processes such as the formation of gullies in soils and soft rocks, rockfalls and collapse of rock cliffs or soil slopes can pose a risk to visitors. Safety may also be compromised by the undermining of coastal or river-side paths by erosion or by the formation of marshy areas due to flooding.

4.5 Negative Indicators

This attribute refers to changes in, near or even distant from the site that may be affecting the site indirectly, or may affect it in the future. Examples could include the construction of new weirs, dams, roads, changes to the way natural vegetation is controlled, stream and flood management, quarrying processes and changes in land use. Detrimental effects to the site should be reported and a note made of any changes that might affect the site in the future, so that they can be monitored.

5 Defining targets for each attribute

Guidance on targets for each attribute is presented in the following table. Mandatory targets define the levels which a feature must achieve m order for its condition to be considered favourable, and are marked in bold in the table. These must be assessed at all sites where the attribute is present. Indicative targets provide additional information about features of interest. Failure of these targets does not necessarily mean that the site is unfavourable, but does provide an indication of factors which may lead to the site becoming unfavourable in the future.

Table 15 6.1 Generic guidance on targets for Quaternary geology and geomorphology sites

Attribute	Target
Physical Attributes	**A site will be favourable if it continues to display the essential features on which the citation is based. Any decrease in the intactness of the morphology and the extent, composition and structure of the features will affect the status.** Sites will tend to be in a favourable condition unless affected by construction, roads, tree-planting, quarrying, excavation, tipping, permanent industrial or building development, build-up of scree, encroachment of vegetation, storage of materials, river bank protection, coast defence works, landfill and restoration, large scale erosion or land sliding. Some disruptions/changes to the site may be tolerated within the 'favourable-maintained' condition. These are detailed in the JNCC Guide under the appropriate Earth Science Conservation Classification for the site.
Visibility	**A site will be favourable if it affords appropriate views of the key features. It will also be favourable if partially obscured by scree or vegetation to the extent that no more than a few hours work with hand tools or an excavator is needed to clear the obstructions.** Close-up views (probably less than 10m) will usually be required to view any sedimentary exposures, while a distant view, possibly from more than one angle, will be needed to appreciate landforms. A site may be unfavourable if obscured by excessive build-up of scree, encroachment of vegetation, tipping, river bank or cliff protection work or coastal defences. Landforms may also be masked by agricultural changes and afforestation.
Access	**A site will be favourable if it affords appropriate access by study groups or researchers to the extent described under Visibility above.** This may require access to more than one vantage point. The site will still be favourable if (partially) obstructed by scree or vegetation that can be cleared in a few hours using hand tools or an excavator
Safety	**A site should be safe to visit for people acting in a responsible manner.** The site will be considered to be unfavourable if it is unsafe for people taking reasonable care and without the need for any specialist safety equipment or skills. Safety may be affected by landsliding, flooding or deterioration in paths or footbridges.
Negative Indicators	Any changes in the vicinity of the site that might in the future affect one of more of the above attributes should be reported.

Key: Mandatory targets are highlighted in bold text

6 Measuring whether the targets have been met

6.1 Preparation

A field visit is required to gather most of the information necessary to determine whether the targets have been met. Preparation for field visits should always include reading the previous visit notes to make sure you know what landforms are important at the site and how to recognise them. Before making the first visit it will be necessary to refer to the Site Documentation Reports. A member of the Earth Science Group should be consulted if you need further explanation of the features and how to assess them. You should make a note of the information used, together with annotated maps showing the features so that this knowledge is available for future vests.

If possible take copies of relevant documents with you to the site. For complex areas that have been cited for more than one reason, it will be necessary to determine whether there are any likely conflicts between, for example, the requirements of vegetation/habitat and Earth science features.

6.1.1 Maps

Maps of a suitable scale to show the location and access routes to the site (probably not smaller than 1:50,000) and also the location of features within the sites (not smaller than about 1·5,000 or 1 10,000 depending of the size of the site) will always be needed. Refer to the Site Documentation Reports.

6.1.2 Aerial Photographs

At some larger sites aerial photographs may be useful and you should check whether they are available and take them in the field to mark any changes with a chinograph wax pencil Some sites such as eroding sea cliffs, river channels or sediment deposition may be monitored best by re-photographing at Intervals. In such cases you should check when the most recent photographs were taken and check them against the previous pictures before going out in the field.

6.2 Field Surveys

6.2.1 When to survey

The best time to survey Earth science sites is generally in the early spring before summer vegetation cover begins, in bright weather, preferably lightly overcast to reduce shadows in photographs. Forward planning is required to ensure that sites prone to shadows, tides or other constraints are visited at appropriate times. Once the monitoring is established there is a benefit in re-visiting sites at the same season, and during similar weather conditions and times of day.

6.2.2 Things to Take With You

You will need the following items on site:

- the Site Documentation Report;
- a map, marked with the location, or boundaries, of the site and salient features;

- a camera with a reasonably wide angle lens (35 mm) If the camera has a flash then it must be possible to switch off the flash; photographs should be taken in natural light;
- a compass to check the direction of views in sketches and photographs;
- a ruler to place in close-up photographs as a scale and a board identifying the site, date and time of day and direction of view;
- blank field recording forms and checklist of monitoring questions - refer to the JNCC Guide (1999 Supplement) for the appropriate proforma and the instructions for completion;
- forms from the previous monitoring to ensure photographs are taken from the same view points and in the same directions on each occasion;
- aerial photographs (if appropriate);
- this manual.

6.2.3 Field Procedures

1 In considering the following generalised approach, special attention should be paid to the crucial areas identified in the Site Documentation Report.

2. You should check that the location, or boundaries, previously recorded are correct. For large sites it is important that the whole of the feature of Interest is seen by walking over the site or viewing from suitable vantage points, as appropriate. The details of the inspection should be recorded and repeated in future inspections.

3 A dimensioned site layout sketch should be produced to show the features of the site, access routes, points from which the items of interest can be seen and any changes to the physical attributes, access or safety of the site. On future visits sketches should be made from the same viewpoint to illustrate any changes. A photograph should be taken from the same viewpoint. Locations of additional photographs and detailed sketches (see below) should be shown on the layout sketch.

4 Where necessary, further dimensioned detail sketches should be made of the main features of the site, for example prominent landforms or sedimentary exposures, showing the size and shape of the exposure and any salient details. Records should be taken at the same locations on subsequent monitoring visits and, where relevant, at the same state of tide.

5. When visiting the site, you should refer to the Site Monitoring Question Checklist- (refer to the JNCC Guide, 1999 Supplement). You may also find it helpful to ask yourself the following general questions.
   - Has the site changed in any way from the description on the Citation?
   - Has the site changed in any way since the last Inspection?
   - Try to describe and sketch any changes
   - Do these changes make the site more of less favourable with respect to any of the attributes or do they have no effect?
   - If changes are on-going, is the value of the site being increased or reduced

6.3 Evaluation, Analysis and Record Keeping

The data should be transferred from your field notes to a Site Condition Monitoring Form and compared with the targets for each attribute. The field recording forms should be placed on file for future reference. A note should be kept on file of the length of time taken to carry out the survey.

15.7 GEOMORPHOLOGY SITES [from draft text]

1 Introduction

Geomorphology sites cover the history and development of landforms and geomorphological processes active today or recently active. This includes karsts landscapes and caves, as well as coasts, rivers and landslides. They can range in size from a small area of karst to large coastal systems such as Loch Gruinart on Islay.

Geomorphology sites are all integrity sites. The majority are active process geomorphological sites, though some (such as Mass Movement sites where the main interest is relict post-glacial landslides) are static geomorphological sites. Active process sites may also contain static elements (e.g. meander cut-offs or post-glacial shorelines). Other site types include cave and karst sites, which may include both active feature such as stalactites and relict features such as cave deposits.

2 Skill requirement

Descriptions of the landforms and sedimentary deposits at each site and the key features can be found in the Site Documentation Reports. At the most basic level, you should be able with the assistance of these reports to identify the locations and extent of the main landform types or sedimentary exposures. You do not necessarily need to be able to identify the sedimentary details, but it would be an advantage to be able to recognise some of the key features and the horizons in which they occur.

Monitoring of cave features requires specialist caving skills and knowledge and should only be undertaken by those with appropriate skills.

3 Factors likely to influence the status of sites

The factors most likely to influence the status of Geomorphology Sites are the physical attributes (morphology, extent, composition and structure) and clarity of the main features and a means for gaining safe access to view them. These sites are most at threat from planning developments and land use activities related to construction, flood defence, mineral extraction, agricultural and forestry activities. They may also be affected by natural processes such as changes in vegetation, erosion, and slope instability.

Geomorphology Sites are often relatively large in size, including, for example, extensive sections of coast or river, the ground area over a cave system, or the area of a large post-glacial landslip. Reference should be made to the Site Documentation Report and the list of Potentially Damaging Operations (PDOs) for the particular site for an indication of the high risk activities.

In general, threats to physical attributes are likely to include: construction, excavation (including quarrying), and tipping (including landfill), drainage works, stream diversions or any actions affecting the groundwater table, coast defences and river bank protection works. The activity might damage the site directly or indirectly by obscuring one of more views of the site. Changes in crop type, or cessation of grazing, might lead to masking of subtle features, while afforestation could obscure an entire site.

Geomorphology sites also are prone to the activity of natural processes such as erosion, slope failures and flooding. In some cases these will reduce the definition of relict features, but they are equally likely to be important for the continuing natural evolution of active features. A note should be made of changes resulting from these processes. Soft ground sites may be damaged by animal tracks and excessive grazing or burrowing by rabbits and badgers.

Activities related to stream diversions, flood defence, sinking of wells, building of dams, and field drainage measures may affect the site. The water table may be raised or lowered by planting or clearing trees. Such changes should be recorded and possible effects checked during subsequent monitoring.

Reference should be made to the JNCC Guide for further information on defining favourable and unfavourable condition. This is provided for each category of integrity and exposure site in the Earth Science Conservation Classification.

4 What Attributes do you need to assess?

The following attributes should always be reported for all sites:

4.1 Physical Attributes

Physical attributes relate to the degree to which the site continues to display the key interests that it was selected to represent. **Morphology** refers to the surface forms of the features of interest (landforms) and the degree to which they are intact. **Extent** refers to the extent of the key features and the degree or clarity of their expression or exposure. **Composition** refers to the presence of the key features for which the site is notified. **Structure** refers to the relationships between key features (e.g. between different landforms such as a dune system and machair) and the relationships between the key features and their wider geomorphological context (e g. the position of shingle bar in a wider assemblage of fluvial landforms).

4.2 Visibility

The features of the site should be visible. In exceptional circumstances, for cave or karst Geomorphology sites only, burial may be a conservation requirement to protect vulnerable key elements. If there are stratigraphy elements to the site it may not be practical to maintain clear sections in unconsolidated sediments, or always to maintain the same sections. For example when a river channel migrates and an exposure in the old channel vegetates over. Such changes are acceptable where the active processes are the key features of the site.

In some cases more than one view of a site may be required, for example, close up of smaller landforms and one or more distant views of large landforms such as ridges or valleys. This attribute may be affected by construction, vegetation, tipping and afforestation both at the site and outside at some distance from the SSSI.

4.3 Access

The site should be accessible to the extent practicable. Unlike some other types of site, Earth science sites may be referred to in research work and may have to be visited for comparative purposes. The essential features of the site must be accessible to students and research groups but they need not be readily accessible to

everyone all of the time. For example, it may be necessary to put restrictions on some cave entrances for safety reasons, and some coastal sites may only be visited at low tide.

Accessibility could be affected by new construction, significant changes in vegetation, agriculture or tree growth or by coast defences and river bank protection. Obstruction of paths due to vegetation should be noted, as well as any effect on access from activities such as construction or farming.

4.4 Safety

Processes such as the formation of gullies in soils and soft rocks, rockfalls and collapse of rock cliffs or soil slopes can pose a risk to visitors. Safety may also be compromised by the undermining of coastal or river-side paths by erosion or by the formation of marshy areas due to flooding.

4.5 Negative Indicators

This attribute refers to changes in, near or even distant from the site that may be affecting the site indirectly, or may affect it in the future. Examples could include the construction of new weirs, dams, roads, changes to the way natural vegetation is controlled, stream and flood management, quarrying processes and changes in land use. Detrimental effects to the site should be reported and a note made of any changes that might affect the site in the future, so that they can be monitored.

4.6 Process Dynamics

The active features that the site was selected to represent must be free to operate without constraint. This will include wave, wind and tide action, river erosion and flooding, and dissolution and precipitation processes. This Attribute will apply only to sites where there is an active process element to the key features. It will not apply, for example, to Mass Movement sites where the key features relate only to relict post-glacial landslides.

Process Dynamics could be affected by new construction, significant human-induced changes in vegetation, agriculture or tree growth, by coast defences and river bank protection, or by dredging or other excavations.

5 Defining targets for each attribute

Guidance on targets for each attribute is presented in the following table. Mandatory targets define the levels which a feature must achieve m order for its condition to be considered favourable, and are marked in bold in the table. These must be assessed at all sites where the attribute is present. Indicative targets provide additional information about features of interest. Failure of these targets does not necessarily mean that the site is unfavourable, but does provide an indication of factors which may lead to the site becoming unfavourable in the future.

Table 15.7.1 Generic guidance on targets for Geomorphology sites

Attribute	Target
Physical Attributes	**A site will be favourable if it continues to display the essential features on which the citation is based. Any decrease in the intactness of the morphology and the extent, composition and structure of the features will affect the status.** Sites will tend to be in a favourable condition unless affected by construction, roads, tree-planting, quarrying, excavation, tipping, permanent industrial or building development, build-up of scree, encroachment of vegetation, storage of materials, river bank protection, coast defence works, landfill and restoration, large scale erosion or land sliding. Some disruptions/changes to the site may be tolerated within the 'favourable-maintained' condition. These are detailed in the JNCC Guide under the appropriate Earth Science Conservation Classification for the site.
Visibility	**A site will be favourable if it affords appropriate views of the key features.** Close-up views (probably less than 10m) will usually be required to view smaller features, while a distant view, possibly from more than one angle, will be needed to appreciate larger landforms. A site may be unfavourable if obscured by constructions, encroachment of invasive vegetation, tipping, river bank or cliff protection work or coastal defences. Landforms may also be masked by agricultural changes and afforestation.
Access	**A site will be favourable if it affords appropriate access by study groups or researchers to the extent described under Visibility above.** This may require access to more than one vantage point. The site will still be favourable if (partially) obstructed by scree or vegetation that can be cleared in a few hours using hand tools or an excavator.
Safety	**A site should be safe to visit for people acting in a responsible manner.** With the exception of cave sites, the site will be considered to be unfavourable if it is unsafe for people taking reasonable care and without the need for any specialist safety equipment or skills. For cave sites, the site will be considered to be unfavourable if it is unsafe for people with appropriate caving skills, experience and equipment. Safety may be affected by landsliding, rockfall, cave collapse, flooding or deterioration in paths or footbridges.
Negative Indicators	Any changes in the vicinity of the site that might in the future affect one of more of the above attributes should be reported.
Process Dynamics	**A site will be favourable if the key active features for which the site was selected are free to evolve naturally.** A site may be unfavourable if its natural processes are impeded by constructions, tipping, storage of materials, invasive or planted vegetation, dredging or other excavations, coastal protection, or river bank defences.

Key: Mandatory targets are highlighted in bold text

6 Measuring whether the targets have been met

6.1 Preparation

A field visit is required to gather most of the information necessary to determine whether the targets have been met. Preparation for field visits should always include reading the previous visit notes to make sure you know what landforms are important at the site and how to recognise them. Before making the first visit it will be necessary to refer to the Site Documentation Reports. A member of the Earth Science Group should be consulted if you need further explanation of the features and how to assess them. You should make a note of the information used, together with annotated maps showing the features so that this knowledge is available for future vests.

If possible take copies of relevant documents with you to the site. For complex areas that have been cited for more than one reason, it will be necessary to determine whether there are any likely conflicts between, for example, the requirements of vegetation/habitat and Earth science features.

6.1.1 Maps

Maps of a suitable scale to show the location and access routes to the site (probably not smaller than 1:50,000) and also the location of features within the sites (not smaller than about 1·5,000 or 1 10,000 depending of the size of the site) will always be needed. Refer to the Site Documentation Reports.

6.1.2 Aerial Photographs

At some larger sites aerial photographs may be useful and you should check whether they are available and take them in the field to mark any changes with a chinograph wax pencil Some sites such as eroding sea cliffs, river channels or sediment deposition may be monitored best by re-photographing at Intervals. In such cases you should check when the most recent photographs were taken and check them against the previous pictures before going out in the field.

6.2 Field Surveys

6.2.1 When to survey

The best time to survey Earth science sites is generally in the early spring before summer vegetation cover begins, in bright weather, preferably lightly overcast to reduce shadows in photographs. Forward planning is required to ensure that sites prone to shadows, tides or other constraints are visited at appropriate times. Once the monitoring is established there is a benefit in re-visiting sites at the same season, and during similar weather conditions and times of day.

6.2.2 Things to Take With You

You will need the following items on site:

- the Site Documentation Report;
- a map, marked with the location, or boundaries, of the site and salient features;

- a camera with a reasonably wide angle lens (35 mm) If the camera has a flash then it must be possible to switch off the flash; photographs should be taken in natural light;
- a compass to check the direction of views in sketches and photographs;
- a ruler to place in close-up photographs as a scale and a board identifying the site, date and time of day and direction of view;
- blank field recording forms and checklist of monitoring questions - refer to the JNCC Guide (1999 Supplement) for the appropriate proforma and the instructions for completion;
- forms from the previous monitoring to ensure photographs are taken from the same view points and in the same directions on each occasion;
- aerial photographs (if appropriate);
- this manual.

6.2.3 Field Procedures

1 In considering the following generalised approach, special attention should be paid to the crucial areas Identified in the Site Documentation Report.

2. You should check that the location, or boundaries, previously recorded are correct. For large sites it is important that the whole of the feature of Interest is seen by walking over the site or viewing from suitable vantage points, as appropriate. The details of the inspection should be recorded and repeated in future inspections.

3 A dimensioned site layout sketch should be produced to show the features of the site, access routes, points from which the items of interest can be seen and any changes to the physical attributes, access or safety of the site. On future visits sketches should be made from the same viewpoint to illustrate any changes. A photograph should be taken from the same viewpoint. Locations of additional photographs and detailed sketches (see below) should be shown on the layout sketch.

4 Where necessary, further dimensioned detail sketches should be made of the main features of the site, for example prominent landforms or sedimentary exposures, showing the size and shape of the exposure and any salient details. Records should be taken at the same locations on subsequent monitoring visits and, where relevant, at the same state of tide.

5. When visiting the site, you should refer to the Site Monitoring Question Checklist- (refer to the JNCC Guide, 1999 Supplement). You may also find it helpful to ask yourself the following general questions.
   - Has the site changed in any way from the description on the citation?
   - Has the site changed in any way since the last inspection?
   - Try to describe and sketch any changes
   - Do these changes make the site more of less favourable with respect to any of the attributes or do they have no effect?
   - If changes are on-going, is the value of the site being increased or reduced?

6.3 Evaluation, Analysis and Record Keeping

The data should be transferred from your field notes to a Site Condition Monitoring Form and compared with the targets for each attribute. The field recording forms should be placed on file for future reference. A note should be kept on file of the length of time taken to carry out the survey.

Appendix 3: Current SNH Earth Science SCM Guidance documents

Contents

EARTH SCIENCE SITE CONDITION MONITORING CHECKLIST

Author: **Rachel Wignall**
SNH Earth Science/Geodiversity

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Last revised: **November 2016**

Table of contents:

Introduction

This 'checklist' is designed as a quick reference document to be used as a reminder of appropriate Attributes and Targets for condition monitoring of Earth Science sites. Also included is a short actions checklist.

This document is designed to be used after reading the general information under SNH Earth Science Site Condition Monitoring microsite

The **SNH Earth Science Site Condition Monitoring Guidance** is the principal document you should read before embarking on Earth science.

Guidance on practical aspects of Earth Science SCM '**Practical Monitoring of Earth Science Sites**'

References to relevant sections in the general SNH Earth Science Site Condition Monitoring guidance document are included in the lists below where appropriate.

Action checklist

Attributes and Targets	Check that correct Attributes and Targets are included on the SAT and CMF (see section 3 below)
Baseline	Check that any baseline being used records a FAVOURABLE site condition (see section 3). If in any doubt consult with SNH Earth Science/Geodiversity Group.
Fieldwork plan	Check crucial and 'hotspot' areas of sites, check planned route, check tides, check timing of visit, check access permission, check H&S precautions. (see 'Practical Monitoring of Earth Science Sites' for guidance on all the above except access permission and H&S)
Queries and consultation with SNH Earth Science Group	a) If you have any queries or uncertainties about constructing SATs, or baseline condition, PLEASE CONTACT the SNH Earth Science/Geodiversity Group BEFORE carrying out fieldwork. b) If you have any queries or uncertainties about site condition, appropriate management review, or completing the CMF, PLEASE CONTACT the SNH Earth Science/Geodiversity Group BEFORE submitting the CMF to DASU c) If SNH Earth Science Group is to be consulted as part of a management review (this includes any instance where a site is assessed as 'Partially Destroyed'*) please contact Earth Science/Geodiversity Group directly AS WELL AS including the information on the CMF.

* see 'SNH Earth Science Site Condition Monitoring Guidance' section 8.3

Attributes and Targets summary

Reporting Category	Attribute	Target	Target result affects
All	**Physical Attributes**	**a) If there is NO 'favourable condition' baseline:** The essential physical manifestations of the feature, on which the citation is based, continue to be present and intact; **b) If there is an appropriate 'favourable condition' baseline:** No part of the feature has been damaged, moved or removed (except by natural processes on a *temporary*[+] basis, or through *acceptable consented activities*[++] or as part of the natural evolution of active process indicators[+++]) since the time of an appropriate *baseline*[++++] (e.g. Site Doc.). *Please state baseline survey in full. For Site Docs please state report number and year of site visit.*	**Site condition assessment**
All	**Visibility**	**a) If there is NO 'favourable condition' baseline:** The essential physical manifestations of the feature on which the citation is based are still visible in close and distant views as appropriate (including views appropriate for research and study access). **b) If there is an appropriate 'favourable condition' baseline:** No part of the feature has been partially or wholly covered or otherwise been made inaccessible for viewing (except by natural processes on a *temporary*[+] basis, or through *acceptable consented activities*[++]) since the time of an appropriate *baseline*[++++] (e.g. Site Doc.). *Please state baseline survey in full. For Site Docs please state report number and year of site visit.*	**Site condition assessment**
Coastal Geomorphology of Scotland; Fluvial Geomorphology of Scotland; Karst; Caves; (with some exceptions)	**Process Dynamics**	**a) If there is NO 'favourable condition' baseline:** The essential natural processes on which the citation is based, and/or the natural processes forming the essential *active process indicators*[+++] on which the citation is based continue to operate without constraint. **b) If there is an appropriate 'favourable condition' baseline:** The essential natural processes on which the citation is based, and/or the natural processes forming the essential *active process indicators*[+++] on which the citation is based are not further constrained (except through *acceptable consented activities*[++]) than they were at the time of an appropriate *baseline*[++++] (e.g. Site Doc.). *Please state baseline survey in full. For Site Docs please state report number and year of site visit.*	**Site condition assessment**
All	***Negative Indicators***	*All of the above targets are met and there are no activities or changes in the vicinity of the site that might in the future affect one or more of the above attributes. (Management should be reviewed if current management will not protect the site from the perceived threats.)*	***Decision to review management***

[+] Doc 1, section 7.4 [++] Doc 1, section 7.5 [+++] Doc. 1, section 7.6 [++++] Doc 1, section 7.3 & Doc. 2, section 4
Doc 1: SNH Earth Science Site Condition Monitoring Guidance. Doc 2: Practical Monitoring of Earth Science Site

PRACTICAL MONITORING OF EARTH SCIENCE SITES

Author: **Rachel Wignall**
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Date of issue: **January 2004**
Last revised: **November 2016**

Table of contents:

About this guidance note

This Guidance note complements existing SNH Earth Science Site Condition Monitoring general guidance, last updated in November 2016.

The **SNH Earth Science Site condition monitoring guidance** is the principal document you should read before embarking on Earth science.

This guidance note was produced initially in response to area staff concerns that monitoring large geological SSSIs through comprehensive site visits and photo recording is/will be extremely time consuming. However, it has been expanded from this topic to form what it is hoped(!) will be a useful guide to various 'practical' aspects of SCM.

Included, are practical considerations relevant to monitoring sites of all sizes, such as an introduction to, and discussion of, the problems and practicalities of using a 'monitoring baseline'; and guidance on using 'Fixed Point Photography' to photo-record sites.

The latter sections of this guidance note are concerned with the practicalities of monitoring 'large sites'. The gist of the guidance is that it is acceptable to consider large areas of 'geo interest' within SSSIs to have been monitored without having walked every metre of the area of interest and studied every outcrop/landform.

Instead of covering every part of the area of 'geo interest' in the same detail, it is acceptable to visit a basic list of areas including:

- any small GCR (Geological Conservation Review) sites, sometimes referred to in older reports as SILs (Singe Interest Localities)
- good vantage points
- areas designated as 'hot spots'

and record any damage, potential damage, and the general site condition without having to comment on or photograph every outcrop or landform.

Locating the Earth Science interest within SSSIs

The area of Earth Science interest within almost all SSSIs is defined by the boundaries of the GCR site or sites within (or partly within) the SSSI which are applicable to the notified Interest Feature or Interest Features.

For 'geo' SSSIs with one geo Interest Feature, the SSSI boundary is expected to coincide with the GCR site boundary (minor differences are usually due to the location of convenient site boundary markers on the ground for defining the SSSI boundary, and may be disregarded). For 'geo' SSSIs with more than one Interest Feature, the SSSI boundary may be expected to include all the relevant GCR sites with minimal extra area included. For 'mix' SSSIs, however, the SSSI boundary may be completely different from the relevant GCR site boundaries.

Areas of the SSSI outside the relevant GCR site(s) need not be monitored for that Interest Feature. In some cases two or more GCR sites (belonging to the same GCR block) will lie within one SSSI; and in such cases, these GCR sites will form parts of a single SSSI Interest Feature. In other cases, GCR site boundaries of different GCR block/Interest Features within an SSSI may overlap or one may be entirely included within another. There are also cases

where GCR sites extend outside any SSSI or a large GCR site extends across several SSSIs. In these cases, any portions of the GCR site(s) outside the SSSI need not be monitored for SCM. If observations on feature condition in areas of the GCR site outside the SSSI are made, then they may be recorded in the Management Note, but should not be used to complete the Target results or influence the condition assessment of the feature.

All GCR site boundaries are available on GeoView (see the 'GCR sites' layer). Therefore it is easy to check where GCR site boundaries differ significantly from the SSSI site boundary as will often occur in 'mix' SSSIs. Maps of the GCR site boundaries are also usually available in the relevant Earth Science Site Documentation Report/Earth Science Site Management Brief (hereafter referred to as the 'Site Doc.') although in some cases where there are multiple geo interest features, particularly if they overlap (e.g. multiple Palaeontology interests and an igneous interest at River Esk, Glencatholm SSSI in Dumfries and Galloway) the specific GCR site boundaries for each site may not be shown in the Site Doc. Therefore the GCR site boundaries on GeoView should always be checked. N.B. if the boundary on GeoView differs from a GCR site boundary shown in a Site Doc, or looks odd, please contact SNH Earth Science/Geodiversity Group as there have been some errors with GCR boundaries on GeoView.

Note that an electronic version of the **Site Doc report for any GCR site can be accessed through GeoView**. Bring up the GCR sites layer, click on the relevant site to bring up the site information box, click on 'Show related records', scroll down and the ERDMS link to the Site Doc should be available to click on.

Always check that the GCR sites you are considering are the appropriate ones for the Interest Features you are monitoring - the name of the GCR block to which the GCR site belongs should correspond with the name of the Interest Feature you are monitoring (N.B. some GCR block names differ slightly from the Standardised Feature Names and a list of how these correspond is given in Appendix 1 of the SNH Earth Science Site Condition Monitoring Guidance.

The GCR site boundary is the essential guide to the area of interest. However, the GCR site boundary may for simplicity include areas lacking in Earth Science interest (for example an area with no outcrop in an Igneous Petrology site), or areas that are of less importance for the particular interest feature (for example areas of Torridonian rock in a Lewisian site, or areas of non-fossil-bearing rock in a fossil site). These areas are not specifically mapped, though may be apparent from site photographs and/or geological maps. Note that in the 'crucial' and 'context' zones map in many Site Doc reports the 'crucial' zones do NOT necessarily correspond to all areas where the interest feature occurs (for example they will not necessarily include all areas of Lewisian rock in a Lewisian site, though they are more likely to include all fossil-bearing areas of a fossil site). The feature will definitely occur within all 'crucial' zones, but it may also occur in some or all of the 'context' zones.

The definition of 'small', 'medium' and 'large' sites

Because every SSSI with an Earth Science interest (usually one or more GCR sites) is unique in terms of the distribution of the geo interest, landscape and access, it makes no sense to define a 'small site' as one 'under x hectares' or a 'large site' as one 'over y hectares'. What is relevant to site condition monitoring is really how long it will take to monitor the site; but

if you wish to use that as a guide to 'site size' the methodology of monitoring the site must also be specified.

Hence it is very hard to define a 'small site' or a 'large site'. Suggestions for what might be considered a 'large site' are given in the discussion of 'Monitoring Large Site' in section 9 for each specific type of 'large site'; but in the general discussion in sections 4-8 below the following loose 'definitions' are used:
A small site: a site where it is possible to comprehensively photo-record the whole site in 1 day or less.
A medium site: a site where it is possible to visit every outcrop/landform and view every area of the site in 1 day or less; but where it is not feasible to photo-record the whole site.
A large site: a site where it is not possible to visit every outcrop/landform or view every area of the site in 1 day.

The monitoring 'baseline'

As described in the general SNH Earth Science Site Condition Monitoring Guidance, the methods of Geological Site Condition Monitoring used by SNH require a 'baseline' condition for the site, against which later site condition is monitored.

For all SNH SCM, monitoring baselines are defined photographically. In the majority of cases, the Earth Science Site Documentation report or Earth Science Site Management Brief (Site Doc.) provides an appropriate baseline for SCM. There are two types of exceptions to this, however:

1) Sites which were not in an appropriate 'favourable' condition when visited during preparation of the Site Doc. i.e. sites which did not meet the minimum criterion of 'conditions necessary to ensure the continued existence of the scientific interest as stated on the citation', or sites that had recently been excavated (as also discussed in the general SNH Earth Science Site Condition Monitoring guidance). In the case of sites in poor condition, assuming no significant improvement in site condition in the interim, the report on the first monitoring visit should state what conditions are required for the feature to be in favourable condition. If it is thought possible to return the feature to a favourable condition a Condition Assessment of 'unfavourable' should be recorded. If it is not thought possible to return the feature to favourable condition, a Condition Assessment of 'destroyed' should be recorded. If the site was very recently excavated or cleaned, so that the visibility levels of the site are unlikely to be practically maintainable, an appropriate length of time should be allowed to elapse (for slope stabilisation and some vegetation growth to occur) before a baseline is set. **If you are unsure if a Site Doc. records a site condition which is 'acceptable' as a baseline, please contact an Earth Science advisor.**

2) Sites for which the information in the Site doc. is insufficient to provide a baseline for SCM. This usually occurs when the site is large and the limited number of site doc. photos does not comprehensively cover the site; or when not all of the site has been visited, either because it was too large or access permission was not given for part of the site. In these cases the first SCM visit will augment and/or update the baseline.

It is essential that you consider how complete the available baseline is before undertaking any monitoring work on a site.

Monitoring sites and 'Fixed Point' photography

The basic things to check when monitoring an Earth Science site are that outcrops/exposures/landforms are still there, undisturbed and unobscured (any more than they were at the time of the baseline); and, in 'active' Geomorphology sites (see general SNH Earth Science SCM guidance for discussion of 'active' sites), it is also necessary to check that natural processes are still operating. In short, it is necessary to check that all Targets specified on the Site Attribute Table (SAT) are met (see general SNH Earth Science SCM guidance for discussion on setting Targets).

In many cases this will simply involve looking at the outcrop(s) or landform(s) and checking for hammer marks, rock saw marks, rock core drill holes, signs of excavations, constructions, encroaching vegetation, tipping, tree planting etc. However, for Palaeontology (fossil) sites and Mineralogy (mineral) sites, where the fossils or minerals of interest are found in loose material, it is also important to check that the relevant fossil(s) or mineral(s) are still found by conducting a search for specimens and making a (rough) count of numbers of specimens found (a count of 'lots' or 'abundant' is acceptable!). This is because disturbance to and removal of specimens from loose material can occur without any obvious signs (e.g. hammer marks) being left to record it by, and changes in volumes of loose material may be hard to determine through comparison of photographs. Note that where counting of specimens is necessary, site monitoring may take slightly longer than otherwise.

Site Doc. reports should, in most cases, contain pictures of fossils and minerals found in Palaeontology and Mineralogy sites; however, in some cases specialist advice may be required. In these cases please do not hesitate to contact an Earth Science advisor.

'Fixed Point' photography

'Fixed point photography' is the method used to record a 'favourable condition baseline' for Earth science SCM, with views from 'fixed points' needing to be checked, and recorded (if there is any change) during each SCM visit. However in practice some flexibility is required to allow sites to be considered 'monitored' without all fixed point photographs having been re-taken.

This is due to simple practicalities such as light – the direction and intensity of the sunlight may be inappropriate to re-take some shots (there would be little point if the result was just a silhouette of a sky-line for example). It may also be considered unsafe or be impossible to return to some locations from which fixed point photos were taken on previous visits (this may or may not entail the site failing the 'visibility' target).

In all cases, if nothing has changed there is strictly no need to repeat the shot.

In general 'Fixed Point' photos of PDOs and 'rare/best/unique exposure/occurrence of something the site is particularly noted for' (see section 8.1.2 for further discussion on these) should be retaken from as near the original location as possible as this makes it easier to measure any change. Additional views may be taken and may be added to the list of suggested 'fixed points' if they are thought potentially useful. Photographs of any new PDOs should also be taken (appropriate written notes should be made on any new PDOs as well).

Exact repetition of shots of 'general views' (including 'representative examples of outcrop' etc.) is not vital if there are no significant changes. Changes such as minor sand accumulation

or seasonal vegetation variation are not usually considered significant (see also discussion in general SNH Earth Science Site Condition Monitoring Guidance); however, they may be instructive if the changes are noticeable, particularly so in sites notified for active geomorphology.

In general it should be stressed that 'fixed point photography' is a means of *recording* site conditions and is *not* essential for drawing conclusions about site condition. Observations recorded as written comments are the crucial factors, with photographs acting to support and illustrate points.

It should, however, be borne in mind that during the next monitoring cycle, the better the photographic record, the better the changes of noting any change. Therefore, if the old photos are unclear/weather was bad etc. it would be good to take some new ones even if there has been no change; and if there has been change it should be photographed. It is also always possible to add new 'fixed point photographs' to the record (although there is currently no ideal way of recording, during the current monitoring cycle, exactly which photos should be used for the baseline during the next monitoring cycle).

Always record the grid reference of any photographs you take irrespective of whether it is from a new location or a repetition of an old one. This makes life a lot easier for the next person who has to monitor the site and re-take Fixed Point photos!

Monitoring 'small' sites

For small sites (e.g. a single quarry face, or a few hundred metres of foreshore or of a stream) it is often quite feasible to take a photographic record of the entire site.

In such cases the site should be visited and recorded photographically. It is likely in such cases that the baseline provided in the Site Doc. report will be fairly comprehensive; and some or all photo localities from the Site Doc. may be used as 'Fixed Points'.

The condition of all parts of the site at the time of the SCM visit should be compared to their condition at the time of the baseline (e.g. Site Doc, or Site Doc. supplemented with Cycle 1 or later photos) and the overall site condition recorded accordingly.

Monitoring 'medium' sites

For some 'medium' sites (e.g. a disused quarry, or a moderately long stretch of river with discrete areas of rock/sediment outcrop) a photographic record of all outcrop or landforms may be possible; for others, however, although all outcrop or landforms may be visited (all parts of the site looked at) it may not be feasible, in terms of time and numbers of photos required, to photograph all areas of Earth Science interest (this may depend on the openness of the site as much as its size).

What to record when monitoring a 'medium' site

Where it is not feasible to photograph all areas of outcrop or landform, the following types of area should be photographed where possible:

- Damage, PDOs, areas at risk of damage, or likely areas where PDOs might occur (see section 8.1.2 for suggestions of where these might be)
- General views of the site including either the main areas of outcrop or landform (where this is applicable – the Site Doc. report should give an indication of where these are if it is not obvious from the ground) or representative areas (if e.g. the outcrop is spread patchily across the whole site).

For 'medium' sites, the photographic baseline provided by the Site Doc. is likely to be less comprehensive than for small sites. However, photos in the Site Doc. are also likely to correspond to the photos desirable for SCM; therefore some or all of the photos in the Site Doc. may be adopted as SCM 'fixed points'. But the photos in the Site Doc. may not include *all* areas which should ideally be photographed for SCM so further photos should be taken and 'fixed points' suggested where appropriate. **Always bear in mind that the photos in the Site Doc. were not chosen with SCM in mind; so some may not be appropriate or necessary for SCM and additional photos/fixed points may also be desirable.**

Site condition – favourable or unfavourable?

For the purposes of SCM, the condition, at the time of the SCM visit, of all parts of the site photographically recorded in the baseline, should be compared to their condition at the time of the baseline.

Areas NOT recorded photographically in the baseline pose more of a problem for monitoring. Generally all PDOs or damage in 'medium' sites *will* have been photographically recorded in the Site Docs and any SCM used for the baseline (some damage *may* only be mentioned in the text of the Site Doc. so it is worth checking this also); so damage in these areas is likely to be post-baseline. However, where damage does not look 'recent', the person monitoring the site must make a judgement as to whether it is pre- or post-baseline.

If the damage is pre- a favourable condition baseline, then the damage will NOT cause the site to be in unfavourable condition. Pre-baseline damage, however, should be noted for management action if appropriate (e.g. not either irreversible or reversible without action). If the damage is post-baseline then it will result in failure to meet attribute targets and an 'unfavourable', 'partially destroyed' or 'destroyed' condition assessment (see also main Earth Science SCM guidance, section 8).

Monitoring 'large' sites

The problems with monitoring the condition of sites increase further with large sites, where it may be entirely unfeasible to even visit every area, outcrop and landform during a single monitoring cycle let alone photo-record them!

The impracticality of comprehensive site visits and photo-recording of larger Earth Science sites leads to several problems in monitoring these sites:

- It is unlikely that any 'baseline' will include a comprehensive photographic or written description of every outcrop or landform of interest in the site;
- It is unlikely that every area of the site was visited prior to compiling the Site Doc./baseline; so **it is possible that not all damage and PDOs present at the time**

of the Site Doc./baseline are recorded in the Site Doc. (Note: this is different from what is assumed in the case of 'medium' sites, where the initial assumption is that the whole site was visited on the 'Site Doc. visit' and all damage and PDOs were recorded in the Site Doc.);

- It will be unfeasible to visit every area of the site during a single SCM cycle or to check every outcrop or landform (in a similar way to that in which it is considered unfeasible to search every inch of a biological site counting every plant of a species of interest).

In order to draw up a feasible solution to monitoring any large site, therefore, an acceptable and practical strategy must be developed. A guide to such a strategy, including advice on 'where to go' and 'what to record' is outlined in section 8.1 below.

Where to go and what to record

Assuming that it will not be possible to visit all parts of the site during a single monitoring cycle, decisions on where to actually go within the site may be based on considerations such as:

a) How is the Earth Science interest distributed within the site?
b) Where are the most likely places for damage and PDOs to occur?
c) Where might good vantage points be?
d) How might the 'rest of the site' be covered?

HOW IS THE EARTH SCIENCE INTEREST DISTRIBUTED WITHIN THE SITE?

As mentioned above (section 2), the GCR boundary is the essential guide to the area of interest within an SSSI. If the SSSI is made up of a number of GCR sites, sometimes referred to as 'single interest localities' ('SILs'), then monitoring any small GCR sites should be undertaken as though they were small SSSIs - the GCR site should be visited, inspected thoroughly and fixed point photographs taken covering the site as appropriate.

In the case of an SSSI containing one or more large GCR sites (and also in some cases a large GCR site/SIL occurring partly within a number of smaller SSSIs), where it is impractical to visit all parts of the site, considerations which may be used in deciding where to go during monitoring are outlined in the following sub-sections. Suggestions of 'what to record' are also included.

'HOT SPOTS' : WHERE ARE THE MOST LIKELY PLACES FOR DAMAGE AND PDOS TO OCCUR?

Assuming that it will not be possible to visit all parts of the GCR site in the same 'detail', an important consideration in deciding where to go is 'Where are the most likely places within the site for damage and PDOs to occur?'. This should give rise to a list of 'hot spots' which should be visited during every monitoring visit.

Such 'hot spots' might include:

- Roads, tracks or paths passing through the site;
- Land adjacent to forestry plantations where self-seeded trees might occur;
- Areas near human habitation or obvious landmarks (e.g. ruined castle, cave) which might attract people;

- Areas where coastal or river defences have been constructed or may foreseeably be required (e.g. coast/river edges of golf courses);
- Active quarries/pits;
- Disused quarries/pits which may be used as tips;
- Anywhere where consent for a PDO has been requested and/or given;
- Historic/famous outcrops or landforms (e.g. 'Hutton's unconformities' at Siccar Point SSSI, Borders; and North Newton Shore SSSI, Arran);
- Classic student teaching outcrops/landforms (e.g. the Glencoul thrust exposure in Loch Glencoul SSSI, West Sutherland);
- Rare/best/unique exposure/occurrence of something the site is particularly noted for (particular rock/landform type, junction between two rock types (e.g. the actual location of the Ordovician-Silurian boundary at Dobb's Linn SSSI, Dumfries and Galloway), mineral vein, particularly fossiliferous horizon (e.g. the actual exposures of the fossil horizons at Weydale Quarry SSSI, Caithness) etc)

Sufficient information to draw up a list of 'hot spots' should, in many cases, be available from studying an up-to date map of the site and from information in the site files and the appropriate Site Doc. Consultation with local area offices, owners/occupiers, or other interested parties such as researchers or student group leaders who use the site, may also help provide useful information for site condition monitoring.

The hardest types of 'hot spot' for a non-specialist Earth Scientist to identify will almost certainly be those, such as the last three on the above list, which will be primarily attractive to geologists (and therefore most at risk from damage by geologists!). These will be specific areas within a GCR site; but such 'hot spots' will not occur in every GCR site. If there are any of these areas in an SSSI, they *should* be mentioned (although not of course as 'hot spots'!) in the Site Doc. for the site, and are likely to be illustrated as 'figure-type' photographs with captions (rather than general site views). However in some cases information in the report/brief may not be sufficient/specific enough and it may be necessary to consult a specialist Earth Scientist (e.g. SNH Earth Science/ Geodiversity Group).

It is also worth noting that not all captioned photographs in the Site Doc. will be of features worthy of 'hot spot' status, as some will undoubtedly be merely examples of certain things which occur throughout the site or areas of the site (e.g. ubiquitous sediment structures or banding in metamorphic rock). **If you are unsure of the importance, with respect to SCM, of outcrops or landforms shown in Site Doc. photos, please do not hesitate to contact an SNH Earth Science advisor.**

What to record at 'hot spots'

All new, increased or previously unrecorded damage and PDOs should be recorded comprehensively, preferably photographically with appropriate notes.

Any areas considered particularly at risk from PDOs should also ideally be photographically recorded and notes made as to the perceived risk. This does not mean that all 'hot spots' should be comprehensively photographically recorded (such recording of the entire length of a track or road, for example would be impractical) but more localised 'potential risk' areas

should be photographically recorded where possible[21] and written comments should be recorded on other 'hot spot' areas (e.g. 'no Negative Indicators noted along track between x and y').

Examples of 'potential risk areas', which ideally should be photographically recorded might be: a short stretch of golf course very close to a coastal or river edge; an area where tipping has occurred pre-baseline, or where quarrying for (local) track or road building material has previously occurred; an area where a road is subsiding and may shortly require repair, or where the bank beside a road or track is unstable or actively eroding.

WHERE MIGHT GOOD VANTAGE POINTS BE?

It may not be feasible to visit every metre of the site but a selection of good vantage points (e.g. the tops of tree-less hills) should be pin-pointed and all, or a selection of these, should be visited (in suitable weather and possibly with a pair of binoculars) during each monitoring cycle.

What to record from vantage points

ESSENTIAL: It is important, primarily because it will be very useful for future monitoring visits, that monitoring records the general appearance of the Earth Science Interest Feature throughout the site (e.g. is the outcrop ubiquitous or sporadic? What is the vegetation cover like?).

The Site Doc./baseline will usually include some general views of the site which might usefully be suggested as points for 'Fixed Point' photographs (section 5 explains when to re-take 'Fixed Point' photos). Further general views should be added, where appropriate, from other vantage points bearing in mind that it may be particularly useful (for future monitoring and also for site management) to record typical examples of outcrops or landforms. In such cases notes and appropriate photos captions (e.g. 'General view showing typical outcrop in the area between X & Y' or 'the only outcrop in the Z area') are vital to ensuring the photograph is of use for future SCM.

OPTIONAL: Recording good examples of 'general' Earth Science phenomena

Recording 'good examples of 'general' Earth Science phenomena' is an extension of recording 'typical outcrop'-type shots. A record of where good examples of fossils, sedimentary structures, well-exposed examples of rock types, small-scale erosional features etc. are within a site is a useful record for a) anyone considering proposals for PDOs within the site, and b) anyone studying the site or using it as an educational resource. However, if the fossils/rocks/erosional feature are fairly common within the site (i.e. they do not warrant 'hot spot' status) then it is not necessary to repeatedly photo-record them.

[21] Any areas of particular interest to geologist (e.g. historic/famous outcrops or landforms; classic student teaching outcrops/landforms; rare/best/unique exposure/occurrence of something the site is particularly noted for) will normally be photographed in the Site Doc. If this is the case then these (or better) views should be included in the list of 'Fixed Point Photography'. If, however, such areas are NOT photographically recorded in the Site Doc./baseline, then new 'Fixed Points' should be established to record these areas (whether or not they are damaged or appear at imminent risk from a PDO). If such areas are too large for comprehensive photo-recording, then 'typical' areas and any particularly 'vulnerable' areas (e.g. easily accessible, highly visible and spectacular) should be recorded.

Clearly, it is easiest for a specialist Earth Scientist to find 'good examples', but if some such 'good examples' are already photographically recorded (in the Earth Science Site Documentation report/Management Brief report or on a previous monitoring visit) then non-specialists may be able to recognise other good examples.

There is no necessity to record 'good examples' of common Earth Science phenomena in order to monitor a site; however, the additional information produced by noting such things, may augment the baseline and therefore be helpful when making management decisions relating to the site.

HOW MIGHT THE 'REST OF THE SITE' BE COVERED?

Visiting all 'hot spots', any small GCR sites, and some good vantage points, is probably a bare minimum 'coverage' of the site to draw a conclusion on its condition.

During each monitoring cycle, therefore, it is also advised that a selection of areas are visited which do not fall into any of these 'essential' visiting categories ('hot spots', small GCR sites, vantage points). Clear candidates for such visits are areas which cannot be seen from any vantage point; but other areas too may usefully be included (for example closer inspection of areas of outcrop visible from vantage points).

The important point is that, unless something is noted in these areas which it is thought necessary/advisable to visits during the following monitoring cycle (in which case its location should be added to the list of locations which it is essential to visit), the areas visited should be varied from cycle to cycle so that more of the site is visited. Therefore any points suggested for 'Fixed Point' photography within these areas should be seen as 'advised fixed points' for when this area is next visited, not 'must re-take every monitoring cycle' photos.

A strategy for 'where to go', therefore could perhaps be summarised as 'visit all 'hot spots', small GCR sites and good vantage points, varying the routes between them to ensure the widest possible coverage of the site over time'. But try to ensure a roughly even coverage of the site - do not leave vast tracts of the site unvisited because all the 'hot spots', small GCR sites and good vantage points happen to be in one corner!

What to record in the 'rest of the site'

Any damage or PDOs should be recorded or any areas thought particularly at risk from damage or PDOs. See section 8.1.2.1 for more details.

Further 'general views' and 'examples of typical outcrop/landforms' may also be useful for future SCM. See section 8.1.3.1 for more details.

Site condition – favourable or unfavourable?

For the purposes of SCM, the condition, at the time of the SCM visit, of all parts of the site photographically recorded in the baseline, and re-visited during the current monitoring cycle, should be compared to their condition at the time of the baseline.

As in the case of 'medium' sites, areas NOT recorded photographically in the baseline pose more of a problem for monitoring. Unlike the case for 'medium' sites (see section 7.2),

however, it is unlikely that every area of a 'large' site was visited prior to compiling the Site Doc./baseline; so **it is possible that not all damage and PDOs present at the time of the Site Doc./baseline are recorded in the Site Doc/baseline.** This means that if damage (which may be defined as any anthropomorphic act or catastrophic natural event which has had an adverse effect on Physical Attributes, Visibility, or Process Dynamics) is found in a previously 'unrecorded' area of the site, it may be difficult to know whether the damage pre- or post-dates the baseline, and therefore whether it should cause the site to be in unfavourable condition.

In such situations, the person monitoring the site must make an appropriate judgement; however, it is advised that, in general, where small areas of damage have occurred (e.g. a small borrow pit of unknown age in an esker; sea defences obscuring a relatively small proportion of outcrop), the condition of the site, including the damage, is taken as the baseline (i.e. the damage is not considered to cause the site to be in unfavourable condition). The exception to this is where the damage is clearly very recent and unconsented i.e. **damage is definitely post-baseline** (e.g. signs of recent working in a borrow pit; recent construction of sea defences; or the activity is *known* to be post-baseline). In these cases, the damage will cause the site to be in unfavourable/partially destroyed condition (due to whatever monitoring targets are not met) depending on whether the damage is reversible or irreversible.

For any areas considered to be 'large' areas of damage, it should be considered that the larger the area of damage, the more likely it is that it would have been recorded in the Site Doc./baseline report. Any damage, for example, which reduces the condition of the feature to a state where it is 'insufficient to retain the Earth Science interest' *would* have been recorded in the Site Doc. report. **If you are in any doubt as to whether damage would or may not have been recorded in the baseline; or whether any damage should or should not cause a site to be in 'unfavourable' condition, please do not hesitate to contact an Earth Science advisor.**

Guidance for monitoring specific types of large site

This section contains brief guidance notes for monitoring five different types of large site:

1) River sites
2) Coastal sites
3) Upland sites
4) Cultivated sites/lowland sites
5) Forested sites

Monitoring large river sites

WHAT COUNTS AS A 'LARGE' RIVER SITE?

Any site where walking out along one bank and back along the other (if both banks lie within the site) would take more than one day.

WHERE TO GO

When the far side of the site on one bank is visible from the other it may not be necessary to walk both banks during each monitoring cycle. Walk just one bank (can vary which bank along length of river).

If any potential PDO/damage is spotted which cannot be assessed properly from the bank you are on, note its location and investigate from the other bank also. Binoculars may be useful.

Try to vary which bank is walked from visit to visit but do repeat any sections where PDOs were noted previously or where there are crucial outcrops/landforms and these are not clearly visible from the opposite bank (note that e.g. some outcrops are *better* viewed from the opposite bank of the river).

WHAT TO PHOTOGRAPH AND RECORD

Repeat any baseline, or previous SCM cycle 'fixed point' photographs. PDOs and other 'hot spots' (see section 8.1.2), general views especially ones which give information about access routes, good examples of geological phenomena (optional). (See sections above for more information.) Sections with no specific interest (outcrop, landforms etc) or PDOs will warrant a general view at most.

Where active geomorphology is notified, changes in the active landforms which make up the Interest Feature is obviously more likely than for non-active sites, especially where there are 'soft sediment' landforms present (e.g. river bars or migrating meander bends); therefore more photographs may be required at active sites. It is important to note that a record of even very subtle change could be important. Any evident of changes in sediment supply or water volume should be noted and visual evidence photographically recorded where possible. Predicted responses of river channel morphology to changes in sediment and water volume supply are summarised below:

The predicted effects of changes in sediment and water volumes on river channel morphology (after Schumm 1977)

Change	River channel morphology	Change	River channel morphology
$Q_S+ Q_W=$	aggradation, channel instability, wider & shallower channel	$Q_S+ Q_W-$	aggradation
$Q_S- Q_W=$	incision, channel instability, narrower & deeper channel	$Q_S+ Q_W+$	processes increased in intensity
$Q_S= Q_W+$	incision, channel instability, wider & deeper channel	$Q_S- Q_W-$	processes decreased in intensity
$Q_S= Q_W-$	aggradation, channel instability, narrower & shallower channel	$Q_S- Q_W+$	incision, channel instability, deeper, wider? channel

Key: Q_S sediment discharge + increase = remains constant .
. Q_W water discharge - decrease ? uncertain response

For all types of site, note possible access routes and river crossing points (for the benefit of the next person monitoring the site!).

Check if any new/recent aerial photos of the site are available as these may be very useful for monitoring, particularly for large active river sites

A TIME GUIDE

A rough guide to the length of time which may be needed to monitor a large river site is that for an 'average' river site, where there is a path along some sections and not along others, about 5 km a day can probably be covered, or about 7 km if there is vehicle transport at both ends of the section. In any 'time plan', additional time should be allowed for checking any potential PDOs observed on the opposite river bank to that walked during monitoring.

Factors which will affect the length of time taken to monitor the site are:

- presence or absence of a foot path
- cliff sections of river or dense woodland/vegetation which necessitate climbs or detours from the river bank
- abundance of outcrop or landforms
- specific fossil or mineral 'hot spots'/small GCR sites where resource abundance and condition need to be checked
- number and size of GCR sites/SILs
- the number of new or continuing PDOs (unknown prior to visit).

Monitoring large coastal sites

WHAT COUNTS AS A 'LARGE' COASTAL SITE

Any coastal site where it is considered 'unfeasible' to photo-record the whole site (it is usually quite easy to photo-record a small or medium-sized coastal site because its open nature means that general views of the site are easy to obtain). In practice this probably means any site which will take more than half a day to monitor.

WHERE TO GO

If the site is only composed of the foreshore, then walk the whole length of the foreshore if this is possible. If it is not possible to walk the foreshore – for example the coast has high cliffs with little to no access along their base even at low tide – then the site may be monitored from the cliff top, provided that views of the foreshore/cliff outcrops or landforms of interest are clear and there are no fossil or mineral 'hot spots'/small GCR sites. If there are fossil or mineral 'hot spots'/small GCR sites then these must be visited. If the foreshore/cliff outcrop or landforms of interest cannot be seen from the cliff top and access along the foreshore/cliff base is impossible or dangerous, then the site may need to be monitored from a boat.

For all coastal sites time visits to coincide as much as possibly with low tide. Obviously if the site will take several days to monitor, it is not possible to do it all at 'low tide' . But plans can be made sensibly e.g. if the tide is low in the morning, start monitoring ASAP and use time later in the day, at higher tide level, to walk back to vehicle; if the tide is low later in the day, walk out to the furthest end of the site in the morning and do the monitoring on the way back. In the largest sites, the tide may sweep along the coast in one direction, and by monitoring in the same direction you will maximise low-tide coverage.

If there are additional sections of the site away from the foreshore, cover them as you would any other inland site of comparable size (these may also be ideal areas to work on at high tide).

WHAT TO PHOTOGRAPH AND RECORD

Repeat any baseline, or previous SCM cycle 'fixed point' photographs. PDOs and other 'hot spots', good examples of geological phenomena (optional), general levels/changes in seaweed and sand cover (these are almost always 'acceptable natural changes' – see discussion in general SNH Earth Science SCM guidance). General views – for non-active sites with outcrop it is useful to take some general views showing extent and location of outcrop – is it at the beach back or in the intertidal zone?

Sections with no specific interest (outcrop, landforms etc) or PDOs will warrant a general view at most. Where active geomorphology is notified, changes in the active landforms which make up the Interest Feature is obviously more likely than for non-active sites, especially where there are 'soft sediment' landforms present ' (e.g. sand dunes, shingle spit); therefore more photographs may be required at active sites. It is important to note that a record of even very subtle change could be important. Note that sediment volumes may vary systematically throughout the year (e.g. large amounts of sand removed by winter storms and replaced during the rest of the year).

For the benefit of the next person to monitor the site, note areas which are passable only at (very) low tide, sections which may involve scrambling and access points to the foreshore if these are limited.

A TIME GUIDE

A rough guide to the length of time which may be needed to monitor a large coastal site is that for an 'average' coastal site, where there is a coastal path of variable quality, continuous Earth Science interest and maybe one mineral/fossil 'hot spot' (per day), about 5 km a day can probably be covered, or about 7 km if there is vehicle transport at both ends of the section.

Factors which will affect the length of time taken to monitor the site are:

- sections of cliff where access along the foreshore is impossible and detours away from the coast are necessary.
- presence or absence of a foot path, particularly if only one vehicle is being used so a 'walk out' or 'walk back' is necessary.
- abundance/continuity of outcrop or landforms
- specific fossil or mineral 'hot spots'/small GCR sites where resource abundance and condition need to be checked
- number and size of GCR sites/SILs.
- the number of new or continuing PDOs (unknown prior to visit).

Monitoring large Upland sites

WHAT COUNTS AS A 'LARGE' UPLAND SITE

Any site where it is not possible to visit sufficient locations to obtain clear views of the whole site during one day of monitoring.

WHERE TO GO

Compile a list of 'hot spots' as described above (section 8.1.2) and plan a route (or several routes over several days) which visits these, any small GCR sites (see section 8.1.1) and a number of 'good vantage points' (see section 8.1.3). Plan some parts of the route(s) to cross areas not designated as 'hot spots'. Try to ensure a roughly even coverage of the site. Do not leave vast tracts unvisited because all the 'hot spots' happen to be in one corner of the site.

WHAT TO PHOTOGRAPH AND RECORD

Repeat any baseline, or previous SCM cycle 'fixed point' photographs. PDOs and other 'hot spots', good examples of geological phenomena (optional), general views and 'examples' (see guidance notes above for more details).

Note the amount of human visitation apparent (e.g. are paths worn or overgrown?), and grazing / animal tracks likewise.

A TIME GUIDE

As a rough guide, some of the larger upland GCR sites/SILs may take up to 3-5 days to monitor. If a large SSSI contains a number of GCR sites, then the time taken to monitor all the geo interests in the SSSI may be longer than 5 days.

Factors which will affect the length of time taken to monitor the site are:

- number of 'hot spots' where resource abundance and condition need to be checked
- number and size of GCR sites/SILs.
- the number of new or continuing PDOs (unknown prior to visit).
- presence/absence and quality of paths along the routes chosen.
- Upland weather (e.g. low cloud may prevent photography – but see section 5) – visits may have to be rescheduled or repeated

Monitoring large lowland/cultivated sites

WHAT COUNTS AS A 'LARGE' LOWLAND/CULTIVATED SITE

Any site where it is not possible to visit sufficient locations to obtain clear views of the whole site in one day of monitoring.

WHERE TO GO

Defining 'hot spots' on cultivated/lowland sites is often harder than for upland sites because the whole site is probably frequently accessed by people (e.g. farmers/landowners). However, flat fields are easier to get good clear views across than are hilly/mountainous upland sites. Therefore, for lowland/cultivated sites locating and visiting 'good view points' may be more productive than trying to decide which areas are the 'hottest hot spots'. For the flattest large sites, such as salt marshes, recent air photos may be an essential replacement for 'viewpoints', and can be very useful for navigation. Clearly it is still important to visit areas most at risk from PDOs (i.e. 'hot spots') and a similar method of listing these and visiting them along with 'good view points' every monitoring cycle should be used.

WHAT TO PHOTOGRAPH AND RECORD

Repeat any baseline, or previous SCM cycle 'fixed point' photographs. PDOs and other 'hot spots', good examples of geological phenomena (optional), general views and 'examples' (see guidance notes above for more details).

Note apparent amount of human usage and what the current (agricultural) use of different areas is.

A TIME GUIDE

As a rough guide, some of the larger GCR sites/SILs may take up to 2-3 days to monitor. If a large SSSI contains a number of GCR sites, then the time taken to monitor all the geo interests in the SSSI may be longer than 3 days.

Factors which will affect the length of time taken to monitor the site are:

- number of 'hot spots' where resource abundance and condition need to be checked

- number and size of GCR sites/SILs.
- the number of new or continuing PDOs (unknown prior to visit).
- presence/absence and quality of paths along the routes chosen.

Monitoring large forested sites

WHAT COUNTS AS A LARGE FORESTED SITE?

Any forested site where visiting all (accessible) areas of the site would take more than one day. These guidelines may also be applied to any forested site where access and views are restricted by tree cover.

WHERE TO GO

Large forested sites are difficult to monitor as outcrop and landforms are usually obscured by the trees. As with other large sites, though, a list of 'hot spots' can be compiled which should be visited every monitoring cycle. A list of 'good view points' can also be compiled, and, because in forested areas this list is likely to be short, it is probable that all such viewpoints should be visited every monitoring cycle.

'Visiting other areas of the site' may be restricted by tree cover and in some cases there may be only a short list of 'possible routes' through the site and a correspondingly limited amount of outcrop/number of landforms which is/are accessible. It may well be, therefore that the accessible areas of the site are so limited that they *can* all be visited in the course of each monitoring cycle.

WHAT TO PHOTOGRAPH AND RECORD

Repeat any baseline, or previous SCM cycle 'fixed point' photographs. PDOs and other 'hot spots', general views and 'examples' (these may include all accessible outcrop if it is severely limited!), good examples of geological phenomena (optional) (see guidance notes above for more details).

Note accessible routes into and through the site, and locations of any good view points. A very common 'PDO' to watch out for is self-seeded trees obscuring visibility.

SNH EARTH SCIENCE SITE CONDITION MONITORING GUIDANCE

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Table of contents:

OVERVIEW

1.1 This document provides essential guidance to all SNH staff undertaking Earth Science (geo) site condition monitoring[22]. Included are

- a description of the principles which underpin Earth Science SSSI monitoring;
- essential information and guidance on aspects of producing a Site Attribute Table (SAT) e.g. reporting categories, attributes, likely threats, targets;
- guidance for determining monitoring outcomes (favourable/unfavourable condition, totally destroyed/partially destroyed etc.) on geo sites and multiple interest sites;
- a brief discussion of the skills required to monitor geo sites.

Further guidance on the practical aspects of SCM is available in the 'Practical Monitoring of Earth Science Sites' guidance note (ref b97831).

1.2 This document in based on the JNCC Interagency guidance document, with advice specific to SNH site condition monitoring procedures added where appropriate.

1.3 The rationale of the JNCC Interagency guidance document is that it 'aims to provide general guidelines and a framework for common standards for monitoring Earth science (geological and geomorphological) sites. It is not intended to provide a universal template for recording sites in the field, nor does it supersede detailed guidance being issued by statutory nature conservation agencies in the UK to monitoring personnel. Its purpose is to demonstrate the rationale and summarise the common principles that underpin Earth science SSSI and ASSI site monitoring work in the UK.'

1.4 As such the JNCC guidance provides a framework for SNH monitoring procedures and background information for monitoring personnel. It should not be necessary for monitoring staff to read the JNCC guidance in addition to this guidance. The original JNCC guidance is available for reference if required (ref b46132).

INTRODUCTION: GEOLOGICAL SIGNIFICANCE OF THE UK

2.1 The comparatively small, but complex, part of the Earth's crust we call the 'United Kingdom' contains an unusually diverse assemblage of rocks, mineral and fossil deposits, landforms and superficial deposits that provide a natural record of much of the long physical and biological history of the Earth. In fact, this geological 'record' in the UK spans over three billion years, with every geological 'system' being represented by rocks in the UK. Such a rich *Earth heritage* in such a small area is highly unusual, and it reflects a particularly dynamic geological history. More information about the geology of Britain is given in GCR volume 1 'An Introduction to the Geological Conservation Review' and in other literature included in the reference section below (section 13).

2.2 Scotland is a microcosm of this geological diversity (geodiversity) and can be justified in boasting the most varied geology of any country of its size in the world. More information on Scottish geology and Scottish regional geology can be found on the Scottish geology website

[22] As noted in the JNCC interagency guidance (para 1.2): Although geology and geomorphology have a fundamental role in determining habitat type, the monitoring of types of habitat that are strongly dependent on underlying geology/geomorphology – e.g. chalk grassland, sand dunes as a coastal habitat feature, or karst as a habitat – is covered by separate guidance. However, 'mixed' interest sites – containing both biological and geological features of interest will need to be reported on separately (e.g. Bempton Cliffs, Yorkshire, will be monitored for its geology and independently for its breeding seabird colonies).

http://www.scottishgeology.com and in the SNH 'Landscape Fashioned by Geology' publications series. Information on individual geological sites - SSSIs and Geological Conservation Review (GCR) sites – can be found in the Earth Science Site Documentation report/Earth Science Site Management Brief report for the relevant site produced by SNH Earth Science Group Advisory Services and available on the SNH intranet at http://10.200.1.39/objective/?B101016. Further literature on Scottish geology is included in the reference section below (section 13).

2.3 Sites of importance to the study of Earth sciences are a fundamental part of our Earth heritage, the latter term embracing a wider perspective that includes aesthetic and cultural aspects of the geological and geomorphological significance of the UK.

2.4 It is perhaps because of this unusual diversity, coupled with the scientific awakening that began over two hundred years ago, that the UK is frequently referred to as the 'cradle of geology' – the place where study of rocks, sediments, fossils and the features of the landscape led to the development of geological science itself. Generations of leading geologists have studied – and continue to study – the geology and geomorphology of the UK, and sites here continue to contribute to the development and testing of theories, and to the unravelling of the geological history of the islands.

2.5 This founding position in the development of the Earth sciences not only gives the UK a historical, and ongoing, significance in the study of geology, geomorphology and Earth history, but also has led to the establishment here of formally recognised sedimentary rock successions that are used internationally as comparative standards ('stratotypes'). In fact, many of the divisions of geological time used throughout the world are named after British sites or areas, for instance the Cambrian, Ordovician and Devonian systems, the Ludlow Series and the Kimmeridgian and Portlandian stages.

2.6 Further importance in UK sites is as renowned, archetypal, 'textbook' features (e.g. the Giant's Causeway, County Antrim – columnar basalt jointing, and Chesil Beach, Dorset – gravel barrier beach/tombolo). Also, there are sites that are widely recognised as playing a key role in the development of the Earth sciences (e.g. Earth movements at Hutton's Unconformity, Siccar Point, Berwickshire; cauldron subsidence in Glencoe, Argyll, and ancient glaciation at Agassiz Rock in Edinburgh). There are also internationally famous 'type' sites – yielding definitive fossil, rock or mineral material – some sites even lending their names to minerals and fossils, such as Cayton Bay, Yorkshire – the fossil tree *Caytonia*, and Anglesey (Ynys Mon) – the mineral anglesite). Furthermore, many fossil and mineral names originate from eponymous geologists from the UK studying specimens recovered from rocks here – for example, Geikielite after Sir Archibald Geikie and *Megalosaurus bucklandi* after William Buckland.

2.7 ***Earth science site conservation – rationale***

2.7.1 Much of the information that allowed us to build up a picture of Britain's Earth history and understand the underground arrangement of rock formations relies upon the availability of field sites for study and interpretation. To piece together the geological history of Britain stretching back hundreds of millions of years, tens of thousands of sites have been studied and documented. Although it is impracticable to conserve every rock exposure and landform feature, it is important that the most important of these sites remain available for study. The most distinctive and most representative sites of importance to scientific research have been identified through site-based evaluation programmes with a view to their long-term conservation and statutory protection.

2.7.2 For Earth sciences in *Britain,* the statutorily conserved sites are those localities that were identified by the Geological Conservation Review (1977 to the present), according to the criteria summarised in Ellis *et al.*, 1996. In Northern Ireland, the broadly similar Earth Science

Conservation Review (ESCR) provides the rationale and methods for Earth science ASSI selection.

EARTH SCIENCE INTEREST FEATURES & REPORTING CATEGORIES

3.1 The definition of Earth science interest features for monitoring must relate to the reasons for the selection of geological and geomorphological SSSIs and ASSIs, and therefore relate to GCR and ESCR site selection categories. The GCR sites were selected according to around 100 geological categories, called 'GCR Blocks'. Suites of sites were selected for these categories, but only the *minimum number* of sites was chosen in order to represent the scientific highlights of the geology and geomorphology, so there is minimal duplication of features of special interest between sites. The detailed reasons for why a particular site qualified for selection for a GCR/ESCR 'Block' are documented in SSSI/ASSI citations, the GCR Series of publications and in country conservation agency site archives.

3.2 In the case of SSSIs in Scotland, a full plain English description of the Earth Science interest of any GCR sites within the SSSI is available in the relevant Earth Science Site Documentation report/Earth Science Site Management Brief report (these can be accessed through the GCR layer on Geoview: left-click on GCR site to bring up 'Attributes', click on 'Show related records', scroll down and click on the ERDMS link).

3.3 In the Earth sciences, it is the combination of ESCR and GCR 'Blocks' that is used as the interest feature list (see 'JNCC's UK Interest Feature name' Appendix 1). It should be noted that this list is not exactly the same as the list of GCR Blocks, because JNCC needs to report at a UK level and therefore has produced an aggregated ('common denominator') interest feature categorisation that embraces both ESCR and GCR Blocks. However, it is a simple matter for JNCC to aggregate data if supplied by GCR or ESCR Block for the relevant interest feature, since each interest feature relates to one or more GCR and ESCR Blocks (i.e. Blocks are not divided across interest features).

3.4 SNH's current Standardised Interest Feature names are also listed in Appendix 1, and where these differ from the JNCC's UK Interest Feature names, this is noted and an explanation given where appropriate.

3.5 The interest features have been grouped into seven broad themes by JNCC. These groups are equivalent to the 'GCR Block Types' selected by the GCR (Ellis 1996), and are used by SNH as the 'Reporting Categories' for site condition monitoring. These 'Reporting Categories' are listed below:

- Stratigraphy
- Palaeontology
- Quaternary geology and geomorphology
- Geomorphology
- Igneous petrology
- Structural and metamorphic geology
- Mineralisation/Mineralogy[23]

[23] SNH uses the term 'Mineralogy' which is in agreement with the JNCC Interest Features list in Appendix I and the original GCR terminology. JNCC, however, used the term 'Mineralisation' interchangeably with 'Mineralogy' in the Interagency guidance.

The differences between the broad categories of interest features are outlined below. A full list of the 78 Earth science interest features is given in Appendix 1.

3.6 *Stratigraphy*

3.6.1 From the early days of geological science, geologists have attempted to set up a series of divisions and sub-divisions of rock layer sequences (both sedimentary and volcanic) and to sub-divide geological time into convenient portions. There is also the need to relate (correlate) rock layers (or beds) and rock layer sequences of an area to other beds and sequences, regionally, nationally and internationally.

3.6.2 Relating stratified rocks, especially their sequence in time, the character of the rocks and the correlation of beds in different localities, is the basis for ***stratigraphy***. This fundamental aspect of geology is important, for example, in determining the occurrence and extent of an economic coal seam across the Midland Valley, or understanding oil-bearing sequences in the North Sea.

3.6.3 For the most part, stratigraphical interest features relate to stratigraphical age (principally, geological *stages*) or to a range of stratigraphical ages (e.g. Caradoc–Ashgill). Some stratigraphical interest features, however, were defined not purely by age, but also by environmental setting, where there are significant variations in rocks across the UK formed at the same time. This is why there are two for the Devonian Period, one for marine rocks and one for non-marine rocks (though no marine Devonian rocks occur in Scotland). Sites that are of particular interest for their sedimentology (e.g. lithology or sedimentary structures) are included within the stratigraphy interest features.

3.6.4 Most sites that are important to geological research because of their invertebrate fossils (e.g. trilobites, corals, echinoderms, shellfish, ammonites and other molluscs) are also addressed within the stratigraphical interest features, because these fossils are widely used in correlating rock strata and are relatively common. Therefore, some 'stratigraphy' sites will have been selected specifically for their fossil invertebrate content, because they are of crucial importance palaeontologically and palaeobiologically, or because they yield significant assemblages of invertebrates that provide evidence for past ecosystems and the evolution of life. Moreover, some sites have international significance because they have yielded fossils that are the 'type' material for a taxonomic group.

3.6.5 However, because of the relative rarity of vertebrate and terrestrial plant fossils, these are covered by separate palaeontological interest features.

3.6.6 The scale of stratigraphy sites can range from a relatively small outcrop (a few square metres) to a contact running across a valley side. They may comprise one or more relatively small exposures, or they may include exposures over a wide area (such as hills slopes of many hectares), which demonstrate the relationships between different strata.

3.7 *Palaeontology*

3.7.1 In contrast to the manner in which most invertebrate fossils are represented, fossils of vertebrates (reptiles, fish, mammals, birds), arthropods (insects, arachnids, terrestrial and aquatic crustaceans *excluding trilobites* [which are relatively common]), and terrestrial plants do have their own dedicated interest features. These interest features come under the reporting category of 'Palaeontology', which means 'the study of fossil flora and fauna'.

3.7.2 These Palaeontology sites address the evolution and diversity of significant animal and plant groups that are not included in the stratigraphy blocks (see above). Geological time is used as the basis to define some interest features, for example, Jurassic-Cretaceous *Reptilia*.

3.7.3 Palaeontology sites will usually be an area of exposed sedimentary rock (commonly siltstone, mudstone or sandstone) or loose material such as quarry waste; and it is important to note that in Palaeontology sites, loose rock material is often as important as *in situ* rock outcrop. The fossils may consist of the remains of any type of organism (e.g. cast of tree root, calcified bones), or may be tracks and traces or organisms including footprints and burrows.

3.8 *Quaternary geology and geomorphology*

3.8.1 During the Quaternary Period (the Pleistocene Epoch and 'Recent' (Holocene) times, together representing the time period from about 2 million years ago to the present day) northern UK was covered by a succession of ice sheets, whereas southernmost Britain was not glaciated, a history that has resulted in a variety of Quaternary stratigraphical units and range of geomorphological features of this age in different parts of the UK.

3.8.2 Quaternary sites may include glacial landforms such as drumlins and eskers, sedimentary exposures of glacial and interglacial deposits, periglacial landforms and lochs and bogs with detailed palaeo-environmental records. These sites range in size from small stratigraphic exposures to extensive landform assemblages (such as the Cairngorms).

3.8.3 The relative recency of Quaternary landforms and sediments means that there are potentially a large number of surviving sites available for study, with a more 'complete' record of geological events than older sediments. In consequence of the regional 'distinctiveness' and numbers of sites available, the Quaternary interest features are classified on a *regional* basis. Sites included in the Quaternary interest features are those that represent the stratigraphy and fauna and flora of Quaternary successions, and the development of landforms.

3.9 *Geomorphology*

3.9.1 Geomorphology relates to the shaping of the surface of the Earth and all sites in the Geomorphology reporting category were selected because of the processes which formed them, or are active within them today. The processes for which sites were selected in the Geomorphology Reporting Category are:

- Coastal processes (e.g. development of a beach-dune system);
- River processes (e.g. bedrock control of a river course);
- Mass movement processes (e.g. giant landslide);
- Cave and Karst forming processes (i.e. processes of dissolution of carbonate rocks).

3.9.2 Within the Geomorphology Reporting Category, the history and development of landforms is covered as well as the evolution of landforms under geomorphological processes which are active today. Because Geomorphology features/sites include these historic and development aspects of the processes, they may include one or other, or a mixture of, **relict** landforms and **active process** indicators.

3.9.3 **Relict** landforms are part of the history and development of landforms; they were produced in former times by processes which no longer operate today or in environments which no longer exist in this country. If destroyed, relict landforms will not be reformed by present day active processes. Many relict landforms, including drumlins, eskers and other products of glacial or glacio-fluvial activity, are included under the Quaternary Geology and Geomorphology Reporting Category. However, those related to the specific processes outlined above (in 3.9.1) will be included in the Geomorphological reporting category. In some cases (e.g. Corrieshalloch Gorge – a classic river gorge/bedrock controlled section of river course and waterfall, but formed initially by glacial processes), sites may be included in both Reporting Categories (i.e. there will be two geo interest features for the site).

3.9.4 **Active process** indicators are landforms and other physical characteristics which have been formed under contemporary environmental conditions and so are still changing or have the

capacity to change. Examples of 'active process indicators' include coastal spits and beaches, dunes and machair, the channels, bars and flood-plains of river systems, alluvial fans, debris flows and upland periglacial forms (patterned ground, wind patterned vegetation, solifluction). In some sites the actual land forming processes themselves are notified - such as 'slope failure' or 'channel migration' – rather than just the landforms which result.

3.9.5 In summary, Geomorphology interest features cover the history and development of landforms and geomorphological processes that are actively evolving today, for example, in rivers, coasts, caves and landslides. Unlike geological sites where processes can only be inferred, active geomorphological sites provide field sites where active processes can be studied directly. Some of these sites also include important static, relict (no longer active) geomorphological features in the assemblage of landforms (e.g. emerged beaches, stabilised/vegetated dunes and relict spits) that contribute to the historical and scientific interest of the site.

3.10 *Igneous Petrology*

3.10.1 Petrology simply means the study of rocks and in this case, 'Igneous Petrology', it refers to the study of 'igneous' rocks, which are rocks formed from molten magma. These rocks may have solidified underground ('intrusions'), or erupted as lava flows or explosively to produce deposits such as volcanic ashes. Exposures of contacts between igneous rocks and those they have intruded into or flowed over (country rocks) are often important sites; and in these cases the surrounding country rock is an important part of the interest feature, alongside the igneous rocks. The country rock may have been affected by the heat and pressure of the intruding igneous rock resulting in 'contact metamorphism' or deformation phenomena that can be important aspects of the interest feature. Igneous Petrology sites may show signs of mixing of rock types in a plastic state or inclusions of one rock type in another; varying sizes of minerals, some unusual or rare; trapped gas bubbles; or growth of later minerals due to water infiltrating the cooling rock. In the case of igneous intrusions, as well as the rock types themselves, importance may be attached to the shape of the intrusion, such as a volcanic pipe or 'plug' (e.g. Castle Rock, Edinburgh & Castle Rock, Dumbarton) or a dyke or sill (i.e. a wall or sheet of igneous rock) which may be tens of metres wide (e.g. Salisbury Crags, Edinburgh).

3.10.2 The igneous petrology interest features relate to major episodes of intrusive and extrusive igneous activity in the UK. These major episodes of igneous activity form the basis of six igneous interest features, and these are associated with the effects of mountain building activity, such as the Caledonian Igneous rocks associated with the Caledonian 'Orogeny', and the 'opening' of oceans (e.g. Tertiary[24] Igneous events which resulted in the opening of the North Atlantic Ocean, and are responsible for the British Tertiary Volcanic Province and the Antrim basalts).

3.10.3 Sites that are important for unravelling the geological history of these major igneous events will also be important for demonstrating general processes of igneous rock petrology, magma evolution and emplacement, and volcanology (e.g. Cauldron Subsidence theory at Glencoe) irrespective of their role in building up a picture of the sequence of events of geological history of the UK.

3.11 *Structural and Metamorphic Geology*

3.11.1 Structural and metamorphic are terms used to describe rocks that have been subjected to some form of temperature and/or pressure-induced changes since they were first formed. Structural changes refer to deformations of the layered structure of the rock, which may include shearing or folding of the original layering (bedding) of the rock, ranging from gentle to highly contorted. Metamorphic changes occur when the minerals, making up the rock, become unstable

[24] Note that the term geological period formerly known as the 'Tertiary' has now been divided into the 'Palaeogene' and the 'Neogene'; so the 'British Tertiary Volcanic Province' should now be referred to as the 'British Palaeogene Volcanic Province'. The 'Tertiary Igneous' interest feature title should more correctly be 'Palaeogene Igneous'; but this has not been updated as yet.

under the changed conditions of pressure and/or temperature, and break down, being replaced by minerals that are stable at higher temperatures and/or pressures.

3.11.2 Structural interest features relate to the rock deformation and metamorphic processes including three major mountain building orogenies [events] (Caledonian, Variscan and Alpine) and their variation across the UK. These interest features include geological structures such as folds and faults and other phenomena resulting from compressional and tensional forces acting within the crust of the Earth, as well as petrological change resulting from (thermal and/or compressional) metamorphism.

3.11.3 Four interest features relate to Precambrian rocks in Scotland and Ireland: Torridonian, Moine, Lewisian and Dalradian. There is no feature in the Stratigraphy Reporting Category for Precambrian rocks in Scotland; so this is the only Reporting Category/GCR Block Type under which these rocks can be listed. Therefore, all aspects of these rocks are covered here, including stratigraphical, structural, and metamorphic aspects. Rocks within three of these interest feature categories, Moine, Lewisian and Dalradian, have been deformed and metamorphosed during the mountain building. Therefore, sites often contain an inseparable mix of stratigraphical, structural and metamorphic interests. In these cases, inclusion of a 'Precambrian of Scotland' GCR block/feature name, would have meant almost entirely duplicating the network of sites, which was considered unnecessary (presumably). The inclusion of the Torridonian rocks in the Structural and Metamorphic Geology category is slightly anomalous as these rocks, although around 900 million years old, have not been metamorphosed or strongly deformed. However, their close relationship to the underlying Lewisian rocks and tectonic relationships to the over-thrust Moine rocks mean that it makes sense to keep them in the same reporting category (or presumably that was the rationale!).

3.12 ***Mineralogy/Mineralisation***

3.12.1 Mineralogy refers to the study of minerals. Minerals are the main constituent of most rocks, but the more common minerals which make up the majority of rocks do not warrant sites specially notified for them. However, in some places unusual minerals are found or unusually large or pure specimens of more common minerals, and these are considered worthy of notification in their own right.

3.12.2 Mineralogy interest features may relate to minerals produced as the result of igneous, metamorphic or sedimentary processes according to major regions that have a linked geological setting, or 'ore province'.

3.12.3 These features are likely to comprise exposures of rock, either natural or in quarries, mines, and shallow workings; or loose material in spoil heaps. Although in many cases the context in which the minerals of interest are found is as important as the structure and size of the minerals themselves, it is also often the case that loose rock material is as important as *in situ* rock outcrop.

MANIFESTATION OF INTEREST FEATURES AT A SITE

4.1 As indicated above, most Earth science sites will have a complex mix of geological and/or geomorphological features that led to a site being selected for a specific Interest Feature. For example, a site might have eskers, kames, drumlins and moraine, and a Quaternary stratigraphy that together led to the site being selected for the Quaternary of Scotland interest feature. It is also the case that the geological importance of, for example, a 'Marine Permian Stratigraphy' site, will seldom be confined to one geological entity, and instead will be manifested by a collection of factors such as the rock type (chemical and physical composition), the *range of* (succession of) rock types, the fossils, the relationship of the Permian rocks to older and younger ones, the sediment structures (preserved ripples, etc.), the orientation of the rocks and so forth.

4.2 For monitoring of the interest feature at a site to be meaningful, we need to identify the whereabouts of the actual entities that made the site qualify for selection – the primary, or critically important, geological features that will be the main focus of monitoring work, rather than 'hosted' or 'incidental' ones; however it will also be important to consider not only the critically important entities, but also how much important contextual exposure or landform is required to support the scientific value of the key entities, e.g. the sediment layers between true 'igneous' deposits and intrusions in large Igneous Petrology sites. Therefore, the entities to be monitored within a site, or *manifestations* of the interest feature, may be complex to describe, even if technical jargon is avoided. (Some example descriptions of manifestations of Earth Science interest features are given in Appendix 2.)

4.3 As well as manifestations of the interest feature being complex to describe, it is also the case that sites of different physical type can be selected for the same interest feature; so a generic 'manifestation of the interest feature' for each Earth Science Interest Feature (e.g. 'Tertiary igneous' or 'Quaternary of Scotland') is not possible.

4.2 The JNCC have developed a shorthand code for listing sites by broad physical type. This is known as the Earth Science Conservation Classification (ESCC) (See Appendix 3 for details). However, although this is useful for developing general guidance on conservation objectives for each ESCC category (see Appendix 3), these broad physical types are not sufficiently detailed to derive manifestation descriptions that would be of use for monitoring.

4.3 To avoid lengthy descriptions of the manifestation of the interest feature at Earth science sites, photographic recording is used by SNH for SCM. For cycle 1 SCM, photographic records within the relevant Earth Science Site Documentation reports was used where available (these can be accessed through the GCR layer on Geoview: left-click on GCR site to bring up 'Attributes', click on 'Show related records', scroll down and click on the ERDMS link). For later SCM cycles the Site Doc photos and photos taken in cycle 1 or later cycles may be used in combination (e.g. where the Site Doc had incomplete photographic coverage, additional Cycle 1 photos may be used to supplement the photographic baseline information); or Cycle 1 or later photos may be used on their own if these are the earliest suitable photos (see also section 7.3).

4.4 ***Multiple Interest Feature Sites***

Some sites attain SSSI/ASSI status independently for several interest features, for example where the same locality is selected for the GCR for more than one GCR Block (such as 'Silurian-Devonian Chordata' [Fossil fish] and also 'Non-Marine Devonian' [stratigraphy]), or the area of the SSSI/ASSI includes the areas of two or more separate GCR sites. This often happens when the SSSI/ASSI also has biological 'interest features' which extend over the area between the separate GCR sites. Biological features may also, of course, occur in the same area and in some cases may be intricately related to the geological features. For example, a single site might be important for Coastal Geomorphology on account of its beach/dunes *and* soft cliffs, it might also be selected for the Aptian-Albian Stratigraphy [Cretaceous] rocks and have an important colony of birds nesting in burrows in the soft sediments.

THREATS TO EARTH SCIENCE SITES

5.1 The need to take active measures to conserve geological sites is, perhaps, less obvious than for biological sites, which ensure the survival of important or rare animals, plants and habitats. Rocks are, after all, commonly hard and durable, and some have existed for many millions of years. Similarly, some mature landscapes have remained almost unchanged for centuries. However, resources such as crushed rock, sand and gravel are required to meet the demands of modern society. There is also an increasing need for waste disposal sites, and quarries, gravel

pits, old mines and caves have all been used for this purpose. Some historically important sites have been lost to science as a result.

5.2 Since the start of SNH's Site Condition Monitoring programme, the most common pressures recorded as negatively affecting notified Earth science features (i.e. threats to Earth Science Features) are:

- vegetation growth (through planting/forestry, or neglect/natural event/invasive species);
- dumping of waste material;
- quarrying, mining and gravel extraction;
- coastal protection and river engineering;
- specimen collection (minerals more so than fossils). Recorded as 'extraction' or 'recreation/disturbance' depending on scale.

Other recorded pressures include graffiti, the impacts of climate change (e.g. warmer winters affecting the formation of freeze-thaw features), and damaging activities permitted for overriding reasons such as public safety (e.g. safety netting permanently obscuring important rock features but necessary to avoid rock-fall).

5.3 ***Vegetation growth, neglect and site degradation***

5.3.1 As with many biological sites which may need a certain level of grazing, burning or other management to remain in favourable condition, some geological sites will require active human management so as not to deteriorate into an unfavourable condition.

5.3.2 The types of geological site which are most likely to require human management to avoid site degradation are those sites which include man-made outcrops such as quarries, road and railway cuttings. In these cases, neglect of the site will almost certainly result in growth of vegetation over the outcrop and deterioration of the site to a level where the Earth Science interest is lost. This is a different issue to the deliberate planting of coniferous trees, often in upland areas, which has obscured landforms and geological exposures. However, sites adjacent to or including plantations, are also likely to require continual management, because self-seeded trees are liable to spread over the site. In any of these situations, where vegetation will progressively obscure the feature if left unchecked, efforts should be made to remove vegetation growing on or within 10 m of outcrop, particularly seedlings, shrubs or other perennial vegetation.

5.3.3 A certain level of vegetation (trees and shrubs) is acceptable in most geological sites, for example trees and shrubs along a stream or river section, as this would have been the site condition when the feature was first identified. Additionally, particularly in man-made sites such as quarries or road cuttings, a certain degree of vegetation growth and deterioration in outcrop condition is unavoidable in practice. Therefore, although the 'ideal targets' for an Earth science site would be 'perfect maintenance of exposure', in practice, *some deterioration in condition will be tolerated away from this hypothetical ideal situation* within the 'favourable' conservation condition status. Therefore, so long as quality and quantity of the features on critically important parts of the site *remain at acceptable levels* that do not unduly inhibit study of the site, a degree of concealment through soil build-up or vegetation cover will be tolerated.

5.3.4 In sites where landforms form the interest feature or where outcrop is natural (not man-made), a balance is likely to exist which will conserve the site in roughly the same condition with respect to vegetation levels over time, and this condition is likely to be acceptable in terms of conserving the Earth Science interest. However, problems may arise through the spread of species such as gorse or if land use changes (e.g. grazing is reduced or stopped, or trees are planted). In these cases active management may be necessary, as in the case of man-made outcrops mentioned above.

5.3.5 If a vegetated area is excavated into, to allow study, and subsequently back-filled and plants encroach upon the back-filled area, there should be no cause for concern, as the site is merely

reverting to its former condition. However, there should be no attempt to accelerate the process of re-vegetation, with the planting of trees and shrubs.

5.3.6 In some cases, vegetation cover may be seen as providing protection against damage to a feature (see also 5.9 'Buried Sites' below). However, vegetation growth is not necessarily the ideal means of obscuring rock even in an attempt to conserve particularly rare and vulnerable fossils and minerals. This is because roots may damage outcrops of even the hardest rock and particularly soft glacial sediments. Also, if vegetation is used for cover, then the degree of cover is very difficult to control without intensive continual management. Ideally if radical measures are required, such as covering a feature for protection, boulders or rock spoil (machine removable) should be placed over/against an outcrop in an attempt to conserve the interest, rather than it being covered by soil and planted-up. However, the use of soil and vegetation to protect a vulnerable geological resource can be effective: the Rhynie Chert Locality SSSI has lain undisturbed for a century beneath a metre or two of soil and overlying vegetation; but in this case the amount of vegetation is kept low by managed grazing.

5.4 *Dumping of waste material*

Fly-tipping and dumping of building or agricultural waste on a small scale (e.g. by landowners) can be sufficient to destroy a site through permanent burial. Golf course waste, such as cut grass, dumped over coastal cliffs at the golf course edge, and obscuring outcrop above normal high tide mark has been noted as an issue on some sites. Foreshore exposures have also been obscured by dumping of material, ranging from building rubble to half-used paint tins. This, like the golf course waste, may in some cases be due to the misconception that the sea will 'clear it away', though in other cases it is clearly an attempt at haphazard coastal defence (see 5.6 below). Debris, such as paint tins may also obviously cover outcrop in paint, with similar removal issues to graffiti (see 5.9 below).

5.5 *Quarrying, mining and gravel extraction*

5.5.1 Rock exposures created by quarrying and related activities have played a key role in the interpretation of Britain's geology and have proved vital to the development of the Earth sciences over the last 200 years. Although active quarrying and conservation of the Earth heritage may not appear to be compatible, since quarrying is essentially a destructive process, it has also *revealed* exposures of rock formations, mineral veins and fossils that would otherwise have been known from natural exposures alone, or not at all. Therefore, quarrying can be both a threat and a potential benefit. This situation also applies to road construction, which can both destroy exposures and create new ones. Even the shape of the land has been changed as features are levelled or exploited to extract materials for the construction industry.

5.5.2 In many cases, the greatest threat to the geological interest of an extraction site is not the quarrying or extraction of material, but the landscape restoration that often follows on cessation of extraction works. This can obscure important rock faces if geologcial conservation principles are not incorporated during the design phase

5.6 *Coastal Protection and River engineering*

5.6.1 Development and the effective conservation of the Earth heritage are not mutually exclusive if properly co-ordinated; however, some engineering practices can pose problems for Earth heritage sites. The most common cause of damage to Earth science features from development, is from coastal and river engineering. In protecting coasts from erosion, for example, rock exposures of value to science may be covered and natural processes may be disrupted leading to degradation or loss of active process coastal features. Hard engineering can not only conceal the geology and geomorphology, but may exacerbate erosion elsewhere by altering the geomorphological process regime, for example, cutting off the sediment supply that feeds and maintains coastal shingle bars, beaches, salt marshes and mud flats, causing them to become eroded by the action of the sea.

5.6.2 Similarly, river engineering works can obscure river-bank exposures and alter natural fluvial geomorphological features, temporarily or permanently disrupting the natural process regime, and potentially causing new erosion problems downstream. Further engineering works may then be seen to be required to 'fix' these new problems, leading to further disruption, damage to geomorphological features and processes, and yet more knock-on problems.

5.7 *Fossil/mineral specimen collecting*

5.7.1 Specimen collecting has been recorded as a problem on a small number of sites. In many circumstances, fossil collecting is not harmful to fossil resources and fossil localities. This is particularly true where the fossils are relatively common or the locations in which they are found are subject to high levels of natural or artificial degradation, such as coastal cliffs that are being eroded or quarries that are being actively worked. In such situations collecting fossil specimens, that might otherwise be destroyed, can benefit our understanding of geology provided that they are properly documented and made available for study. Collecting also helps prevent fossil locations becoming neglected and overgrown. Ongoing fossil collecting can therefore be a valuable activity in the management and safeguarding of our fossil heritage.

5.7.2 However, some localities are highly sensitive to certain fossil collecting activities, and if these activities are not carefully managed, the scientific value of the resource can be damaged. Locations where there is either a limited fossil-bearing resource, or particularly rare and exceptional fossils, are vulnerable and susceptible to damage. Locations are also regarded as vulnerable where fossils exposed at the surface are used for educational field demonstrations.

5.7.3 Mechanical diggers, rock saws, and even explosives have all been used to collect fossils in Scotland, to the benefit of palaeontological research. However, in the hands of irresponsible collectors, such equipment can cause enormous damage and can threaten to annihilate vulnerable fossil-bearing resources and the fossils they contain. Excavation by collectors at river and coastal exposures can cause undermining, resulting in the collapse of rock faces, and burial of fossil-bearing layers. When rare and particularly significant fossils are collected by inexperienced and/or irresponsible people, the fossils can lose their geological context and much of their value as objects of study. The collectors may not recognise the importance of a find, or fail to record essential information at the locality.

5.7.4 The issues regarding collecting of mineral specimens are similar to those of fossil collecting except that a much higher proportion of mineral sites are of very limited extent. Therefore, there is a higher likelihood that damaging irresponsible collecting will occur.

5.7.5 Information on appropriate levels of collecting at Scottish sites is usually available in the Earth Science Site Documentation Report/Site Management Brief for the site. If this is not the case, or further information is required, please contact an SNH Earth Science advisor. Quite often the nature and scale of collecting has to be considered on a site-by-site basis.

5.7.6 In rare cases where material left *in situ* is considered to be highly at risk. Either burial for protection or consented removal of vulnerable material to a suitable repository, (e.g. a museum where the material will be preserved for research *ex situ*), may be considered. Such drastic conservation measures, however, will only apply in a few exceptional cases. The excavation and removal of an exposed fossil-bearing resource from a beach at Granton near Edinburgh is the only instance of this measure being implemented in Scotland to date. The natural occurrence of the internationally and extremely vulnerable Rhynie Chert beneath farmland within the Rhynie Chert SSSI is natural, if possibly somewhat fortuitous!).

5.8 ***Graffiti***

5.8.1 Both carved and painted graffiti has been observed on SSSI outcrops during SCM. Carved graffiti clearly damages the rock surface, potentially impacting the 'Physical Attributes' (see section 6) of the feature. In most cases, rocks that is soft enough to be carved by hand will eventually weather sufficiently to remove the carving provided that the rock surface is exposed to weathering (e.g. not inside a cave or otherwise sheltered form erosion). Painted graffiti affects the visibility of the feature. It can be removed by various methods. Historic Environment Scotland (formerly Historic Scotland) has greatest expertise in this area.

5.8.2 One significant issue that should be considered with any type of graffiti is that its presence encourages further graffiti. Therefore, while painted graffiti may weather off in time, it is often desirable to actively remove it as soon as possible. There is a bigger issue with carved graffiti in this respect, as waiting for it to weather away leaves plenty of time to it to 'inspire' further graffiti. Sometimes this means that as old graffiti weathers away, new graffiti is carved so the average amount remains the same. If the level of carved graffiti was increasing dramatically over time, artificial 'speeding up of weathering' by abrasion may be the only solution; however, this has not yet occurred during recorded SCM.

5.9 ***Climate change impacts***

5.9.1 Recent (2015) work by SNH as part of a ClimateXChange (http://www.climatexchange.org.uk/) project concludes that 8.8% (80) of GCR sites in Scotland should be considered at 'High risk' from climate change. The risks range from permanent inundation or complete erosion due to rising sea levels, and erosion of river banks as a result of increased flooding, to drying out of peat resulting in destruction of pollen records, and cessation of formation of patterned ground (which relies on freeze-thaw processes for formation) due to warmer winters. Of these risks, only the last has so far been recorded during SCM, with the formation of stone stripes in Tinto Hill SSSI failing to occur or occurring only weakly during some winters.

5.9.2 The work also highlights the risks to geological sites from human responses to climate change impacts, including increasing demand for coastal and river defences (see section 5.6 above) to protect 'immovable assets' such as roads and buildings.

5.9.3 Geological features that have been assessed as at High risk from climate change are detailed in draft actions reports (a1723606). The same data (and any subsequent updates) is also available in the Earth Science sites database (a57434). It is hoped that this data will eventually be incorporated into the SCM database.

ATTRIBUTES

6.1 In general terms in JNCC's scheme of Common Standards for Monitoring, 'attributes' should be quantitatively measurable. But in geological monitoring, attributes may also include subjectively assessable *quality* of geological features, rather than e.g. presence or absence of indicative species in a chalk grassland sward. Therefore, the 'visibility' or 'intactness of exposure' of geological features or 'naturalness of geomorphological processes' are important attributes.

6.2 *Attributes to be used*

7.2.1 JNCC guidance summarises the attributes to be monitored as follows: 'Given that the list (Appendix 2) indicates the entities we are assessing, then the attributes of these entities to monitored will include:

- quality of appearance or lack of disturbance to the internal structure of entities – the physical condition of rock/sediment/landform/spoil heap/etc. e.g. lack of disruption of sediments in a landform (that are not yet visible); lack of fragmentation of exposure, no physical damage to important parts of rock 'faces'/sediment stacks/landforms etc.; quality and visibility are intimately linked attributes;
- extent of features (e.g. quantity of important geological material such as volume of important spoil material in a mine dump, or area of rock face in an exposure site where it is advantageous to have a greater amount of rock exposure to study);
- 'visibility'– factors to be monitored will be lack of concealment from vegetation/soil/ talus build ups/ engineering constructions;
- Process dynamics: freedom of geomorphological processes to evolve naturally and unimpeded.'

6.2.2 For purposes of monitoring geological features in Scotland, SNH has simplified this list (recognising that the first two entities are frequently inseparable) to give three **condition assessment** attributes: 'Physical attributes', 'Visibility' and 'Process dynamics'. The first two ('Physical attributes' and 'Visibility') must be monitored for ALL Earth Science features, and the third ('Process Dynamics') must be monitored for all 'active process sites' in order to determine the site condition. SNH also includes one **management review** attribute ('Negative Indicators') that must be monitored for all Earth Science Features; but will NOT have any effect on determining the feature condition. Instead, factors recorded under the 'Negative Indicators' **management review** attribute will be used to recommend review of site management.

6.2.3 The condition assessment attribute called **'Physical Attributes'** includes the entities in the first two bullet points listed above, which may be summarised as: 'extent, composition, structure' or 'extent, composition, structure, morphology' where the morphology of the feature is important – for example a Quaternary Geology and Geomorphology feature including glacial landforms. (Note that these descriptors were tagged onto the attribute name for Cycle 1, but not for Cycle 2 onwards). This attribute must be monitored for all Earth Science features. For active process sites 'Physical Attributes' will include 'active process indicators' (landforms and other physical characteristics which have been formed under contemporary environmental conditions and so are still changing or have the capacity to change - see section 3.9).

6.2.4 The condition assessment attribute called '**Visibility**' must also be monitored for each Earth Science feature. As stated above 'factors to be monitored will be lack of concealment from vegetation/soil/talus build up/ engineering constructions'. This will involve assessing whether 'appropriate views' of the feature are available/maintained, where 'appropriate views' may, for example, be defined as the views of the feature/the visibility of the feature in the relevant Site Doc. 'Appropriate views' will usually include close-up views (e.g. close enough to touch a rock outcrop or sediment section) and more distant views (e.g. showing overall structure of folds in a rock face). Factors affecting ability of monitoring personnel to physically access the relevant points to obtain the 'appropriate views' should also be monitored under this target (see also 7.3 below).

6.2.5 For active process geomorphology sites (see section 3.9 above) a third condition assessment attribute must be monitored. This attribute is entitled '**Process Dynamics**' and, as stated above, this attribute is designed to ensure that the 'freedom of geomorphological processes to evolve naturally and unimpeded' is maintained. In practice this will mean checking that no artificial constraints have been imposed, such as coastal or river defences. Extraction of, for

example sand and gravel, may also disrupt natural processes and be relevant to this attribute as well as to 'Physical Attributes'. Factors outside the site may also affect the Process Dynamics within the site.

6.2.6 For the management review attribute, '**Negative Indicators'**, it is especially important to ensure that this attribute is included on the SAT where outside contractors are undertaking monitoring. This attribute is designed to ensure that any factors which might adversely affect the site in the future are recorded. If specific factors are thought likely to be a threat to the site (e.g. dumping of quarry waste, or growth of self-seeded trees) these may be flagged up specifically in the attribute target in addition to a general requirement for potentially damaging factors to be noted. The important thing for this attribute is that targets which are set should ensure that any foreseeable future problems or damage which may cause any of the condition assessment attribute targets to fail in the future are recognised and acted on before the site is damaged, reduced to an unfavourable condition, or partially/totally destroyed.

6.2.7 Safety of access to the feature should be included in the Negative Indicators target where safety issues may in future affect the Visibility target (e.g. it may become unsafe and therefore impossible to view the feature from the appropriate places).

6.2.8 Issues relating to access to the feature by third parties (e.g. access permission and restrictions) may be included in the Negative Indicators target where appropriate. For example, ensuring an appropriate mechanism of applying and granting permission for access to the site is still in place, may be important for monitoring visitor numbers and numbers of specimens collected at a fossil or mineral site. However, access issues relating to third parties may not always be considered relevant to site condition and, therefore, it may be considered inappropriate to include them in the Negative Indicators target.

6.2.9 The attributes to be monitored during SCM are therefore:

Condition assessment attributes

- Physical Attributes
- Visibility
- Process Dynamics (for active geomorphological sites only)

Management review attributes

- Negative Indicators

6.2.10 It is now possible to copy a SAT from a previous cycle rather than constructing one from scratch each time; however, if you are doing this please check that the attributes selected in the SAT you are copying are the correct attributes (QA has highlighted many cases where incorrect attributes were selected for early Cycles. For example no 'Process Dynamics Attribute' for an active site, including a 'Process Dynamics' attribute for a Stratigraphy or other non-active site). With respect to selecting attributes and targets see also section 7.

6.3 *Note on Cycle 1 Earth Science attributes*

6.3.1 SNH Earth Science monitoring guidance prior to 2004 (i.e. for most of Cycle 1) included 'Access' and 'Safety' attributes (following JNCC guidance). However, there were problems with the word 'access' during the first monitoring cycle, particularly in England, with some failing the target if access permission was not granted by the owner. There were also problems with the 'Safety' attribute, with people's concepts of what is 'safe' varying considerably depending, for example, on what terrain they were used to traversing.

6.3.2 JNCC's current guidance therefore states that: 'Access (by third parties) and safety are not used as criteria for determining the condition of the interest features, because they do not affect the appearance or ongoing physical presence of the key geological entities themselves.' It

is important to note here that the aspect of 'access' no longer to be monitored is access *by third parties*. Physical access to the (manifestation of the) interest feature, assuming the SSSI boundary is accessible, and with consent of the site owner, is still an important consideration which needs to be monitored; however, now it must be monitored under the 'visibility' attribute. For example, a 'visibility' target may state that 'the feature must be visible as at the time of the Site Doc. Report', so effectively 'views as in the Site Doc.' must be available. Therefore, any inability to access the appropriate points to see the views, which might previously have failed an 'access' target, would fail the 'visibility' target.

TARGETS

7.1 *Ideal site condition*

7.1.1. The ideal site condition, from the point of view of studying the Earth Science of an exposure site, is 100% exposure: no vegetation, no loose soil, talus or scree, no constructions or tipped material; just 100% bare rock or clean exposure of soft sediment. For active geomorphological sites an ideal condition is no anthropogenic intervention to the natural system (i.e. the system should have the capacity to evolve in an unrestrained way, its rates and magnitudes of change should be natural). For relic landforms sites, the ideal site condition is landforms unaffected by human activity and no cover obscuring any landform: very low vegetation or no vegetation at all, no flooding, no tipped material, no excavations, no construction (e.g. tracks cutting across landforms).

7.1.2. However, in order to protect features from natural erosion, this ideal must be modified somewhat. For example in certain circumstances – especially in soft sediments where trying to preserve an exposure continuously is undesirable, because repeated clearing of loose material would almost certainly result in the feature being rapidly eroded away, some build-up of loose material or talus may be acceptable or even desirable. Similarly low vegetation cover, such as grazed meadow, on landforms will help protect them from damage by erosion. So small amounts of build-up of loose material or low vegetation may be desirable for an 'ideal site condition'.

7.1.3. In reality, unfortunately, it is probably safe to say that no geo site has ever been in an ideal condition or is ever likely to be! All sites will have some vegetation and soil (even a fresh quarry face is likely to have soil and vegetation on the ground surface at the top of the face in land which is within the SSSI and loose talus at the foot of the face), which is not 'desirable to protect the feature', and many will have standing water, talus and boulders. In addition most sites will have some anthropogenic element which is not ideal[25], for example tracks, roads or houses, planted trees, dams, coastal defences, jetties etc. Therefore, some degree of acceptance of these 'non-ideal' factors must be incorporated into the SCM targets for 'favourable site condition'.

7.2 *Targets when there is no photographic baseline*

7.2.1. SCM targets must a) ensure the continued existence of the scientific interest within the site; and b) be realistically and practically achievable. Taking into account the non-ideal conditions of all geo sites (section 8.1), an 'optimal but non-ideal site condition' may be defined which is the best site condition which is reasonably and practically achievable. The fundamental requirement for this 'optimal but non-ideal site condition' is that it defines a condition in which the essential physical manifestations of the feature, on which the citation is based, are present, intact, and visible in close and distant views as appropriate; and (for active process sites only) the essential

[25] It is also true that many sites exist *only* due to anthropogenic activities, for example quarry sites, road and railway cuttings; so it would be wrong to assume that *all* anthropogenic activity is 'not ideal' or is undesirable.

natural processes on which the citation is based, and/or the natural processes forming the essential active process indicators on which the citation is based continue to operate without constraint.

7.2.2. These fundamental requirements can be used as the generic targets for all Earth Science SCM features. Assessing whether these generic targets are met or not will usually require expert judgement; therefore, for each feature where these targets are used, SCM assessment must be done by an expert. However, if such an 'optimal but non-ideal site condition', which fulfils these fundamental requirements, can be recorded photographically, then this record can be used as a 'favourable condition baseline' for future monitoring. This is the approach taken by SNH. Therefore the fundamental requirements above are only used as SCM targets where there is no photographically recorded 'favourable condition' baseline available.

7.2.3. Attribute targets for Earth science features where there is no 'favourable condition' baseline are summarised below (the 'Process Dynamics' attribute, should only be included for active process features):

Attribute	**Target**
Physical Attributes	The essential physical manifestations of the feature, on which the citation is based, continue to be present and intact
Visibility	The essential physical manifestations of the feature on which the citation is based are still visible in close and distant views as appropriate (including views appropriate for research and study access).
Process Dynamics	The essential natural processes on which the citation is based, and/or the natural processes forming the essential *active process indicators* on which the citation is based continue to operate without constraint.
Negative Indicators	*All of the above targets are met and there are no activities or changes in the vicinity of the site that might in the future affect one or more of the above attributes. (Management should be reviewed if current management will not protect the site from the perceived threats.)*

7.2.4. When assessing whether these targets are met or not, it should be born in mind that what constitutes the 'physical manifestations of the features on which the citation is based' in any SSSI will depend on site-specific factors such as how and where the interest feature is manifested within the site and how much contextual material is needed to retain the scientific interest of the site (e.g. if the manifestation of the interest feature is 'the contact between two rock bodies', how much exposure of the rock on either side of the contact is necessary to ensure that it is still of scientific interest?). It will also depend on the wording of the citation (e.g. does the citation state 'continuous exposure', 'excellent exposure', 'the best exposure' or just 'exposure'?). For example, many sites are notified for being 'excellent' (e.g. 'excellent exposure' or 'excellent example of a beach-dune system') or '*the best'* (e.g. 'the best exposure of x' or 'the best example of a y landform in Britain') so if the site no longer has 'excellent exposure' or 'the best example of a y landform in Britain', or whatever is stated in the SSSI citation, the scientific interest for which the site was notified has not been conserved; so the site will not be in favourable condition[26]. Another important point to consider is the value of the site for research and teaching. In some cases this may be specifically included in the citation (e.g. 'this is an important site for

[26] Phrases in SSSI geo citations such as 'excellent' and 'the best' give clues to why one 'Stratigraphy' site is only favourable if a large cliff outcrop is exposed while another consists of a few grubby, half-buried outcrops in the banks of a small stream. The large cliff outcrop may be notified as an 'excellent' exposure or 'the best' exposure where there is another which is 'very good'. The site with the grubby, half-buried outcrops is probably 'the best' exposure. It is not very impressive but there is nothing better!

research', 'there is great potential for research at this site' or 'this is an important site for teaching'); however, even where it is not stated explicitly, suitability of sites for study is inherent in their selection for notification, because the full potential of an Earth Science site cannot be realised unless it is possible to study it. This idea is embodied in the 'Visibility' SCM target.

7.3 *Target when there is a 'favourable condition' baseline*

7.3.1. Although condition at time of notification may seem to be the obvious choice for a 'favourable condition baseline' the condition of Earth Science features at time of notification is rarely recorded, either in words or photographically. Therefore, the solution adopted by SNH is to use the first suitable record of a site condition that fulfils the fundamental 'no baseline targets' (section 7.2 above) as the 'favourable condition' baseline for SCM.

7.3.2. For many Earth Science features, the photographically recorded 'Favourable Condition' baseline used for SCM is the Earth Science Site Documentation Report/Earth Science Site Management Brief (hereafter referred to as the 'Site Doc'). In some cases, the photographic record in the site doc is supplemented by early SCM Cycle photographs to give a more complete baseline. Where there was no Site Doc. report, or the Site Doc. report did not record a favourable condition baseline, 'no 'favourable condition' baseline' targets were used for the SCM assessment until a 'favourable condition' baseline could be photographically recorded. Therefore some 'favourable condition' baselines are the site condition as recorded photographical in Cycle 1, Cycle 2 or Cycle 3 etc. In cases where a geological site has just been cleared, either for scientific research or as part of the SCM remedies programme to improve site condition, it may be that the level of visibility of the feature directly after clearance is practically not maintainable. In such cases, a suitable length of time should be allowed to elapse, for natural slope stabilisation and an acceptable level of vegetation growth to occur, before a 'favourable baseline' condition is recorded. Expert judgement may be required to assess when a baseline should be recorded.

7.3.3. Where there is a 'favourable condition' baseline, targets are set so that any decline in site condition below this baseline results in a **condition assessment** target failing and the site being recorded as not being in 'favourable condition'.

7.3.4. Attribute targets for Earth science features where there is no 'favourable condition' baseline are summarised below (the 'Process Dynamics' attribute, should only be included for active process features):

Attribute	**Target**
Physical Attributes	No part of the feature has been damaged, moved or removed (except by *natural* processes on a *temporary* basis, through *acceptable consented activities*, or as part of the natural evolution of *active process indicators*) since the time of an appropriate *baseline*.
Visibility	No part of the feature has been partially or wholly covered or otherwise been made inaccessible for viewing (except by natural processes on a temporary basis, or through *acceptable consented activities*) since the time of an appropriate *baseline*.
Process Dynamics	The essential natural processes on which the citation is based, and/or the natural processes forming the essential *active process indicators* on which the citation is based are not further constrained (except through *acceptable consented activities*) than they were at the time of an appropriate *baseline*.

Negative Indicators	*All of the above targets are met and there are no activities or changes in the vicinity of the site that might in the future affect one or more of the above attributes. (Management should be reviewed if current management will not protect the site from the perceived threats.)*

7.3.5. If a **condition assessment** target fails, then the feature should be recorded either as 'destroyed' or 'unfavourable' (e.g. 'unfavourable – no change', 'unfavourable – declining', 'unfavourable – recovering' as applicable) (see section 8 below).

7.3.6. In all cases, if site condition is improved significantly, for example through an active management programme, the SCM baseline can be 'updated' if this is considered appropriate. The baseline will also require up-dating if the site is partially destroyed (see section 8.3).

7.4 *Acceptable natural temporary variations from the monitoring baseline condition*

7.4.1. Temporary loss of Physical Attributes or decrease in Visibility, compared to the favourable condition baseline, is acceptable in instances where obscuring or removal of part of the feature occurs *naturally* and is known (or reasonably believed) to be temporary or periodic (e.g. seasonal). In such cases, the original baseline state must be considered highly likely to reoccur with no need for management intervention. Some examples of this are given below.

7.4.2. Temporary removal of physical attributes

- Natural destruction of active landforms which form part of the notified interest feature in an active geomorphological site (e.g. river bars during periods of flood, or parts of a dune system during winter storms) is acceptable if the process dynamics of the site are considered capable of recreating such landforms (see also 8.2 below).

7.4.3. Temporary decrease in visibility of feature (temporary obscuring of feature)

- Seasonal vegetation. Vegetation (e.g. bracken and giant hogweed) may partly obscure the feature during part of the year (e.g. summer/autumn) but if it is not for the whole year it is considered to be temporary and acceptable, as long as the overall area affected by the vegetation has not increased since the baseline. Although if the opportunity for management intervention to clear such vegetation exists it should be welcomed (and the baseline may then be re-set as appropriate).
- Flooding. Flooding of quarries, rivers or other water bodies may obscure outcrop or landforms; but it is considered temporary if it is seasonal or dependent on rainfall and the outcrop/landform is not obscured more than ~50% of the time.
- Tidal levels. Many coastal sites include inter-tidal outcrop which is obscured at high tide or in some cases obscured except at very low spring tide. Obscuring by tide is considered temporary and acceptable (and was almost certainly the condition of the site at the time of notification) unless sea-level rise makes parts of the feature completely inaccessible.
- Weather. Some landforms may not be visible from specified 'view points' in bad weather, particularly fog; but this is clearly temporary.
- Variations in sand volume on a beach/shore. This may be seasonal, or weather dependent and highly unpredictable; but variations in sand volume are natural and are usually considered to be temporary and acceptable.
- Variations in sea-weed cover on coastal outcrops. Also highly unpredictable but variable, so changes to higher coverage by sea-weed are usually considered temporary and acceptable.

7.4.4. Some of these possible variations may be obviously applicable to a site and could/may be included in the targets from the outset, for example 'visibility of outcrops is tide-dependent' or 'natural variation in sea-weed cover on outcrops is acceptable'. In some cases a recommendation

of when is best to monitor the site (e.g. 'winter' or 'low tide') may also be worth specifying in the Management Note.

7.4.5. Other changes affecting the feature, unless they are clearly natural, temporary and will reverse with no management intervention, are likely to be significant. If such changes are also detrimental (e.g. decreasing rather than increasing the visibility or damaging physical attributes) they will result in one or more of the condition assessment Attribute targets not being met and the feature being assessed as not in favourable condition. Note that the Negative Indicators management review Attribute target will also not be met, prompting a review of the management.

7.4.6. If any change is foreseen at a site which might be seen as temporary but which is known not to be, this may be included in a relevant attribute target for clarity (e.g. 'tipping of golf course waste onto the foreshore at X is unacceptable as it will not be washed away by the sea, because X is above high tide mark').

7.5 *Acceptable consented activities*

7.5.1. *Acceptable consented activities* that will not cause a target to not be met, are those that have been consented by SNH and for which the remaining portion of the feature fulfils the 'no baseline' attribute target (i.e. The essential physical manifestations of the feature, on which the citation is based, continue to be present, intact and appropriately visible, and the essential natural processes on which the citation is based, and/or the natural processes forming the essential active process indicators on which the citation is based continue to operate).

7.5.2. Non-critical parts of Earth Science sites are frequently lost through consented activities for unavoidable reasons (e.g. protecting dwelling houses from coastal erosions, stabilising roads). However, the granting of consent for any activity that has had a detrimental impact on Earth science features should have involved a process very similar to that employed when considering 'partially destroyed' features (see section 8.3), or that employed when making an initial assessment for a 'favourable baseline' condition, with appropriate assessment of the scientific value of the 'remaining' area of the site against the 'no baseline' Attribute targets.

7.5.3. Therefore, consented loss or modification to Earth science features in SSSIs, since the time of the baseline, is *usually* considered acceptable. However, if there is any doubt about the appropriateness of a given consent when a site is monitored, this should be followed up (by consultation with the SNH Earth scientists and other experts if required) and it may be considered more appropriate to record the site as 'partially destroyed' (e.g. if the consented activities has proved more damaging than was anticipated, including where new scientific research has revealed that the 'lost' part of the site was more important to the designated interest than was previously thought).

7.6 *Natural evolution of active process indicators*

7.6.1. Active process indicators are landforms and other physical characteristics which are evolving under the current natural process regime. These are usually mentioned on the citation in broad terms such as 'beach-dune system including blow-outs' or 'active meandering river channel'; so the exact form of these indicators may vary while still fulfilling the conditions of the citation. However, when a 'favourable condition' baseline is used, this variability will be lost unless it is included specifically within the 'Physical Attributes' target. Therefore, 'except as part of the natural evolution of active process indicators' is now included in the Physical Attributes target where a baseline is being used.

7.6.2 The natural evolution of active process indicators is anything that does not result from direct human activities on the site, or immediately adjacent to it. Therefore, for example, flood or storm 'damage' is acceptable. Climate change, while exacerbated by human activity, is also a natural process; so changes to active process indicators resulting from climate change related phenomena

(e.g. increases in storminess or rising sea-levels) are also acceptable if they affect only the active process indicators and NOT the occurrence of the active processes (e.g. lack of freezing conditions in winter will result in the freeze-thaw process not occurring. This would be recorded as 'target not met' for the Process Dynamics target. This is different to rising sea level causing erosion of a dune edge, which would be assessed as 'target met' for the Physical Attributes target).

7.6 *Summary of Attributes and Targets*

Reporting Category	Attribute	Target	Target result affects
All	**Physical Attribute**	**If there is NO 'favourable condition' baseline:** The essential physical manifestations of the feature, on which the citation is based, continue to be present and intact; **If there is an appropriate 'favourable condition' baseline:** No part of the feature has been damaged, moved or removed (except by natural processes on a *temporary*[+] basis, through *acceptable consented activities*[++], or as part of the natural evolution of *active process indicators*[+++]) since the time of an appropriate *baseline*[++++]. *(State baseline survey in full. For Site Docs state report number, and year and month of site visit.)*	**Site condition assessment**
All	**Visibility**	**If there is NO 'favourable condition' baseline:** The essential physical manifestations of the feature on which the citation is based are still visible in close and distant views as appropriate (including views appropriate for research and study access). **If there is an appropriate 'favourable condition' baseline:** No part of the feature has been partially or wholly covered or otherwise been made inaccessible for viewing (except by natural processes on a *temporary*[+] basis, or through *acceptable consented activities*[++]) since the time of an appropriate *baseline*[++++]. *(State baseline survey in full. For Site Docs state report number, and year and month of site visit.)*	**Site condition assessment**
Coastal Geomorphology of Scotland; Fluvial Geomorphology of Scotland; Karst; Caves; (with some exceptions)	**Process Dynamics**	**If there is NO 'favourable condition' baseline:** The essential natural processes on which the citation is based, and/or the natural processes forming the essential *active process indicators*[+++] on which the citation is based continue to operate without constraint. **If there is an appropriate 'favourable condition' baseline:** The essential natural processes on which the citation is based, and/or the natural processes forming the essential *active process indicators*[+++] on which the citation is based are not further constrained (except through *acceptable consented activities*[++]) than they were at the time of an appropriate *baseline*[++++]. *(State baseline survey in full. For Site Docs state report number, and year and month of site visit.)*	**Site condition assessment**
All	***Negative Indicators***	*All of the above targets are met and there are no activities or changes in the vicinity of the site that might in the future affect one or more of the above attributes. (Management should be reviewed if current management will not protect the site from the perceived threats.)*	***Decision to review management***

[+] section 7.4 [++] section 7.5 [+++] section 7.6 [++++] section 7.3

CONDITION ASSESSMENT

8.1 ***'Physical Attributes' and 'Visibility' attribute***

8.1.1. In all cases, a feature will be in 'unfavourable condition' if the 'Physical Attributes' or 'Visibility' target (or both) is not met. Using a 'favourable condition' baseline approach as outlined above (section 7) will mean that in most cases the feature will be considered to be in 'favourable condition' only if there is no deterioration in Physical Attributes and Visibility, or if deterioration in Physical Attributes and Visibility is natural and either fluctuating (e.g. seasonal) or will otherwise reverse without any management intervention.

8.1.2. Where deterioration in Physical Attributes or Visibility requires active management intervention to return the site to its baseline condition, the site will be in 'unfavourable' condition. If the condition of the feature will deteriorate further if left (e.g. vegetation growth will increasingly obscure the feature; or further dumping of material may occur), then it should be assessed as 'Unfavourable – declining'. If no further deterioration of the feature is expected to occur (e.g. storage of materials against a rock face), then the feature should be assessed as 'Unfavourable – No change'. If management measures to reverse the deterioration have begun, the site may be considered to be in 'unfavourable – recovering' condition. Where deterioration in Physical Attributes or Visibility is irreversible, the site will be considered to be 'partially destroyed' or 'totally destroyed' (see 8.3 below)

8.2 ***'Process Dynamics' attribute (active geomorphological process sites)***

8.2.1 Any feature for which the 'Process Dynamics' attribute is included (i.e. any active process geomorphological feature) will be in 'unfavourable' condition if the target for the Process Dynamics feature is not met. This will usually mean that the feature is in unfavourable condition if anything has occurred to disrupt the natural active processes within the site since the time of the baseline. Things that disrupt the natural processes of the site are usually human activities such as installation of coastal or river defences, tipping or dumping of material into the river or onto the foreshore, dredging, gravel and sand extraction, vehicle tracking that has exacerbated erosion, damming of a watercourse, installation of weirs or bunds, stabilisation of loose material (e.g. sand, or eroding river bank), and changes in livestock levels.

8.2.2 If disruption of natural processes has occurred, and it is <u>certain</u> that the continued action of natural processes within the site will remove all trace of the disruption over time, then the site is in 'unfavourable – recovering' condition. Expert opinion may need to be called on to make a judgement as to whether disruption will be removed naturally; however, if traces of the disruption are already starting to heal, then it may be reasonable to assess the feature as 'unfavourable – recovering'. Examples where damage may be reversible naturally are dredging in a very active river channel, tipping of soil/grass clipping into river that is easily capable of transporting soil particles.

8.2.3. If the damage is very recent, then it may be harder to assess whether it is naturally reversible and it may not be appropriate to apply an 'unfavourable – recovering' assessment. In such cases a precautionary assessment of 'unfavourable –no change' may be more appropriate; or assessment deferred until a second visit can be made at a later date when it may be more apparent if recovery will occur naturally.

8.2.3 If trace of the disruption to the natural processes of the site cannot be removed through continued action of the natural processes, but can be removed by management intervention, then the feature will be in 'unfavourable – no change' or 'unfavourable – declining' condition. 'Unfavourable-declining' will apply where the impact of the disruption is still ongoing, so the full impact is as yet unknown (e.g. the downstream erosion impact of new river defences, or the extent of blow-out resulting from sand extraction from a dune system).

8.2.4. Where the cause of the disruption of the natural processes cannot practically be removed (naturally or through management intervention), so that the natural processes of the site are permanently constrained, the feature will be either 'partially destroyed' or 'totally destroyed' (see section 8.3 below).

8.2.5. Note that active process sites may be damaged by activities outside the confines of the sites (e.g. through upstream changes that affect water discharges or sediment inputs). This may or may not lead to the site being recorded as in 'unfavourable' condition, depending on how obvious the effects of the disruption are within the site. If appropriate management measures outside the site are possible in these circumstances, then they should be welcomed.

8.3 *Partially destroyed*

8.3.1 If a site is recorded as 'unfavourable' and the factors/damage which make it 'unfavourable' are irreversible, but the remaining portion of the feature fulfils the 'no baseline' attribute target (i.e. The essential physical manifestations of the feature, on which the citation is based, continue to be present, intact and appropriately visible, and the essential natural processes on which the citation is based, and/or the natural processes forming the essential active process indicators on which the citation is based continue to operate), then the site should be recorded as 'partially destroyed'.

8.3.2 In cases of partial destruction, the feature should be recorded as 'partially destroyed', and a 'Loss and damage' form will need to be completed. An *expert* assessment must then be made as to whether the remaining part(s) of the interest feature are sufficient to maintain the scientific interest as stated in the citation. If they are, then the feature should be monitored during the next SCM cycle using a revised baseline. This will allow the condition of the remaining part(s) of the site to continue to be assessed.

8.3.3 If the remaining parts of the Interest Feature are not considered sufficient to maintain the scientific interest as stated on the citation (i.e. the 'No baseline' targets are met), then the site should be re-assessed as 'totally destroyed' (see section 8.4 below).

8.4 *Totally destroyed*

8.4.1 An interest feature is 'Totally Destroyed' if it has undergone *irreversible detrimental change* to an extent where the 'no baseline' targets are no longer met and the site cannot be restored to a condition where the targets are met. In these cases, the feature should be recorded as 'Totally Destroyed' and the feature should be removed from the SSSI citation.

8.5.1. Expert opinion should always be sought in these cases. A 'Loss and Damage' form will also need to be completed.

8.5 *Unfavourable – recovering*

8.5.1. If a site that is in 'unfavourable' condition shows potential for return to favourable status through natural change, or if site management action has begun to improve the site, then the site would be recorded as 'unfavourable – recovering' Examples include removal of 'hard' coast-protection structures (either through natural erosion or site management action) allowing geomorphological systems to become re-naturalised, and grazing regime changes resulting in landforms being less susceptible to concealment and damage by scrub invasion.

8.5.2. Note that 'Unfavourable – recovering' is classed as 'favourable' condition for SCM reporting.

REPORTING

At a UK level, JNCC will be reporting site condition statistics according the themes ('groups of interest features') given in section 3.5 and Appendix 1. Therefore, at a national level, site condition statistics will also be reported according to these themes.

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APPENDIX 1 – GCR blocks, JNCC & SNH Interest Features list

The list of JNCC 'UK Interest Features' included here is an updated Interest Features list provided by JNCC in December 2003. The list also includes corresponding GCR blocks. SNH Standardised Interest Features are listed beside JNCC's UK Interest Features, and where the two differ, an explanation is included in the 'comments' column. Interest Features NOT relevant to Scotland are shaded grey.

Note on JNCC'S UK Interest Features: The interest features, which combine both SSSI [Britain] and ASSI [Northern Ireland] selection categories for Earth science sites are not the same as the GCR 'block' list – but each GCR block will fall into one interest feature category.

SNH Standardised Interest Feature name	Comment on SNH Standardised Interest Feature name	JNCC's UK Interest Feature name	GCR Blocks (as listed on Site Doc.)
Stratigraphy			
		Neogene	Neogene
		Palaeogene	Palaeogene
Cenomanian-Maastrichtian		Cenomanian-Maastrichtian	Cenomanian–Maastrichtian
		Aptian-Albian	Aptian-Albian
		Berriasian-Barremian	Berriasian-Barremian
		Portlandian-Berriasian	Portlandian-Berriasian
		Wealden	Wealden
Kimmeridgian		Kimmeridgian	Kimmeridgian
Oxfordian		Oxfordian	Oxfordian
Callovian		Callovian	Callovian
Bathonian		Bathonian	Bathonian
Aalenian-Bajocian		Aalenian-Bajocian	Aalenian-Bajocian
Toarcian		Toarcian	Toarcian
Hettangian, Sinemurian, Pliensbachian	As GCR block name	Hettangian-Pliensbachian	Hettangian, Sinemurian, Pliensbachian
		Rhaetian	Rhaetian
Permian-Triassic (red beds)	As GCR block name	Non-marine Permian and Triassic	Permian-Triassic (red beds)
		Marine Permian	Marine Permian
Upper Carboniferous [Namurian (part) - Westphalian]	Name chosen to ensure importance of Namurian rocks on these sites is recognised.	Westphalian (Upper Carb)	Westphalian
		Namurian	Namurian
Lower Carboniferous [Dinantian – Namurian (part)]	Name chosen to ensure importance of Namurian rocks on these sites is recognised.	Dinantian (lower Carboniferous) Scotland; N. Ireland; N. England and N. Wales; Devon and Cornwall; S. England and S. Wales.	Dinantian of Scotland
			Dinantian of northern England and North Wales
			Dinantian of Devon and Cornwall
			Dinantian of southern England and South Wales

Non-Marine Devonian	As GCR block name	Old Red Sandstone	Non-Marine Devonian
			Pridoli
		Marine Devonian	Marine Devonian
		Ludlow	Ludlow
Wenlock		Wenlock	Wenlock
Llandovery		Llandovery	Llandovery
Caradoc-Ashgill		Caradoc-Ashgill	Caradoc-Ashgill
Llandeilo		Llandeilo	Llandeilo
Arenig-Llanvirn	As GCR block name	Tremadoc-Llanvirn	Arenig-Llanvirn
			Tremadoc-Arenig
			Tremadoc
Cambrian	As GCR block names to ensure importance of Tremadoc rocks is still recognised.	Cambrian	Cambrian
Cambrian-Tremadoc			Cambrian-Tremadoc
		Precambrian of England and Wales	Precambrian of England and Wales
		Precambrian Palaeontology of England	Precambrian Palaeontology
Palaeontology			
		Tertiary Reptilia	Tertiary Reptilia
Jurassic-Cretaceous Reptilia		Jurassic-Cretaceous Reptilia	Jurassic-Cretaceous Reptilia
Permian-Triassic Reptilia		Permian-Triassic Reptilia	Permian-Triassic Reptilia
		Tertiary Mammalia	Tertiary Mammalia
Mesozoic Mammalia		Mesozoic Mammalia	Mesozoic Mammalia
Pleistocene Vertebrata		Pleistocene Vertebrata	Pleistocene Vertebrata
		Aves	Aves
Palaeoentomology		Palaeoentomology	Palaeoentomology
Arthropoda (excluding insects and trilobites)		Arthropoda (excluding insects and trilobites)	Arthropoda (excluding insects, ostracods, trilobites and Quaternary arthropods)
Silurian-Devonian Chordata		Silurian-Devonian Chordata	Silurian-Devonian Chordata
Permian/Carboniferous Fish/Amphibia		Permian/Carboniferous Fish/Amphibia	Permian/Carboniferous Fish/Amphibia
		Mesozoic-Tertiary Fish/Amphibia	Mesozoic-Tertiary Fish/Amphibia
Tertiary Palaeobotany		Tertiary Palaeobotany	Tertiary Palaeobotany
Mesozoic Palaeobotany		Mesozoic Palaeobotany	Mesozoic Palaeobotany
Palaeozoic Palaeobotany		Palaeozoic Palaeobotany	Palaeozoic Palaeobotany
Quaternary Geology and Geomorphology			
		Quaternary of Northern Ireland	
		Quaternary of East Anglia	Quaternary of East Anglia
		Quaternary of the Midlands and Avon	Quaternary of the Midlands and Avon
		Quaternary of E. England	Quaternary of eastern England

		Quaternary of north-east England	Quaternary of north-east England
		Quaternary of Cumbria	Quaternary of Cumbria
		Quaternary of the Pennines	Quaternary of the Pennines
		Quaternary of south-east England	Quaternary of south-east England
		Quaternary of south central England	Quaternary of south central England
		Quaternary of South-West England	Quaternary of South-West England
		Quaternary of Somerset	Quaternary of Somerset
		Quaternary of the Thames	Quaternary of the Thames
Quaternary of Scotland		Quaternary of Scotland	Quaternary of Scotland
		Quaternary of Wales	Quaternary of Wales
		Subsumed into Quaternary regions above	Holocene Sea Levels
Quaternary of Scotland		Subsumed into Quaternary regions above	Tufa
		Subsumed into Quaternary regions above	Pollen stratigraphy of England
Geomorphology			
Caves	As GCR block names because of very different monitoring prescriptions.	Karst and Caves	Caves
Karst			Karst
		Coastal geomorphology	Coastal Geomorphology of England
Coastal Geomorphology of Scotland	As GCR block name		Coastal Geomorphology of Scotland
			Coastal geomorphology of Wales
Coastal Geomorphology of Scotland	As above		Saltmarsh morphology
		Fluvial Geomorphology	Fluvial Geomorphology of England
Fluvial Geomorphology of Scotland	As GCR block name		Fluvial Geomorphology of Scotland
			Fluvial Geomorphology of Wales
Mass Movement		Mass Movement	Mass Movement
Igneous Petrology			
Tertiary Igneous	As GCR block name	Tertiary Igneous rocks	Tertiary Igneous
Carboniferous-Permian Igneous	As GCR block name	Carboniferous-Permian Igneous rocks	Carboniferous-Permian Igneous
Old Red Sandstone Igneous	As GCR block name	ORS Igneous rocks	Old Red Sandstone Igneous
Ordovician Igneous	As GCR block name	Ordovician Igneous rocks	Ordovician Igneous

Caledonian Igneous	As GCR block name	Caledonian Igneous rocks	Caledonian Igneous
		South-West England Igneous rocks	South-West England igneous
Structural and Metamorphic Geology			
Moine		Moine	Moine
Torridonian		Torridonian	Torridonian
Lewisian		Lewisian	Lewisian
Dalradian		Dalradian	Dalradian
		Post Variscan Structures	Alpine Structures of southern England
		Variscan Structures	Variscan Structures of South-West England
			Variscan Structures of South Wales and the Mendips
	NOT as GCR block names because originally the 'Caledonian Structures of Shetland' block did not exist (added 2016) but two sites were still in Shetland.	Caledonian Structures	Caledonian Structures of the Lake District
Caledonian Structures			Caledonian Structures of Shetland
			Caledonian Structures of the Southern Uplands
			Caledonian Structures of Wales
Mineralogy			
		Mineralogy	Mineralogy of the Lake District
			Mineralogy of the Pennines
			Mineralogy of the Mendips
			Mineralogy of the Peak District/ Leicestershire/ Cheshire/Shropshire
			Mineralogy of South-West England
			Mineralogy of Wales
Mineralogy of Scotland	As GCR block name		Mineralogy of Scotland

APPENDIX 2 – examples of manifestation of interest features

Manifestations of interest features at Earth science sites

This list (from the JNCC interagency guidance) is not intended to be exhaustive but merely to indicate the kinds of entities that led to a site qualifying for an interest feature and therefore as an SSSI or ASSI. For example, the site Compton Bay on the Isle of Wight qualifies for the Cenomanian–Maastrichtian Interest Feature because it displays a continuous succession through the different rock horizons ('members') of the Grey Chalk subgroup; someone monitoring the site need not necessarily know what this means, because they will be concerned with the continuity, quality of and amount of exposure of the rock 'face' between two grid reference points. However, it is important to note here that not all manifestations which come under the heading of 'exposure of a sequence of rock units' can be defined as exposure between two grid reference points. For example, the geo interest of an SSSI described as 'exposure of a sequence of rock units' may consist a number of scattered outcrops across a hillside.

- exposure of a sequence of rock/sediment units (i.e. several lithological units in continuity)
- exposure of rock body (e.g. -igneous sill, igneous dyke, volcanic neck)
- exposure of specific 'horizon' in a rock/sediment succession (e.g. lithological unit, change in rock type or fossiliferous layer)
- exposure of a junction or boundary between rock/sediment bodies (unconformity; igneous contact; contact metamorphism
- exposure of rock body/layer/ veins potentially bearing fossils or minerals
- exposure of rock body/layer/ veins actually containing minerals/fossils (excluding 'cave mineral deposits' below)
- buried rock body containing rare or unusual mineral/fossil material (*where burial is part of the conservation management of the site)*
- presence of specific mineral or fossil not *in situ* (loose/within boulders, slag heap etc)
- exposure of sedimentary structures (sole marks, cross bedding; ripples etc.)
- exposure of deformation structures (folding; faulting; cleavage)
- exposure of visible/large/visually spectacular fossils (e.g. tree stumps; footprints)
- active landslip landform
- relict landslip landform
- glacial (including glacio-fluvial) interglacial and/or periglacial landforms/morphological features (deposits or erosional features e.g. moraine, drumlins, isostatic/eustatic features - raised beaches, striations, róche moutonnée, crag and tail, patterned ground)
- soft sediment containing buried, but excavatable, important 'fossil' material/information' (e.g. bog sites)
- cave chamber or passage
- cave choking/collapse feature;
- cave mineral deposits [speleothem; tufa]
- cave sediments, fossiliferous cave deposit Is it important to distinguish 'cave' deposits from other deposits? (Carboniferous 'lagoonal ' and river' deposits are not, for example differentiated. Could 'cave sediment' not come under 'exposure of a sequence of rock/sediment units (i.e. several lithological units in continuity)' or 'soft sediment containing buried, but excavatable, important 'fossil' material/information' (see 'Quaternary bog') as appropriate to whether cave sediments buried or exposed. Similarly fossiliferous cave deposits could be included in other categories.
- chalk/limestone drainage feature; active solutional processes, relict solutional processes]
- karst landform [doline, karst valley, dry valley; gorge; limestone pavement; scar]
- active coastal erosion/deposition landform assemblage: shingle structures; beach complexes; spits, dunes, soft cliffs; hard-rock cliffs; beach complexes, machair
- relict coastal erosion/deposition landforms (including 'fossil' shingle structures, spits; beaches; machair; raised wave-cut notches or wave cut platforms)
- saltmarsh
- active fluvial landforms [erosion/deposition characteristics] (e.g. active bars, meanders, gorges, waterfalls, levees) and/or fluvial process characteristics (e.g. river bed form (potholes; rocky, gravely or muddy character), river 'load' type and quantity) and/ or river channel and floodplain change characteristics (e.g. rejuvenation evidence, storm surge deposition, ox-bow lakes)
- relict fluvial landforms [not part of a currently active fluvial system: relict erosion/deposition characteristics e.g. terraces, relict river channels, river capture evidence].

APPENDIX 3 – The Earth Science Conservation Classification

A3.1 In the Earth sciences, it is not helpful to give general guidance on conservation objectives *directly* for Earth science interest features. This is because sites of different physical type (that have very different threats and management needs) can be selected for the same interest feature. For example, it is not possible to give guidance on conservation objectives for the conservation of the 'Marine Permian Stratigraphy JNCC Interest Feature' in itself that has real practical use. Any attempt to draw up general guidance on setting conservation objectives for this interest feature directly would be littered with exceptions to the general rules, to cope with the different conservation strategies associated with disused quarries, coastal cliffs, foreshore exposure etc.

A3.2 Nevertheless, it is possible to develop a framework for setting conservation objectives by classifying *sites of a similar physical type*. For example, it is possible to produce general guidance (without immediate reference to the interest feature) for conservation objectives of an important body of rock in a *disused quarry* (e.g. concerning extent of rock exposure and degree of concealment by vegetation), and different guidance for exposures of rock on a *foreshore*. A useful classification of site by physical types was devised by NCC (NCC, 1990), called the 'Earth Science Conservation Classification' (ESCC – see 5.8 below for a list of ESCC categories) It is recognised that this classification will need to be amended in the future, so that each category better fits its association with monitoring work. One round of modification was confirmed in October 2004 and the ammendments relating to this are incorporated in the following text. The main modifications were the division of 'intergrity sites' into 'intergrity sites' and 'finite sites'; re-naming 'exposure sites' as 'exposure or extensive sites'; and re-introduciton of 'buried sites' catagories.

A3.3 Sites may fall into more than one ESCC category. For example, an active quarry site containing an extensive stratigraphical interest would lie in the 'Active Quarries and Pits' ESCC category, but localized mineral veins within the same site would be classified as 'finite mineral or fossil or other geological site'. Conservation objectives for the stratigraphical and mineralogical interests would be different: whereas removal of rock would be unlikely to damage the stratigraphical interest (as more equivalent rock material should be uncovered), removal of mineral vein material could result in partial or complete loss of mineralogical features of interest. Another example of a multi-ESCC site might be a large site with a Structural and Metamorphic interest which may include areas of coastal cliff and also areas of inland outcrop and a disused quarry.

A3.4 For Earth science features in SSSIs in Scotland, ESCC categories for all the relevant GCR sites can be found on the GCR Sites spreadsheet (a57434).

A3.5 ***'Integrity Sites', 'Finite Sites, and 'Exposure or Extensive sites'***

In the ESCC, categories can be placed into three main groups – 'Integrity Sites', 'Finite sites' and 'Exposure or Extensive Sites', described below, although as indicated above (A3.3) it is recognized that in a single 'exposure or extensive site' there may be localised areas that are of a 'finite site' nature, for which the ESCC category 'finite mineral or fossil or other geological site' will apply.

5.5.1 **Integrity sites** are sites where inappropriate interference with one part of the site may damage or destroy the integrity of the entire site. Examples are active process geomorphological sites such as rivers and coasts where the active process system may be disrupted by interference in part of the site; and 'static' geomorphological sites created by processes that are no longer active (e.g. moraines and eskers formed by glaciers and glacial meltwater during the Ice Age) where the spatial and topographic

relationships between individual landforms are frequently important (site integrity) and may be lost if part of the site is damaged or fragmented. Cave and karst systems are also classed as integrity sites and may contain components of both 'active process' and 'static geomorpoholgical' interests.

5.5.2 **Finite sites** are sites which contain a finite amount of the resource which forms the interest feature. 'Finite' may be loosely defined as the entire known resource being contained within the site, or a unique national/international example a feature which is of limited extent. A typical situation is a mineral or fossil sites where the mineral or fossil bearing body of rock is of very limited extent. Other examples include mine dumps, and some buried interest sites such as those containing pollen records.

5.5.3 **Exposure or extensive sites** provide exposures of a rock that are extensive so that removal of rock should uncover more material of the same type. Exposure or extensive sites are numerically the more common type and may include exposures in disused and active quarries, cuttings and pits; exposures in coastal and river cliffs; foreshore exposures; mines and tunnels; inland outcrops and stream sections.

A3.6 The broad conservation principle for these groups of sites is different. 'Integrity sites' and 'Fintie sites' by definition, are finite and irreplaceable. To conserve them a 'protectionism' approach must be adopted, seeking to maintain the physical integrity of the deposits or landforms, with restrictions against detrimental anthropogenic changes. This does not mean, for example, that no specimens can be collected from an 'integrity site' or 'finite site', but there may be a need to monitor and control such usage of the site, depending on the vulnerability of the resource.

A3.7 In contrast, the principle for 'exposure' sites depends on the maintenance of an exposure, the precise location of which is not always critical. Thus, for example, it may be stated that it is acceptable for an outcrop to be lost provided that the amount/quality of exposure is retained or increased. Quarrying may be welcomed under some circumstances because it creates a fresh exposure and progressively reveals new rock surfaces enabling a rock body to be analysed in three dimensions. Similarly, marine erosion is often vital in creating fresh exposure, particularly in softer rock formations. Conversely, maintaining a high quality exposure of soft sediments by regular manual cutting of 'faces' may lead to unnecessary erosion or removal of the important material.

A3.8 The consideration of the nature of the locality as an 'integrity site', 'finite site' or 'exposure site' helps define the fundamental conservation objective: to protect the resource or maintain the exposure.

Original JNCC Classification		Old SNH code	Revised Classification	
Integrity Sites			**Integrity Sites**	
Static/relict geomorphological sites	IS	T3	Static (fossil) geomorphological sites	IS
Active process geomorphological sites	IA	T1	Active process geomorphological sites	IA
Caves and Karst	IC	T2	Caves	IC
			Karst	IK
			Finite Sites	
Unique mineral, fossil or other geological site	IM	T4	Finite mineral, fossil or other geological sites	FM
			Underground mines and tunnels	FU
		T6	Buried interest	FB
Mine dumps	ID	T5	Mine dumps	FD
Exposure Sites			**Exposure or Extensive sites**	

Mines and tunnels	EM	E2	Underground mines and tunnels	EU
Inland outcrops and stream sections	EO	E3	Inland outcrops and stream sections	EO
			Road, rail and canal cuttings	ER
Foreshore exposures	EF	E4	Coastal cliffs and foreshore	EC
Coastal and river cliffs	EC	E5		
			River cliffs	EW
Active quarries and pits	EA	E6	Active quarries and pits	EA
Disused quarries, pits and cuttings	ED	E7	Disused quarries and pits	ED
		E1	Buried interest	EB

A3.9 ***Buried sites and site burial***

5.9.1 If a site has important geological characteristics of limited extent ('integrity site') and they are considered to be vulnerable, a conservation strategy of *deliberate burial* or allowing talus to build up to protect the features, may be applied. The sites will usually be those that were once in the ESCC category 'finite mineral, fossil or other geological site', but where the extent of the resource has reached critically low levels and needs stronger protection measures. In this situation the conservation objective will be that *the features remain concealed by the protective cover but are accessible through excavation* and that the cover is not removed or disturbed without consent. Retaining the potential of the site is the key requirement for favourable status – the burial must not be irreversible. 'Unfavourable' conditions might include irresponsible excavation of the material, failure to re-bury the site after excavation, excess accumulation of natural cover to the point where re-excavation is virtually impossible (e.g. covered by a slump or rock fall); permanent developments above the buried material.

5.9.2 General guidance on setting conservation objectives for buried sites can be accounted for elsewhere – particularly under the 'finite mineral, fossil or other geological site' ESCC category. This is because the original ESCC did not include categories for buried sites and JNCC has not yet produced specific guidance for them.

5.9.3 If the scientifically important parts of an '*exposure* site' become buried, then by definition the site will generally not be in favourable condition, but a defined degree of cover can usually be tolerated, particularly if in non-critical parts of the site, and if cover is relatively easily excavatable and/or ephemeral, for example, if the cover can be removed using hand tools in less than one man-day (see also 'Threats - Neglect and site degradation' section 4.7).

A3.10 [The ordering of categories in the list in 5.8 above indicates broadly the continuum from 'Integrity' to 'Finite' to 'Exposure or Extensive' sites. Evidence available so far confirms the supposition that 'integrity sites' and 'finite sites' are more sensitive to change/vulnerable in comparison with 'exposure or extensive sites', and generally are likely to constitute higher monitoring priority.

A3.11 By combining the two systems of categorising Earth science sites – interest feature and ESCC site type, patterns of conservation rationales become apparent (e.g. all stratigraphy interest features in disused quarry sites, all palaeontology interest features river cliff exposure sites etc.). It is this combination of the two systems that is fundamental to deriving a uniform approach in monitoring sites for different interest features, since knowledge of the 'integrity', 'finite' or 'exposure/extensive' nature of the site, coupled with its ESCC type and the interest feature, directs the monitor to the relevant attributes, factors and conservation objectives for a site.

A3.12 The ESCC is used [by JNCC] as the basis of the common standards for setting conservation objectives, and monitoring guidance for each category (of the ESCC prior to October 2004 revisions) is discussed below in section 16 (Appendix 3).

APPENDIX 4 – examples of completed CMFs (with SATs)

The following are examples of completed CMFs. The monitoring visits and site conditions are real, but the information has been transferred to the most recent CMF (version 12) and the form of the SAT and reporting updated in accordance with the guidance within this document. The sites are:

- **Black Loch (Abdie) SSSI**, in Fife, - **Quaternary of Scotland** - is a site notified for its buried pollen stratigraphy, which occurs in a small lochan, now used for fishing, and surrounding marshy area. There have been problems in the past (prior to baseline) with one owner dredging part of the lochan and there is a notice of consent for some farm activities including dumping in specified small areas.
- **Benbeoch SSSI**, in East Ayrshire, - **Carboniferous-Permian Igneous** - is notified for exposure of the Carboniferous-Permian age 'Benbeoch sill' – a roughly horizontal sheet of formerly molten rock intruded into the surrounding coal-bearing sediments. The site is surrounded by and partly lies in open cast coal workings. Since the baseline (time of Site Doc. visit) mining activities have exposed an important new rock face.
- **Dunnet Links SSSI**, in Caithness, - **Coastal Geomorphology of Scotland** – is notified for its beach, dunes cut by rivers and blow-outs, and the extensive links/machair behind. In the past (pre-baseline), sand has been extracted from part of the dune system and debris dumped in the area of extraction. Measures to stabilise the largest blow-out have also been on-going since 1981 as the sand from this blow-out has caused problems on the road which cuts through the site. There are various paths and tracks through the dunes to the shore and the area is used for recreation. Some vehicle tracking was noted at the time of the baseline survey (Site Doc. visit in 1996).
- **River Clyde Meanders**, in South Lanarkshire, - **Fluvial Geomorphology of Scotland** – is notified as a nationally important example of an actively meandering upland river system. The site encompasses a section of the River Clyde and part of one of its tributaries, the Medwin Water as well as old, abandoned river channels. River defense works were constructed in the site in the 1930's. The Site Doc. used as a baseline (Site Doc. 297, 2001) contains a site map and written description of the site condition and history, but no photographs. Therefore some qualified decision was required in distinguishing 'old' damage from 'new /ongoing' damage, and photos were taken on the SCM visit with a view to their supplementation of the written/mapped baseline description.

17.1 Example 1: Black Loch (Abdie) SSSI CMF

Version 12

Condition Monitoring Form	Date signed off in Area:	
	Initials:	

Site Name:	Black Loch (Abdie)	MIDAS Site Code:	S213
Designation: (SSSI/SAC/SPA/Ramsar)*	SSSI	SNH Area:	Forth and Borders
Name of SNH staff member completing form/assessment**:	Rachel Robson	Date form completed:	27/08/02

*Only report on SSSI and SAC/SPA/Ramsar features on one form if there is only one SSSI making up the Natura site. Where this is the case, please provide the name and site code for the Natura site as well as the SSSI.

**We need the name of the SNH staff member who completed the form or approved the form that was drafted by someone else eg a contractor. The person named should be the staff member who would deal with any queries on how the form has been completed/the condition assessment of the features.

For each of the features reported on this form, please list the following information:

Names of features reported on here[1]	Issue date of guidance used/date received draft from advisor[2]	Date of Monitoring visit[3]	Name of surveyor(s)	SNH staff/ National contractor/Local contractor/Other (specify)[4]	Approx time taken by SNH Area staff to monitor feature (in hours)[5]	Estimate of costs from Area Contracts to monitor feature
1.1 Quaternary geology and geomorphology	October 2004	20/08/02	Rachel Robson	SNH staff (ESG)	4.5	

[1] Please ensure that the name of the feature being reported on matches that in the notified features spreadsheets/MIDAS. If you have any queries on the appropriateness of the feature name then please raise them with DASU before completing the form.

[2] It is sometimes difficult to tell which version of guidance has been used to assess features. Recording the issue date of the guidance (found in the footer of the guidance documents) will assist with this. If the assessment was done using a draft of guidance sent to you by an advisor please give us the date when you received the draft guidance from them. Please note that you should use the version of the guidance that was current at the time the feature was monitored to complete the assessment of the feature.

[3] The visit date allows us to know on what date a feature was in a particular condition. Please provide an exact date of visit wherever possible, or at the very least the month and year of a visit. For features that were monitored over a range of dates, please provide the range of dates, ensuring that you do provide the last date on which the feature was monitored in that period.

[4] Please provide the name and address of any local contractors or contacts for external data eg name and address of local RSPB staff.

[5] The estimate of time taken to monitor features should include time taken by Area staff to complete any of the following tasks: produce SATs/ arrange access/ monitor the feature/ complete the CMF. Estimates should therefore be given for features monitored by Area staff and those monitored under national contracts. An estimate of cost per feature is only needed for features covered by local contracts.

1. COMPLETE ANY OF THE FOLLOWING BOXES (A AND/OR B) WHICH APPLY:

A. **Visit details** (where data derived from visit)

Person(s) contacted:	Own./Occup./Other
[Data removed from example form to comply with Data Protection]	Own
[Data removed from example form to comply with Data Protection]	Own
[Data removed from example form to comply with Data Protection]	Own
If no-one contacted, give reason:	

B. **Survey details** (where data derived from specialist survey or monitoring project)

Survey/project title:			
Organisation:		File Reference:	
Authors:		Pub. Date	
Additional details		Visit date/s for survey	

2. SITE ATTRIBUTE TABLE AND RESULT OF MONITORING

- Please copy and paste information from the relevant Site Attribute Table into the shaded columns. Only copy the information for those features that have been monitored and that you wish to report on here (this replaces the need to submit SATs with this form and keeps all relevant information in one place).
- Please make sure all mandatory targets have been entered into the SAT, have been monitored and inform the condition assessment.
- Please ensure the prescription entered is the method by which the target was actually assessed. For example, do not say aerial photography at 6 yearly intervals if aerial photographs were not used or aerial photographs are not likely to be taken every 6 years.
- Fill in the result of monitoring and whether or not the target has been met.
- Please include the actual result of monitoring eg % of herbs, height of vegetation under 'Result of monitoring' and not just whether the target has been met.
- Notes to describe the current state should be put in section 6.
- Make a note if the conditions or timing of the visit were not conducive to accurate monitoring eg too late in season.
- Identify maps prepared or photos taken related to monitoring.
- Only report against one set of targets for SSSI and Natura features if there is one SSSI making up the Natura site and the features have the same boundary/population. Please indicate the relevant designations in the interest level eg SSSI/SAC if both features are covered by one set of targets.

Site	Reporting Category	Interest Feature	Interest level	Attribute	Target	Prescription	Result of Monitoring	Target met? (Y/N)
Black Loch (Abdie)	1. Quaternary geology and geomorphology	1.1 **Quaternary of Scotland**: Detailed pollen record and radiocarbon dates in cores give Late-glacial (13,000 BP) and later floral evolution in North Fife. Key reference site for vegetation history of eastern Scotland.	SSSI	1.1.1 **Physical attributes**: extent, composition, structure	1.1.1 Maintain the extent, composition, and structure of the buried sediments as detailed in SNH Earth Science Site Documentation report 572 (excepting the minor disturbances which might be caused by consented research). N.B. Further dredging will render the site 'Partially destroyed'.	1.1.1 Site visit and fixed point photographs, every 6 years.	The target is met. No sign of further sediment disturbance since 1989/1990 dredging. (photos, including new view points on film 0203_18)	Y
Black Loch (Abdie)	1. Quaternary geology and geomorphology	1.1 **Quaternary of Scotland** (as detailed above)	SSSI	1.1.2 **Visibility**	1.1.2 The sediment of interest at the site is buried (i.e. not visible - see SNH Earth Science Site Documentation report 572) and this is acceptable. However it must be accessible for study as documented in Science Site Documentation report 572, e.g. it must be possible to sample to sediment by coring (as part of consented research).	1.1.2 Site visit and fixed point photographs, every 6 years.	Recent dumping of earth has occurred in the area marked 'A' on the 'Notice of Consent Form' map. Recent dumping extends beyond the old boundary of dumping by about 1m. Sediment now beneath the dumped material is now no longer available for study (e.g. by coring) as documented in Science Site Documentation report 572. The target is not met.	N
Black Loch (Abdie)	*1. Quaternary geology and geomorphology*	*1.1 **Quaternary of Scotland** (as detailed above)*	*SSSI*	*1.1.3 Negative indicators*	*1.1.3 There should be no dredging; no unconsented tipping/dumping or tree-planting; no unconsented construction of permanent or temporary structures;*	*1.1.3 Site visit and fixed point photographs, every 6 years.*	*Recent dumping of earth has occurred in the area marked 'A' on the 'Notice of Consent Form' map. Recent dumping extends beyond the old boundary of dumping by about 1m. The owner*	*N*

					or any other changes in or around the site which might adversely affect the feature, now or in the future.		*says '3 more loads' of earth are still to be dumped at this site. This further dumping will obscure 'visibility' of the feature further. The target is not met*	
Black Loch (Abdie)	2. Standing open water and canals	2.1 **Mesotrophic loch**: Small mesotrophic loch.	SSSI					
Black Loch (Abdie)	3. Fen, marsh and swamp	3.1 **Transition mire**: Broad freshwater transition mire.	SSSI					

3. CONDITION ASSESSMENT

- Put a cross in one box only for each feature (unless partially destroyed).
  - If a feature is partially destroyed, enter the area (in hectares) of the feature that has been destroyed against 'partially destroyed' and then make a condition assessment for the remainder of the feature, excluding the destroyed part, and put a cross against the appropriate condition assessment box for the part of the feature that remains.

		Feature Number							
		1.1							
Favourable	Maintained								
	Recovered								
Unfavourable	Recovering								
	No change								
	Declining	X							
Destroyed	Partially destroyed (Area in hectares)								
	Totally destroyed								

4. ACTIVITY ASSESSMENT

For all features, which of the following types of activity or event are having a positive or negative effect on the condition of the feature?

- Identify **no more than three positive (+) and three negative (-) activities (on or off the site)** affecting each feature, by putting a +/- in the box.

	Feature Number							
	1.1							
1. Agricultural operations (e.g. level of/changes in: ploughing, fertiliser, pesticides)								
2. Grazing (including deer browsing)* *If negative effect is it: overgrazing/undergrazing (delete as appropriate)								
3. Burning (presence/absence/methods and changes in these)								
4. Game or fisheries management (e.g. introduction of stock, cutting of river banks, bait digging)								
5. Water management (including nature of/changes to: drainage, dredging, water table).								
6. Water quality – direct or diffuse inputs (including level of/changes to: sediment load, chemical content, run-off volume, nutrient content)								
7. Forestry operations (including level of/changes in: intensity, distribution, methods)								
8. Recreation / disturbance (including scrambling, off road vehicle use, recreation pressure, disturbance of fauna)								
9. Flood defence or Coastal defence works								
10. Development carried out under planning permission (including roads, Acts of Parliament etc)								
11. Statutory Undertaker (i.e. works carried out by a statutory body which is not required to seek planning permission, including military operations)								
12. Lack of remedial management (e.g. stopping-up drains, scrub cutting, erecting deer fences)								
13. Presence or changing extent of invasive species (including bracken or scrub)								
14. Earth Science feature obscured / eroded (e.g. coastal erosion) / modified (e.g. cave entrances)	-							
15. Dumping / spreading / storage of materials	-							
16. Other (specify)*								

*Other – can include non intervention (active, positive choice or possibly passive, negative effect) or no activities eg for seabirds on cliffs. If you specify either of these options, please explain these choices in the Notes section. For no activities enter a cross against the feature ie you do not need to specify positive/negative.

5. MANAGEMENT MEASURES

For each feature, place a cross in the appropriate box to indicate whether you believe the management measures in place are leading to/maintaining the feature in favourable condition or not. If you believe the measures are not leading to/maintaining the feature in favourable condition, indicate the reason you believe they may not be being successful.

	Measure leading to/maintaining feature in favourable condition								Measure not leading to/maintaining feature in favourable condition															
									The agreed management is inappropriate for the feature								The agreed management is not being applied as agreed							
Feature number ⇒																	**1.1**							
SNH Management Agreement																	X							
SNH Grant																								
Other grant eg HLF, LIFE																								
Scottish Forestry Grant Scheme/Woodland grant scheme																								
Agri-environment scheme eg ESA, RSS																								
Planning condition or agreement																								
Nature Conservation Order/SNCO																								
Capital Tax Exemption																								
Other (including management sympathetic or where existing consents are the only form of agreed management)																								

It is possible for a feature to be in unfavourable condition but all on-site management is appropriate. In these cases, the management may be leading to favourable condition and the feature will be recorded as unfavourable recovering. If it is unfavourable declining or no change then this could be because off site measures are affecting the condition of the feature. If this is what you have indicated in the previous sections and you believe that it is off site measures that may be affecting the condition of the feature eg fish stocks affecting seabird populations or climate change affecting vascular plants, then please put a cross in this box (and explain in the Notes section).

	Feature Number							
	1.1							
Review management? (Y/N) *	Y							

* Your decision whether or not to review management should be explained in section 6.

6. DESCRIPTION OF CONDITION AND NOTES ON MANAGEMENT

The further information provided here should allow someone unfamiliar with the site or coming back to monitor the site again to understand what was seen on the monitoring visit and any impact that activities and management measures are having on feature condition.

You should include information on the following:

- Key aspects about the current state of the feature and the results of monitoring (including information on likely reasons why any particular targets were not met).
- Explanation of any site specific targets chosen.
- Explanation of the selection of trend in the condition assessment.
- Further information to describe the positive or negative activities selected.
- Further information to explain the judgement on management measures and whether or not to review management.

Dumping in area 'A': There has been recent (1-3 weeks or so prior to visit) dumping of earth at the area marked 'A' on the 'Notice of Consent Form'.

So far the earth extends about 1 m beyond the former limit of dumping and the owner says there are 'another 3 loads to go'. Assuming that the 'permitted area of dumping' i.e. area 'A' did not originally include an 'extension zone' (the wording on the Notice of Consent Form is 'Dumping of domestic or agricultural refuse within existing dump areas at A and B'), this dumping is obscuring the feature (sediments beneath the dumped material are no longer available for study e.g. by coring); therefore the site is in unfavourable condition. The site is recorded as 'unfavourable declining' because dumping is apparently ongoing, therefore site condition is getting progressively worse.

The dumping is also a specific Negative Indicator as it is adversely affecting the feature now and will also do so in future if it continues as is anticipated. Therefore management needs to be reviewed.

The area around 'A' which the dumping is extending into has been slightly damaged by dredging already but is still of interest for its remaining, undisturbed, lower sediment layers, which will be inaccessible if they're buried by dumped earth. The extension of dumping, therefore, is directly detrimental to the Earth Science interest. The owner made assurances that the dumping was not going to fill up the basin; but it is considered that progressive 'small amounts' of dumped material continuing to be added indefinitely over the years may cause this to happen.

Some photos of the area 'A' were taken (0203_18_36 & 37) but will almost certainly be out-of-date very rapidly if the owner dumps the previously mentioned '3 more loads'.

A further site visit is advised and consultation with the owner to clarify the terms of consent for dumping in area 'A'. Any further extension of the area of dumping should be avoided/prevented. To return the feature to 'favourable' condition, the dumped material must be removed .

Photographs taken during the site visit (film no. **0203_18**) and corresponding photo captions contain further important information for future monitoring of interest feature 1.1 are/will be available in hard copy and digital format from the SNH area office (Cupar) and in digital format from SNH Earth Science Group (Edinburgh).

Note from AO: This site is managed under a Management Agreement. Under the terms of the agreement dumping is permitted within existing dump areas. A site visit has been arranged to further inspect the work and assess if this new dumping exceeds the ' existing dump' areas identified in the management agreement . CG 21-02-03.

17.2 Example 2: Benbeoch SSSI CMF

Version 12

Condition Monitoring Form	Date signed off in Area:	
	Initials:	

Site Name:	Benbeoch	MIDAS Site Code:	S196
Designation: (SSSI/SAC/SPA/Ramsar)*	SSSI	SNH Area:	Strathclyde and Ayrshire
Name of SNH staff member completing form/assessment**:	Rachel Robson	Date form completed:	08/05/02

*Only report on SSSI and SAC/SPA/Ramsar features on one form if there is only one SSSI making up the Natura site. Where this is the case, please provide the name and site code for the Natura site as well as the SSSI.

**We need the name of the SNH staff member who completed the form or approved the form that was drafted by someone else eg a contractor. The person named should be the staff member who would deal with any queries on how the form has been completed/the condition assessment of the features.

For each of the features reported on this form, please list the following information:

Names of features reported on here[1]	Issue date of guidance used/date received draft from advisor[2]	Date of Monitoring visit[3]	Name of surveyor(s)	SNH staff/ National contractor/Local contractor/Other (specify)[4]	Approx time taken by SNH Area staff to monitor feature (in hours)[5]	Estimate of costs from Area Contracts to monitor feature
Carboniferous-Permian Igneous	October 2004	13/02/02, 07/05/02	Rachel Robson	SNH staff (ESG)	15	

[1] Please ensure that the name of the feature being reported on matches that in the notified features spreadsheets/MIDAS. If you have any queries on the appropriateness of the feature name then please raise them with DASU before completing the form.

[2] It is sometimes difficult to tell which version of guidance has been used to assess features. Recording the issue date of the guidance (found in the footer of the guidance documents) will assist with this. If the assessment was done using a draft of guidance sent to you by an advisor please give us the date when you received the draft guidance from them. Please note that you should use the version of the guidance that was current at the time the feature was monitored to complete the assessment of the feature.

[3] The visit date allows us to know on what date a feature was in a particular condition. Please provide an exact date of visit wherever possible, or at the very least the month and year of a visit. For features that were monitored over a range of dates, please provide the range of dates, ensuring that you do provide the last date on which the feature was monitored in that period.

[4] Please provide the name and address of any local contractors or contacts for external data eg name and address of local RSPB staff.

[5] The estimate of time taken to monitor features should include time taken by Area staff to complete any of the following tasks: produce SATs/ arrange access/ monitor the feature/ complete the CMF. Estimates should therefore be given for features monitored by Area staff and those monitored under national contracts. An estimate of cost per feature is only needed for features covered by local contracts.

1. COMPLETE ANY OF THE FOLLOWING BOXES (A AND/OR B) WHICH APPLY:

A. **Visit details** (where data derived from visit)

Person(s) contacted:	Own./Occup./Other
[Data removed from example form to comply with Data Protection]	Occupier With Mineral Rights
[Data removed from example form to comply with Data Protection]	Occupier
[Data removed from example form to comply with Data Protection]	Owner
[Data removed from example form to comply with Data Protection]	Other (site manager)
[Data removed from example form to comply with Data Protection]	Occupier
[Data removed from example form to comply with Data Protection]	Owner
If no-one contacted, give reason:	

B. **Survey details** (where data derived from specialist survey or monitoring project)

Survey/project title:			
Organisation:		File Reference:	
Authors:		Pub. Date	
Additional details		Visit date/s for survey	

2. SITE ATTRIBUTE TABLE AND RESULT OF MONITORING

- Please copy and paste information from the relevant Site Attribute Table into the shaded columns. Only copy the information for those features that have been monitored and that you wish to report on here (this replaces the need to submit SATs with this form and keeps all relevant information in one place).
- Please make sure all mandatory targets have been entered into the SAT, have been monitored and inform the condition assessment.
- Please ensure the prescription entered is the method by which the target was actually assessed. For example, do not say aerial photography at 6 yearly intervals if aerial photographs were not used or aerial photographs are not likely to be taken every 6 years.
- Fill in the result of monitoring and whether or not the target has been met.
- Please include the actual result of monitoring eg % of herbs, height of vegetation under 'Result of monitoring' and not just whether the target has been met.
- Notes to describe the current state should be put in section 6.
- Make a note if the conditions or timing of the visit were not conducive to accurate monitoring eg too late in season.
- Identify maps prepared or photos taken related to monitoring.
- Only report against one set of targets for SSSI and Natura features if there is one SSSI making up the Natura site and the features have the same boundary/population. Please indicate the relevant designations in the interest level eg SSSI/SAC if both features are covered by one set of targets.

Site	Reporting Category	Interest Feature	Interest level	Attribute	Target	Prescription	Result of Monitoring	Target met? (Y/N)
Benbeoch	1. Igneous Petrology	1.1 **Carboniferous-Permian Igneous**: Benbeoch Sill, related to early Permian Mauchline Volcanic Formation. Evidence of complex magmatic evolution.	SSSI	1.1.1 **Physical attributes**: extent, composition , structure	1.1. Maintain the extent, composition and structure of the deposits as detailed in SNH Earth Science Site Documentation report 145 except where these are modified by consented mining operations; in which case new baseline documentation should be established (e.g. Notes and photos from monitoring or other visits).	1.1.1 Site visit and fixed point photographs, every 6 years.	Outcrops detailed in ESSD report 145 are unchanged. New (post the 1995 ESSD report) exposure at NS 490 086 was recorded photographically on 07/05/2002. A detailed geological description is given in the BGS report from the site visit of 10/04/1997 and in the site description in GCR volume 'Carboniferous-Permian Igneous' (in which the grid ref. is given as 'around (485 084)'). Some natural erosion has apparently occurred between the 1997 and 2002 visits as is to be expected from a fresh and relatively unstable rock face (see section 6 below). No 'artificial' degradation of the face was noted.	Y
Benbeoch	1. Igneous Petrology	1.1 **Carboniferous-Permian Igneous** (as above)	SSSI	1.1.2 **Visibility**	1.1.2 Rock outcrops are visible at least to the extent documented in Earth Science Site Documentation report 145 (note that for safety reasons it may be necessary to be accompanied by representatives of the mineral extraction company to view some parts of the site). Additionally, maintain the visibility of any important/significant rock outcrop	1.1.2 Site visit and fixed point photographs, every 6 years.	The visibility of outcrops detailed in ESSD report 145 is unchanged. The visibility of new (post the 1995 ESSD report) exposure at NS 490 086 was recorded photographically on 07/05/2002. This was first described in 1997 (BGS report from the site visit of 10/04/1997). Not all parts of the face are currently accessible (see below) and there has almost certainly been some degradation in visibility due to the natural erosion expected at a fresh and relatively unstable rock face (see section 6 below). However, the sequence from the sill into the underlying	Y

					exposed by consented mining operations, to an agreed and practical extent (a 'baseline' for visibility of such exposures to be set before or at the time of the first monitoring visit after they are noted).		sediments is (as far as can be discerned) still exposed. The base of the sill was not accessed on this visit due to the instability of the new face and recent fallen material. Clearing the material would not improve the safety of access. If left, however the face should stabilise (see section 6).	
Benbeoch	*1. Igneous Petrology*	*1.1* ***Carboniferous-Permian Igneous*** *(as above)*	*SSSI*	*1.1.5 Negative indicators*	*1.1.5. There should be no dumping; afforestation within 10 m of any outcrop; storage of material on or against rock exposures; or any other changes in or around the site which might adversely affect it, now or in the future.*	*1.1.5 Site visit and fixed point photographs, every 6 years.*	*No negative indicators were noted.*	*Y*

3. CONDITION ASSESSMENT

- Put a cross in one box only for each feature (unless partially destroyed).
  - If a feature is partially destroyed, enter the area (in hectares) of the feature that has been destroyed against 'partially destroyed' and then make a condition assessment for the remainder of the feature, excluding the destroyed part, and put a cross against the appropriate condition assessment box for the part of the feature that remains.

		Feature Number							
		1.1							
Favourable	Maintained	X							
	Recovered								
Unfavourable	Recovering								
	No change								
	Declining								
Destroyed	Partially destroyed (Area in hectares)								
	Totally destroyed								

4. ACTIVITY ASSESSMENT

For all features, which of the following types of activity or event are having a positive or negative effect on the condition of the feature?

- Identify **no more than three positive (+) and three negative (-) activities (on or off the site)** affecting each feature, by putting a +/- in the box.

	Feature Number							
17. Agricultural operations (e.g. level of/changes in: ploughing, fertiliser, pesticides)	+							
18. Grazing (including deer browsing)* *If negative effect is it: overgrazing/undergrazing (delete as appropriate)								
19. Burning (presence/absence/methods and changes in these)								
20. Game or fisheries management (e.g. introduction of stock, cutting of river banks, bait digging)								
21. Water management (including nature of/changes to: drainage, dredging, water table).								
22. Water quality – direct or diffuse inputs (including level of/changes to: sediment load, chemical content, run-off volume, nutrient content)								
23. Forestry operations (including level of/changes in: intensity, distribution, methods)								
24. Recreation / disturbance (including scrambling, off road vehicle use, recreation pressure, disturbance of fauna)								
25. Flood defence or Coastal defence works								
26. Development carried out under planning permission (including roads, Acts of Parliament etc)	+							
27. Statutory Undertaker (i.e. works carried out by a statutory body which is not required to seek planning permission, including military operations)								
28. Lack of remedial management (e.g. stopping-up drains, scrub cutting, erecting deer fences)								
29. Presence or changing extent of invasive species (including bracken or scrub)								
30. Earth Science feature obscured / eroded (e.g. coastal erosion) / modified (e.g. cave entrances)	-							
31. Dumping / spreading / storage of materials								
32. Other (specify)*								

*Other – can include non intervention (active, positive choice or possibly passive, negative effect) or no activities eg for seabirds on cliffs. If you specify either of these options, please explain these choices in the Notes section. For no activities enter a cross against the feature ie you do not need to specify positive/negative.

5. MANAGEMENT MEASURES

For each feature, place a cross in the appropriate box to indicate whether you believe the management measures in place are leading to/maintaining the feature in favourable condition or not. If you believe the measures are not leading to/maintaining the feature in favourable condition, indicate the reason you believe they may not be being successful.

	Measure leading to/maintaining feature in favourable condition								Measure not leading to/maintaining feature in favourable condition															
									The agreed management is inappropriate for the feature								The agreed management is not being applied as agreed							
Feature number ⇒	**1.1**																							
SNH Management Agreement	X																							
SNH Grant																								
Other grant eg HLF, LIFE																								
Scottish Forestry Grant Scheme/Woodland grant scheme																								
Agri-environment scheme eg ESA, RSS																								
Planning condition or agreement																								
Nature Conservation Order/SNCO																								
Capital Tax Exemption																								
Other (including management sympathetic or where existing consents are the only form of agreed management)																								

It is possible for a feature to be in unfavourable condition but all on-site management is appropriate. In these cases, the management may be leading to favourable condition and the feature will be recorded as unfavourable recovering. If it is unfavourable declining or no change then this could be because off site measures are affecting the condition of the feature. If this is what you have indicated in the previous sections and you believe that it is off site measures that may be affecting the condition of the feature eg fish stocks affecting seabird populations or climate change affecting vascular plants, then please put a cross in this box (and explain in the Notes section).

	Feature Number							
	1.1							
Review management? (Y/N) *	N							

* Your decision whether or not to review management should be explained in section 6.

6. DESCRIPTION OF CONDITION AND NOTES ON MANAGEMENT

The further information provided here should allow someone unfamiliar with the site or coming back to monitor the site again to understand what was seen on the monitoring visit and any impact that activities and management measures are having on feature condition.

You should include information on the following:

- Key aspects about the current state of the feature and the results of monitoring (including information on likely reasons why any particular targets were not met).
- Explanation of any site specific targets chosen.
- Explanation of the selection of trend in the condition assessment.
- Further information to describe the positive or negative activities selected.
- Further information to explain the judgement on management measures and whether or not to review management.

Owner and access information: The site is accessible for study with the permission and co-operation of Scottish Coal (mining operators), who on both site visits were happy to provide suitable transport through the open cast workings.

Factors affecting the site
Agriculture: grazing on the site, by deer (observed) and sheep (reported to be present on occasions) helps keep vegetation down and access clear.

Development carried out under planning permission (mineral extraction): The results of open cast coal mining within the site have so far been beneficial to the geological interest in that they have resulted in the exposure of a new rock face containing the base of the Benbeoch Sill and underlying sediments (at NS 490 086).

Earth Science feature obscured / eroded: Natural weathering of the 'new' face at NS 490 086 has caused, and is likely in the near future to continue to cause, a decrease in visibility of the rock layers (see below).

The 'new' face at NS 490 086
The geology of the 'new' rock face exposed at NS 490 086 in ~1997 is described in the associated BGS report and in the GCR volume 'Carboniferous-Permian Igneous'. Photographs of the face were taken on 07/05/2002.

The exposure is in two 'layers' separated by a 'bench' or ledge about half way up the face and wide enough to allow access. Exposure of the base of the sill appears to occur near the centre of the section (horizontally) just above the level of the bench. This area was visible but not safely accessible at the time of the site monitoring visit due to unconsolidated material weathered/collapsed onto the bench from the new and rather unstable face. Such rapid weathering and rock-fall is to be expected at such a fresh face especially in rocks such as those of the sill (which lies above the bench) which are strongly jointed and prone to collapse. Clearing loose material from the bench to allow safe(er) access is, even in the best case, likely only to be a short term solution, in the long term possibly only resulting in further collapse of the (newly cleared) face. Clearing of fallen material is therefore not considered a worthwhile project.

As exposure of the base of the sill and underlying sediments is currently still (as far as can be determined) present within the 'new' face, it is thought that the best current action is to leave the face to erode and 'settle'. This will hopefully allow unstable material to fall and loose material on the 'bench' to be washed away (loose earth) or consolidate (rock and remaining earth) and allow safe access along the bench (hard hats and roping together for security may still be necessary precautions).

On the next site visit the above recommendation should be reviewed and other possible measures to ensure access to and visibility of exposure along the 'bench' of the new face (with a long-term view to minimum maintenance) should be considered. Removal of some loose/fallen material may, for example, be considered desirable or necessary.

Photographs of the site taken during the site visits are available in hard copy and digital format (photos 0102_43_23A-36A, 0102_44_0-9 & photos of the 'new' face on film 0203_3). Photograph captions are also available.

17.3 Example 3: Dunnet Links SSSI CMF

Version 12

Condition Monitoring Form	Date signed off in Area:	
	Initials:	

Site Name:	Dunnet Links	MIDAS Site Code:	S572
Designation: (SSSI/SAC/SPA/Ramsar)*	SSSI	SNH Area:	North Highland
Name of SNH staff member completing form/assessment**:	Rachel Robson	Date form completed:	17/03/03

*Only report on SSSI and SAC/SPA/Ramsar features on one form if there is only one SSSI making up the Natura site. Where this is the case, please provide the name and site code for the Natura site as well as the SSSI.

**We need the name of the SNH staff member who completed the form or approved the form that was drafted by someone else eg a contractor. The person named should be the staff member who would deal with any queries on how the form has been completed/the condition assessment of the features.

For each of the features reported on this form, please list the following information:

Names of features reported on here[1]	Issue date of guidance used/date received draft from advisor[2]	Date of Monitoring visit[3]	Name of surveyor(s)	SNH staff/ National contractor/Local contractor/Other (specify)[4]	Approx time taken by SNH Area staff to monitor feature (in hours)[5]	Estimate of costs from Area Contracts to monitor feature
2.1 Coastal Geomorphology of Scotland		04/03/03 & 05/03/03	Rachel Robson	SNH staff (ESG)	8	

[1] Please ensure that the name of the feature being reported on matches that in the notified features spreadsheets/MIDAS. If you have any queries on the appropriateness of the feature name then please raise them with DASU before completing the form.

[2] It is sometimes difficult to tell which version of guidance has been used to assess features. Recording the issue date of the guidance (found in the footer of the guidance documents) will assist with this. If the assessment was done using a draft of guidance sent to you by an advisor please give us the date when you received the draft guidance from them. Please note that you should use the version of the guidance that was current at the time the feature was monitored to complete the assessment of the feature.

[3] The visit date allows us to know on what date a feature was in a particular condition. Please provide an exact date of visit wherever possible, or at the very least the month and year of a visit. For features that were monitored over a range of dates, please provide the range of dates, ensuring that you do provide the last date on which the feature was monitored in that period.

[4] Please provide the name and address of any local contractors or contacts for external data eg name and address of local RSPB staff.

[5] The estimate of time taken to monitor features should include time taken by Area staff to complete any of the following tasks: produce SATs/ arrange access/ monitor the feature/ complete the CMF. Estimates should therefore be given for features monitored by Area staff and those monitored under national contracts. An estimate of cost per feature is only needed for features covered by local contracts.

1. COMPLETE ANY OF THE FOLLOWING BOXES (A AND/OR B) WHICH APPLY:

A. Visit details (where data derived from visit)

Person(s) contacted:	Own./Occup./Other
[Data removed from example form to comply with Data Protection]	Owner
Remainder of GCR site is public access	
If no-one contacted, give reason:	

B. Survey details (where data derived from specialist survey or monitoring project)

Survey/project title:			
Organisation:		File Reference:	
Authors:		Pub. Date	
Additional details		Visit date/s for survey	

2. SITE ATTRIBUTE TABLE AND RESULT OF MONITORING

- Please copy and paste information from the relevant Site Attribute Table into the shaded columns. Only copy the information for those features that have been monitored and that you wish to report on here (this replaces the need to submit SATs with this form and keeps all relevant information in one place).
- Please make sure all mandatory targets have been entered into the SAT, have been monitored and inform the condition assessment.
- Please ensure the prescription entered is the method by which the target was actually assessed. For example, do not say aerial photography at 6 yearly intervals if aerial photographs were not used or aerial photographs are not likely to be taken every 6 years.
- Fill in the result of monitoring and whether or not the target has been met.
- Please include the actual result of monitoring eg % of herbs, height of vegetation under 'Result of monitoring' and not just whether the target has been met.
- Notes to describe the current state should be put in section 6.
- Make a note if the conditions or timing of the visit were not conducive to accurate monitoring eg too late in season.
- Identify maps prepared or photos taken related to monitoring.
- Only report against one set of targets for SSSI and Natura features if there is one SSSI making up the Natura site and the features have the same boundary/population. Please indicate the relevant designations in the interest level eg SSSI/SAC if both features are covered by one set of targets.

Site	Reporting Category	Interest Feature	Interest level	Attribute	Target	Prescription	Result of Monitoring	Target met? (Y/N)
Dunnet Links	2. Geomorphology	2.1 **Coastal Geomorphology of Scotland**: Enclosed 4 km long bay with changes in beach & dune system restricted to onshore-offshore sediment movement. Beach backed by single steep dune ridge - large dunes cut by rivers & blow-outs & subject to frontal wave erosion. Extensive link/machair behind ridge.	SSSI	2.1.1 Physical attributes: extent, composition, structure	2.1.1 Maintain the extent, composition, structure and morphology of the sedimentary deposits, dunes and links/machair within the Dunnet Bay GCR site as detailed in SNH Earth Science Site Documentation report 172 (1996), excepting modification by natural coastal processes (excluding grazing and self-seeding expansion of planted forests).	2.1.1 Site visit and fixed point photographs, every 6 years.	Minor vehicle tracking is occurring on the dunes and beach but this has not significantly damaged the physical attributes (but see section 6). Brushwood fencing, e.g. in blow-out D, is acceptable (see 1.1.6). Previously bare slopes in the old sand extraction pit area have vegetated. Recent drains have been dug between the main dune ridge and the road (e.g. at ND 21828 69287 (photo 0203_42_23A) and to the south). These excavations were not consented and they constitute damage to the dune system/ machair plain therefore the Physical Attributes target is not met.	N
Dunnet Links	2. Geomorphology	2.1 **Coastal Geomorphology of Scotland** (as detailed above)	SSSI	2.1.2 Visibility	2.1.2 Maintain the visibility (including availability for study and research) of the dunes and links/machair within the Dunnet Bay GCR site as detailed in SNH Earth Science Site Documentation report 172, excepting modification by natural coastal	2.1.2 Site visit and fixed point photographs, every 6 years.	Visibility and availability of the site for study and research, has not decreased since the time of the baseline survey (1996). A coastal footpath opened in 2000 gives access through the dunes at the south end of the site.	Y

					processes (excluding self-seeding expansion of planted forests).			
Dunnet Links	2. Geomorphology	2.1 **Coastal Geomorphology of Scotland** (as detailed above)	SSSI	2.1.3 Process dynamics	2.1.3 There must be no (further) constraints on the natural operation of coastal processes in the Dunnet Bay GCR site (since the baseline survey – Site Doc. 172, 1996). In particular, there should be no unconsented construction of coastal defences, or artificial removal or transportation of beach or off-shore, sediment.	2.1.3 Site visit, visual inspection and fixed point photographs every 6 years.	Stabilisation and reduction of erosion in blow-out D by erection of brushwood fencing and planting of dune grass is acceptable as it has been consented, and is a continuation of the work started in 1981 (pre-baseline) so is not a new constraint.	Y
Dunnet Links	*2. Geomorphology*	*2.1* ***Coastal Geomorphology of Scotland*** *(as detailed above)*	*SSSI*	*2.1.4 Negative indicators*	*2.1.4 Within the Dunnet Bay GCR site there should be no unconsented tipping, tree-planting, sand removal or other excavations; no unconsented construction of coastal defences or other permanent or temporary structures; and no other changes which might adversely affect the feature now or in the future.*	*2.1.4 Site visit and fixed point photographs, every 6 years.*	*Minor vehicle tracking on dunes and beach does not appear to be linked to any sand removal and the tracking itself has not currently caused any significant damage to the site (but see section 6)***.** *Excavations/re-excavation of drainage ditches has occurred (see section 6 for details) within the SSSI (over 5m from the road) without consent . The target is therefore not met. The site, however is dynamic and the ditches should eventually fill in, so the damage is reversible.*	*N*

3. CONDITION ASSESSMENT

- Put a cross in one box only for each feature (unless partially destroyed).
  - If a feature is partially destroyed, enter the area (in hectares) of the feature that has been destroyed against 'partially destroyed' and then make a condition assessment for the remainder of the feature, excluding the destroyed part, and put a cross against the appropriate condition assessment box for the part of the feature that remains.

		Feature Number							
		2.1							
Favourable	Maintained								
	Recovered								
Unfavourable	Recovering								
	No change								
	Declining	X							
Destroyed	Partially destroyed (Area in hectares)								
	Totally destroyed								

4. ACTIVITY ASSESSMENT

For all features, which of the following types of activity or event are having a positive or negative effect on the condition of the feature?

- Identify **no more than three positive (+) and three negative (-) activities (on or off the site)** affecting each feature, by putting a +/- in the box.

	Feature Number							
	2.1							
33. Agricultural operations (e.g. level of/changes in: ploughing, fertiliser, pesticides)								
34. Grazing (including deer browsing)* *If negative effect is it: overgrazing/undergrazing (delete as appropriate)								
35. Burning (presence/absence/methods and changes in these)								
36. Game or fisheries management (e.g. introduction of stock, cutting of river banks, bait digging)								
37. Water management (including nature of/changes to: drainage, dredging, water table).								
38. Water quality – direct or diffuse inputs (including level of/changes to: sediment load, chemical content, run-off volume, nutrient content)	-							
39. Forestry operations (including level of/changes in: intensity, distribution, methods)								
40. Recreation / disturbance (including scrambling, off road vehicle use, recreation pressure, disturbance of fauna)	-?							
41. Flood defence or Coastal defence works								
42. Development carried out under planning permission (including roads, Acts of Parliament etc)								
43. Statutory Undertaker (i.e. works carried out by a statutory body which is not required to seek planning permission, including military operations)								
44. Lack of remedial management (e.g. stopping-up drains, scrub cutting, erecting deer fences)								
45. Presence or changing extent of invasive species (including bracken or scrub)								
46. Earth Science feature obscured / eroded (e.g. coastal erosion) / modified (e.g. cave entrances)								
47. Dumping / spreading / storage of materials								
48. Other (specify)*: **Vehicle tracking of unknown origin**	-							

*Other – can include non intervention (active, positive choice or possibly passive, negative effect) or no activities eg for seabirds on cliffs. If you specify either of these options, please explain these choices in the Notes section. For no activities enter a cross against the feature ie you do not need to specify positive/negative.

5. MANAGEMENT MEASURES

For each feature, place a cross in the appropriate box to indicate whether you believe the management measures in place are leading to/maintaining the feature in favourable condition or not. If you believe the measures are not leading to/maintaining the feature in favourable condition, indicate the reason you believe they may not be being successful.

	Measure leading to/maintaining feature in favourable condition								Measure not leading to/maintaining feature in favourable condition															
									The agreed management is inappropriate for the feature								The agreed management is not being applied as agreed							
Feature number ⇒									**2.1**															
SNH Management Agreement									X															
SNH Grant																								
Other grant eg HLF, LIFE																								
Scottish Forestry Grant Scheme/Woodland grant scheme																								
Agri-environment scheme eg ESA, RSS																								
Planning condition or agreement																								
Nature Conservation Order/SNCO																								
Capital Tax Exemption																								
Other (including management sympathetic or where existing consents are the only form of agreed management)																								

It is possible for a feature to be in unfavourable condition but all on-site management is appropriate. In these cases, the management may be leading to favourable condition and the feature will be recorded as unfavourable recovering. If it is unfavourable declining or no change then this could be because off site measures are affecting the condition of the feature. If this is what you have indicated in the previous sections and you believe that it is off site measures that may be affecting the condition of the feature eg fish stocks affecting seabird populations or climate change affecting vascular plants, then please put a cross in this box (and explain in the Notes section).

	Feature Number							
	2.1							
Review management? (Y/N) *	Y							

* Your decision whether or not to review management should be explained in section 6.

6. DESCRIPTION OF CONDITION AND NOTES ON MANAGEMENT

The further information provided here should allow someone unfamiliar with the site or coming back to monitor the site again to understand what was seen on the monitoring visit and any impact that activities and management measures are having on feature condition.

You should include information on the following:

- Key aspects about the current state of the feature and the results of monitoring (including information on likely reasons why any particular targets were not met).
- Explanation of any site specific targets chosen.
- Explanation of the selection of trend in the condition assessment.
- Further information to describe the positive or negative activities selected.
- Further information to explain the judgement on management measures and whether or not to review management.

The Interest Feature is considered to be in 'Unfavourable – declining' condition because its condition has declined since the baseline and the 'Physical Attributes' target is not met.

Vehicle tracking: Vehicle tracking was noted at a number of points in the site.

1) At the south end of the site vehicle tracking over the dunes (e.g. near ND 20278 68109) has broken through the vegetation layer (see photos 0203_41_26A & 27A). This has not currently resulted in any significant erosion of the dunes; but may do so in the future if vehicle tracking persists or increases. Management should therefore be reviewed to consider restriction/prevention of further vehicle access in this area. The vehicle route appears to be from directly opposite a gate on the road. An investigation of what vehicles are using the route and for what purpose is advised and/or some physical obstruction to vehicle access. (There is no evidence in the site doc. report/baseline to indicate if use of this vehicle route is pre or post-baseline).

2) Vehicle tracking is still occurring in the south of the site where a stream cuts through the dunes (see Figure 43 from site doc. report & photo 0203_41_28A from current visit). This vehicle use is on old tracks and is less likely to be damaging to the site than the tracking in 1) above. It is recommended that vehicle use of these tracks is investigated and non-essential use curtailed. This may require physical obstruction to vehicle access at the track ends.

3) Further vehicle tracking was noted on the beach towards the north end of the site (e.g. near ND 21823 69981, photo 0203_42_11A; and ND 21807 70664 – ND 21776 70737, photos 0203_42_18A-19A). Vehicle access at this end to the site appears to have been gained via a track near ND 21807 70664 (photo 0203_42_18A) which joins the road at a rough 'lay-by'. There are no restraints to vehicle access here. The tracking has not caused any significant damage to the site but again it is advised that vehicle use of these tracks is investigated and non-essential use curtailed. This may require physical obstruction to vehicle access at the track end. (There is no evidence in the site doc. report/baseline to indicate if vehicle use of this access route is recent or pre-dates baseline).

Drains: Drains have been excavated or re-excavated in the area between the main dune ridge and the road, predominantly around and south of ND 21828 69287 (photo 0203_42_23A) i.e. south of blow-out D. These excavations were not consented and constitute damage to the physical attributes of the feature (damage to the dunes system/machair plain). However, the dune system is dynamic and in the medium/long term natural processes are likely to fill in the drains returning the morphology to a 'natural' state (although the buried 'structure' of the sediments will clearly not be recreated). The ditches are not likely to cause any major change in the evolution of the dune system (e.g. they are not likely to initiate a large blow-out) so no immediate 'remedial' action is considered necessary.

Other changes in the dune system since the baseline

Apart from the consented stabilisation works in blow-out D. The most noticeable change since the baseline (site doc report visit Oct 1995) is the re-vegetation of the former sand extraction pit near the south end of the site (compare Figure 34 from report with photos 0203_41_29A-31A from current visit). Note that much of the rubble noted at the time of the baseline still remains in the pit. The front of the dune system in this area (Figure 35b & photos 0203_42_24A-29A) has not eroded significantly since the baseline; therefore the risk of the frontal dune system eroding away in this area has reduced since the baseline.

The head of blow-out H appeared to show significant change since the baseline (compare Figure 19b from report with photo 0203_41_36A from current visit) - so much so in fact that no points on the original photograph could be re-located. The overall impression, however is that vegetation levels have increased, possibly quite significantly i.e. the blow-out is stabilising.

The volume of bare sand at the downwind end of blow-out D is similar (possibly slightly less?) to that at the time of the baseline report – compare Figure 30b from report with photo 0203_42_22A (note that seasonal vegetation cover was lacking at the time of the current visit). There were very few footprints in the head of the blow-out (photos 0203_42_5A-7A) and no distinct path down the windward face (Photo 0203_42_22a) possibly because the brushwood fencing hinders/deters access along the blow-out.

In the area of wire fencing shown in Figure 33a from the site doc. report, sand has accumulated in front of the fencing since the time of the baseline, and some of these embryo dunes are vegetated. This is despite the adjacent beach access route through blow-out A (steps to left of shot).

Undercutting of the steps at the end of the path shown in Figure 39d in site doc. report has now removed the bottom step entirely (see photo 0203_42_16A).

Photographs taken during the site visit (films no. **0203_41-42**) and corresponding photo captions contain further important information for future monitoring of interest feature 1.1 are/will be available in hard copy and digital format from the SNH area office (Golspie) and in digital format from SNH Earth Science group (Edinburgh).

17.4 Example 4: River Clyde Meanders SSSI CMF

Version 12

Condition Monitoring Form	Date signed off in Area:
	Initials:

Site Name:	River Clyde Meander	**MIDAS Site Code:**	S1701
Designation: (SSSI/SAC/SPA/Ramsar)*	SSSI	**SNH Area:**	Strathclyde and Ayrshire (Lanark)
Name of SNH staff member completing form/assessment:**	Scott Riddell	**Date form completed:**	05/03/03

*Only report on SSSI and SAC/SPA/Ramsar features on one form if there is only one SSSI making up the Natura site. Where this is the case, please provide the name and site code for the Natura site as well as the SSSI.

**We need the name of the SNH staff member who completed the form or approved the form that was drafted by someone else eg a contractor. The person named should be the staff member who would deal with any queries on how the form has been completed/the condition assessment of the features.

For each of the features reported on this form, please list the following information:

Names of features reported on here[1]	Issue date of guidance used/date received draft from advisor[2]	Date of Monitoring visit[3]	Name of surveyor(s)	SNH staff/ National contractor/Local contractor/Other (specify)[4]	Approx time taken by SNH Area staff to monitor feature (in hours)[5]	Estimate of costs from Area Contracts to monitor feature
Fluvial Geomorphology of Scotland	October 2004	17th February 2003	**Scott Riddell**	**SNH Staff**	**14**	

[1] Please ensure that the name of the feature being reported on matches that in the notified features spreadsheets/MIDAS. If you have any queries on the appropriateness of the feature name then please raise them with DASU before completing the form.

[2] It is sometimes difficult to tell which version of guidance has been used to assess features. Recording the issue date of the guidance (found in the footer of the guidance documents) will assist with this. If the assessment was done using a draft of guidance sent to you by an advisor please give us the date when you received the draft guidance from them. Please note that you should use the version of the guidance that was current at the time the feature was monitored to complete the assessment of the feature.

[3] The visit date allows us to know on what date a feature was in a particular condition. Please provide an exact date of visit wherever possible, or at the very least the month and year of a visit. For features that were monitored over a range of dates, please provide the range of dates, ensuring that you do provide the last date on which the feature was monitored in that period.

[4] Please provide the name and address of any local contractors or contacts for external data eg name and address of local RSPB staff.

[5] The estimate of time taken to monitor features should include time taken by Area staff to complete any of the following tasks: produce SATs/ arrange access/ monitor the feature/ complete the CMF. Estimates should therefore be given for features monitored by Area staff and those monitored under national contracts. An estimate of cost per feature is only needed for features covered by local contracts.

1. COMPLETE ANY OF THE FOLLOWING BOXES (A AND/OR B) WHICH APPLY:

A. Visit details (where data derived from visit)

Person(s) contacted:	Own./Occup./Other
[Data removed from example form to comply with Data Protection]	Owner/Occupier
[Data removed from example form to comply with Data Protection]	Owner
[Data removed from example form to comply with Data Protection]	Former Owner
[Data removed from example form to comply with Data Protection]	Owner
[Data removed from example form to comply with Data Protection],	Owner
[Data removed from example form to comply with Data Protection]	Occupier
If no-one contacted, give reason:	

B. Survey details (where data derived from specialist survey or monitoring project)

Survey/project title:			
Organisation:		File Reference:	
Authors:		Pub. Date	
Additional details		Visit date/s for survey	

2. SITE ATTRIBUTE TABLE AND RESULT OF MONITORING

- Please copy and paste information from the relevant Site Attribute Table into the shaded columns. Only copy the information for those features that have been monitored and that you wish to report on here (this replaces the need to submit SATs with this form and keeps all relevant information in one place).
- Please make sure all mandatory targets have been entered into the SAT, have been monitored and inform the condition assessment.
- Please ensure the prescription entered is the method by which the target was actually assessed. For example, do not say aerial photography at 6 yearly intervals if aerial photographs were not used or aerial photographs are not likely to be taken every 6 years.
- Fill in the result of monitoring and whether or not the target has been met.
- Please include the actual result of monitoring eg % of herbs, height of vegetation under 'Result of monitoring' and not just whether the target has been met.
- Notes to describe the current state should be put in section 6.
- Make a note if the conditions or timing of the visit were not conducive to accurate monitoring eg too late in season.
- Identify maps prepared or photos taken related to monitoring.
- Only report against one set of targets for SSSI and Natura features if there is one SSSI making up the Natura site and the features have the same boundary/population. Please indicate the relevant designations in the interest level eg SSSI/SAC if both features are covered by one set of targets.

Site	Reporting Category	Interest Feature	Interest level	Attribute	Target	Prescription	Result of Monitoring	Target met? (Y/N)
River Clyde Meanders	1. Geomorphology	1.1 **Fluvial Geomorphology of Scotland:** Unconstrained meandering lowland river channel. Channel migration and meander bend cut-off. Abandoned channels. Active tributary with complex meanders responding to downcutting of River Clyde.	SSSI	1.1.1 Process Dynamics	1.1.1 Maintain conditions necessary for continued natural change and development of fluvial features and associated landforms as identified at the time of the site document report no. 297 (2001). Specifically: ▪ The supply of water and sediment. ▪ Unhindered occurrence of flooding, erosion & channel migration.	▪ Field visit (every 2 years) ▪ Aerial Photograph y (every 6 years)	Conditions on site are as follows: ▪ The supply of water and sediments is unhindered. ▪ River defence works derived from the Land Drainage (Scotland) Acts of the 1930's are currently retained, although in various states of disrepair. This will inhibit natural processes. Details of location are shown on map attached. Flooding does continue. This is apparent as oxbow lakes are periodically inundated and strand lines occur in the fields surrounding the main river channels of the Medwin and Clyde. Erosion processes continue as can be seen along the river banks. Both processes have been confirmed by a landowner. Ideally, defence works should be allowed to deteriorate or be removed subject to discussion with landowners and tenants.	Y

River Clyde Meanders	Geomorphology	1.1 **Fluvial Geomorphology of Scotland**: Unconstrained meandering lowland river channel. Channel migration and meander bend cut-off. Abandoned channels. Active tributary with complex meanders responding to downcutting of River Clyde.	SSSI	1.1.2 Physical attributes	1.1.2 Maintain the morphology, extent, composition and structure of the fluvial landforms (relict & active) as documented in site doc. report no. 297 (2001) excepting changes which result from natural river processes e.g. channel migration and flooding. Indicators of suitable conditions include the presence of: River channel, Point bar, Potential cut-off points, Oxbow lakes, Palaeo-channels, Scrolls	▪ Field visit (every 2 years) ▪ Aerial Photograph y (every 6 years)	All landforms have been retained on site including: River channel, Point bar, Potential cut-off points, Oxbow lakes, Palaeo-channels, Scrolls The current extent, composition, structure and the relationships between landforms will become more fully understood once aerial photographs have been taken. It is hoped that this will occur during the summer of 2003.	Y
River Clyde Meanders	Geomorphology	1.1 **Fluvial Geomorphology of Scotland**: Unconstrained meandering lowland river channel. Channel migration and meander bend cut-off. Abandoned channels. Active tributary with complex meanders responding to downcutting of River Clyde.	SSSI	1.1.3 Visibility	1.1.3 Maintain visibility (including availability for study and research) of key active and relict landforms as identified at the time of the site document report no. 297 (2001). (Baseline to be supplemented by photographs from first SCM survey)	▪ Field visit (every 2 years) ▪ Aerial Photograph y (every 6 years)	The majority of landforms that are currently retained are visible and available for study (subject to flooding), however palaeo-channels and oxbow lakes have been obscured by tipping (inc. wire dump) on the east bank of the River Clyde, south of the Medwin Water. Gravel has also been used to infill a portion of a palaeo-channel in this area as part of a track (**Map:** impacts).The dumped materials should be removed.	N
River Clyde Meanders	*Geomorphology*	*1.1 **Fluvial Geomorphology of Scotland**: Unconstrained meandering lowland river channel. Channel migration and meander bend cut-off. Abandoned channels. Active tributary with complex meanders responding to downcutting of River Clyde.*	*SSSI*	*1.1.4 Negative Indicators*	*1.1.4 There should be no:* ▪ *Construction (inc. river defences)* ▪ *Gravel/sand extraction (e.g. quarrying)* ▪ *Tipping* ▪ *Storage of materials* ▪ *Tree planting* ▪ *Any other changes which might affect the feature now or in the future.*	▪ *Field visit (every 2 years)* ▪ *Aerial Photograph y (every 6 years)*	▪ *River defence works derived from the 1930's are either deteriorating or in a state of disrepair. No new works or repairs have been implemented (baseline)* ▪ *It is possible that gravel from a bar on the River Clyde has been used as infill for a palaeo-channel to form vehicle track. No physical evidence of extraction was noted but the composition and nature of the gravel on the track matched that of the gravel bed by the bank of the river. It may be that the physical evidence of extraction has been washed away through natural processes. A vehicle track links the two locations (fail).*	*N*

							▪ *Palaeo-channels and oxbow lakes have been obscured by tipping (inc. wire dump) on the east bank of the River Clyde, south of the Medwin Water (fail).* ▪ *No materials have been stored on site (pass).* ▪ *There has been no tree planting on site (pass).* ▪ *Ploughing has removed all evidence of a flood embankment that forms the SSSI boundary to the south east of the site. Such activity may present a threat to natural landforms and should be monitored (baseline).*	

3. CONDITION ASSESSMENT

- Put a cross in one box only for each feature (unless partially destroyed).
  - If a feature is partially destroyed, enter the area (in hectares) of the feature that has been destroyed against 'partially destroyed' and then make a condition assessment for the remainder of the feature, excluding the destroyed part, and put a cross against the appropriate condition assessment box for the part of the feature that remains.

		Feature Number							
		1.1							
Favourable	Maintained								
	Recovered								
Unfavourable	Recovering								
	No change								
	Declining	X							
Destroyed	Partially destroyed (Area in hectares)								
	Totally destroyed								

4. ACTIVITY ASSESSMENT

For all features, which of the following types of activity or event are having a positive or negative effect on the condition of the feature?

- Identify **no more than three positive (+) and three negative (-) activities (on or off the site)** affecting each feature, by putting a +/- in the box.

	Feature Number							
49. Agricultural operations (e.g. level of/changes in: ploughing, fertiliser, pesticides)								
50. Grazing (including deer browsing)* *If negative effect is it: overgrazing/undergrazing (delete as appropriate)	+							
51. Burning (presence/absence/methods and changes in these)								
52. Game or fisheries management (e.g. introduction of stock, cutting of river banks, bait digging)								
53. Water management (including nature of/changes to: drainage, dredging, water table).								
54. Water quality – direct or diffuse inputs (including level of/changes to: sediment load, chemical content, run-off volume, nutrient content)								
55. Forestry operations (including level of/changes in: intensity, distribution, methods)								
56. Recreation / disturbance (including scrambling, off road vehicle use, recreation pressure, disturbance of fauna)								
57. Flood defence or Coastal defence works	-							
58. Development carried out under planning permission (including roads, Acts of Parliament etc)								
59. Statutory Undertaker (i.e. works carried out by a statutory body which is not required to seek planning permission, including military operations)								
60. Lack of remedial management (e.g. stopping-up drains, scrub cutting, erecting deer fences)								
61. Presence or changing extent of invasive species (including bracken or scrub)								
62. Earth Science feature obscured / eroded (e.g. coastal erosion) / modified (e.g. cave entrances)								
63. Dumping / spreading / storage of materials	-							
64. Other (specify)*								

*Other – can include non intervention (active, positive choice or possibly passive, negative effect) or no activities eg for seabirds on cliffs. If you specify either of these options, please explain these choices in the Notes section. For no activities enter a cross against the feature ie you do not need to specify positive/negative.

5. MANAGEMENT MEASURES

For each feature, place a cross in the appropriate box to indicate whether you believe the management measures in place are leading to/maintaining the feature in favourable condition or not. If you believe the measures are not leading to/maintaining the feature in favourable condition, indicate the reason you believe they may not be being successful.

	Measure leading to/maintaining feature in favourable condition								Measure not leading to/maintaining feature in favourable condition															
									The agreed management is inappropriate for the feature								The agreed management is not being applied as agreed							
Feature number ⇒	**1.1**																							
SNH Management Agreement	X																							
SNH Grant																								
Other grant eg HLF, LIFE																								
Scottish Forestry Grant Scheme/Woodland grant scheme																								
Agri-environment scheme eg ESA, RSS																								
Planning condition or agreement																								
Nature Conservation Order/SNCO																								
Capital Tax Exemption																								
Other (including management sympathetic or where existing consents are the only form of agreed management)																								

It is possible for a feature to be in unfavourable condition but all on-site management is appropriate. In these cases, the management may be leading to favourable condition and the feature will be recorded as unfavourable recovering. If it is unfavourable declining or no change then this could be because off site measures are affecting the condition of the feature. If this is what you have indicated in the previous sections and you believe that it is off site measures that may be affecting the condition of the feature eg fish stocks affecting seabird populations or climate change affecting vascular plants, then please put a cross in this box (and explain in the Notes section).

	Feature Number							
	1.1							
Review management? (Y/N) *	Y							

* Your decision whether or not to review management should be explained in section 6.

6. DESCRIPTION OF CONDITION AND NOTES ON MANAGEMENT

The further information provided here should allow someone unfamiliar with the site or coming back to monitor the site again to understand what was seen on the monitoring visit and any impact that activities and management measures are having on feature condition.

You should include information on the following:

- Key aspects about the current state of the feature and the results of monitoring (including information on likely reasons why any particular targets were not met).
- Explanation of any site specific targets chosen.
- Explanation of the selection of trend in the condition assessment.
- Further information to describe the positive or negative activities selected.
- Further information to explain the judgement on management measures and whether or not to review management.

FEATURE 1: FLUVIAL GEOMORPHOLOGY

The overall condition of the FLUVIAL GEOMORPHOLOGY is UNFAVOURABLE - DECLINING on the basis of the following:

- **Attribute 1.1.3: Visibility** As discussed in SAT.

- **Gravel/sand extraction:** As discussed in SAT.
- **Tipping:** As discussed in SAT.

The following points should also be noted:

- **Attribute 1.1.4: Negative indicators**

- **Other changes:** As discussed in SAT.

The following paragraphs correspond with the sections found within this CMF. They may also be cross referenced with the Site Management Statement (SMS), the Earth Science Site Document 297 (2001) and the Geological Conservation Review (GCR) (details enclosed).

4. Activity Assessment

- **Grazing:** Grazing by livestock is seen as a positive activity, enhancing the visibility of relict fluvial landforms
- *Flood defence works:* ***As discussed in SAT (****Attribute 1.1.4: Negative Indicators****). Details of location are given on the attached map.***
- **Dumping/Tipping:** As discussed in SAT (**Attribute 1.1.3: Visibility & Attribute 1.1.4: Negative Indicators**). Details of location are given on the attached map.

5. Management measures

There is a Management Agreement (MA) in place for a small portion (0.96 ha) of the SSSI. The objective of the MA is to conserve the integrity of relict landforms and sediment sections. The terms of the MA are being applied appropriately.

Photographs are, including captions enclosed *(photos are also available in digital form from Earth Science Group, Anderson Place)****. Captions may be cross referenced with the attached map.***

Appendix 4: Draft field recording forms trialled in SCM Cycle 1

Lead Questions

This short list of questions is designed as a prompt as to which 'subject' areas of the accompanying 'Possible scenarios' list should be checked through for guidance at each site monitored. If the answer to any of the questions is 'Yes', then that subject area on the 'Possible scenarios' should be checked through. The 'No.' and 'Subject' of each questions correspond to the 'No.' and 'Subject' of the appropriate section of the 'Possible scenarios' list.

No.	Subject	Lead Question	Y/N?
1	**Agriculture**	All or parts of the site were or are being used for agricultural purposes.	
2	**Vegetation**	**a)** Vegetation (including trees) in any way obscures visibility of/hinders access to/is a safety hazard near any part of the Earth Science feature, affects the natural evolution of the site, or is likely to do/be any of these within 6 years.	
		b) There has been recent (i.e. post last site monitoring visit/baseline survey) tree (or other vegetation) planting within the site.	
3	**Erosion and Sedimentation**	Erosion (including landslip and collapse of cliff/tunnel sections) and/or sediment build-up is affecting the feature.	
4	**Water**	**a)** Water quality is suspect anywhere within the site.	
		b) Non-tidal water levels have changed since the last monitoring visit/baseline survey due to natural or artificial factors.	
5	**Tipping**	There is tipped/dumped material within the site.	
6	**Coastal and river defences**	**a)** There are new or damaged/crumbling coastal or river defences within or adjacent to the site.	
		b) Coastal reclamation or managed retreat has occurred within or adjacent to the site.	
7	**Slope stabilisation**	Recent (i.e. post last monitoring visit/baseline survey) slope stabilisation has been carried out.	
8	**Construction and stored materials**	**a)** There are recent (i.e. post last monitoring visit/baseline survey) man-made constructions (including roads/tracks) in the site.	
		b) There are stored materials within the site.	
9	**Collecting and research**	Collection or research has recently (i.e. post last monitoring visit/baseline survey) been consented within the site; or has recently occurred within the site.	
10	**Mining and extraction works**	Major or minor extraction/removal of rock, peat, sand, gravel or slag has recently (i.e. post last monitoring visit/baseline survey) occurred within the site.	
11	**Recreation**	Recreational activities (e.g. rock climbing, mountain biking) have recently (i.e. post last monitoring visit/baseline survey) affected the feature.	
12	**Protective measures**	The feature is partly or wholly protected by 'artificial' means (e.g. roof, vehicle restrictions, burial, 'No hammering' sign, safety barriers, etc); or such protection would be beneficial.	

***'active process' feature**: a feature which is being partially or wholly formed/continually reformed by processes still active today, and where the Earth Science interest includes these active formation processes (this includes the majority of features in the 'Geomorphology' reporting category).
'soft sediment' feature: a feature for which the Earth Science interest is (exposure of) partially or wholly unlithified/unconsolidated sediment such as glacial sediment or more recent river sediment (i.e. 'exposure' sites of Quaternary or younger age).
'hard rock' feature: a feature for which the Earth Science interest is fully lithified sediment (i.e. rock) as opposed to partially or wholly unlithified/unconsolidated glacial sediment or present-day sediment (in practice anything older than 'Quaternary').

				Does not make the site unfavourable	The site is unfavourable because the following targets are not met.						Notes to include in CMF
					Physical Attributes	Visibility	Access	Safety	Negative Indicators	Process Dynamics	
No.	**Subject**	**Possible scenarios**	**Suggested category(s)**	**OK**	**PA**	**V**	**A**	**S**	**NI**	**PD**	**NB**
1.1	**Agriculture**	The site is grazed to no noticeable effect **or** grazing on the site helps to keep vegetation levels low/outcrop clear/ access paths clear/access paths visible.	**OK**	0K	PA	V	A	S	NI	PD	NB
1.2		The site is grazed and livestock trampling is causing damage/significant erosion to landforms/rock outcrop (e.g. trampling severely eroding the side of an esker)	**PA**	0K	PA	V	A	S	NI	PD	NB
1.3		Grazing of the site has ceased with no apparent effect on the feature.	**OK**	0K	PA	V	A	S	NI	PD	NB
1.4		Grazing has ceased resulting in an increase in vegetation cover which has no detrimental effect on the feature.	**OK**	0K	PA	V	A	S	NI	PD	NB
1.5		Grazing has ceased resulting in an increase in vegetation cover which obscures part of the feature from view/inhibits access to part or all of the feature.	**V/A**	0K	PA	V	A	S	NI	PD	NB
1.6		Grazing has ceased resulting in an increase in vegetation cover which **will** obscure part or all of the feature or inhibit access to part or all of the feature within 6 years (before the next monitoring visit).	**NI**	0K	PA	V	A	S	NI	PD	NB
1.7		Grazing would help improve the site condition (e.g. by helping to control/lower vegetation levels).	**NB**	0K	PA	V	A	S	NI	PD	NB
1.8		The site is ploughed with no detrimental effect on the feature.	**OK**	0K	PA	V	A	S	NI	PD	NB
1.9		The site has been/is ploughed causing damage to the feature (*e.g. deep ploughing on a glacial terrace?*)	**PA**	0K	PA	V	A	S	NI	PD	NB
1.10		The site has been put to another agricultural use. Specify: ……..… ….... with no detrimental effect on the feature.	**OK**	0K	PA	V	A	S	NI	PD	NB
1.11		The site has been put to another agricultural use. Specify: ……..… ….... with the following effect on the feature. Specify: ……..… ……..		0K	PA	V	A	S	NI	PD	NB

2.1	**Vegetation**	Outcrop is partially/largely covered by seaweed.	**OK**	0K	PA	V	A	S	NI	PD	NB
2.2		Vegetation (excluding seaweed)/tree cover does not adversely affect the feature.	**OK**	0K	PA	V	A	S	NI	PD	NB
2.3		Vegetation (excluding seaweed)/tree cover limits visibility of and/or access to the feature (e.g. partially covers outcrop or blocks an access path) but the vegetation is seasonal.	**OK**	0K	PA	V	A	S	NI	PD	NB
2.4		Vegetation (excluding seaweed)/tree cover limits visibility of and/or access to the feature but the vegetation will almost certainly be removed by natural processes within 1-2 yrs (e.g. a soft sediment feature where exposure is covered by slump and vegetation but regular landslip are expected to continue, re-exposing fresh sediment sections).	**OK**	0K	PA	V	A	S	NI	PD	NB
2.5		Vegetation (excluding seaweed)/tree cover significantly limits visibility of the feature (e.g. covers sections of outcrop) /significantly inhibits access to the feature (e.g. blocks access paths either to the outcrop/landforms or to important vantage points for viewing the outcrop/landforms) and this cover is **not** seasonal.	**V/A**	0K	PA	V	A	S	NI	PD	NB
2.6		Vegetation (excluding seaweed)/tree cover does not adversely affect the feature. Continued vegetation/tree growth at the current rate will significantly limit visibility of/access to the feature within 6 years (before the next monitoring visit) **however** there is a management agreement to clear this vegetation on a regular basis. The regularity of this agreed clearing operation is sufficient to maintain visibility of and access to the feature.	**OK**	0K	PA	V	A	S	NI	PD	NB
2.7		Vegetation (excluding seaweed)/tree cover does not adversely affect the feature. Continued vegetation/tree growth at the current rate will significantly limit visibility of/access to the feature within 6 years (before the next monitoring visit). There is a management agreement to clear this vegetation on a regular basis, **but** the regularity of this agreed clearing operation is thought to be **insufficient** to maintain visibility of and access to the feature. **Or** there is **no** management agreement to clear this vegetation on a regular basis.	**NI**	0K	PA	V	A	S	NI	PD	NB
2.8		Consented tree planting has occurred on the site and does not affect the feature.	**OK**	0K	PA	V	A	S	NI	PD	NB
2.9		Unconsented tree planting has occurred in the site and this is a specified negative indicator. The trees do/do not/will/will not obscure outcrop, block access paths etc. (If there is no detrimental effect on the feature some	**NI**	0K	PA	V	A	S	NI	PD	NB

		form of 'retrospective permission' would return the site to favourable condition)									
2.10		Consented tree planting has occurred on the site and significantly limits visibility of the feature/significantly inhibits access to the feature/inhibits natural evolution of an 'active process'* feature. (Investigate why the planting was consented).	**V/A**	0K	PA	V	A	S	NI	PD	NB
2.11		Consented tree planting has occurred on the site. It does not currently adversely affect the feature but will significantly limit visibility of the feature/significantly inhibit access to the feature/inhibit natural evolution of an 'active process'* feature within 6 years (before next monitoring visit).(Investigate why the planting was consented).	**NI**	0K	PA	V	A	S	NI	PD	NB
2.12		Another scenario, please specify: …… …… …….…… ……..		0K	PA	V	A	S	NI	PD	NB
3.1	**Erosion and sedimentation**	No (visible) erosion/minor 'natural' erosion has occurred.	**OK**	0K	PA	V	A	S	NI	PD	NB
3.2		The feature is partly/largely covered by beach sand (the volume of this/extent of cover is likely to change over time)	**OK**	0K	PA	V	A	S	NI	PD	NB
3.3		The site is an exposure site and active (natural or artificially modified) erosion has produced/is producing new/clean sediment exposure/rock face.	**OK**	0K	PA	V	A	S	NI	PD	NB
3.4		The site is an **integrity** site, but not an 'active process'* feature. The natural, or artificially modified erosion rate is rapidly removing the feature (burial or some other form of protection should be considered).	**PA**	0K	PA	V	A	S	NI	PD	NB
3.5		The site is an **exposure** site and the natural or artificially modified erosion rate is rapidly removing sections of the feature but the extent and quality of exposure is not decreasing.	**OK**	0K	PA	V	A	S	NI	PD	NB
3.6		The feature is a 'soft sediment'* feature. The natural (or artificially modified) erosion rate is resulting/has resulted in a build-up of sediment/slumping which is partially/wholly obscuring the feature. Equivalent fresh exposure will almost certainly be formed/reformed by natural processes (e.g. further landslip) within 1-2 yrs **or** the eroded/slumped sediment material is of a volume which could be removed in a few hours with a hand tool; or by a machine and there is suitable vehicle access.	**OK**	0K	PA	V	A	S	NI	PD	NB

3.7		The feature is a 'soft sediment'* feature. The natural (or artificially modified) erosion rate is resulting/has resulted in a build-up of sediment/slumping which is partially/wholly obscuring the feature. Equivalent fresh exposure will almost certainly **not** be formed/reformed by natural processes within 1-2 yrs (e.g. vegetation has stabilised the slope), the eroded/slumped sediment material is not of a volume which could be removed in a few hours with a hand tool and there is no suitable vehicle access for machine excavation.	**V, A**	0K	PA	V	A	S	NI	PD	NB
3.8		The feature is a 'hard rock'* feature and natural sedimentation/slump/landslip has significantly obscured the feature. The obscuring cover is likely to be removed by natural processes within 1-2 years.	**OK**	0K	PA	V	A	S	NI	PD	NB
3.9		The feature is a 'hard rock'* feature and natural sedimentation/slump/landslip has significantly obscured the feature. The area of sedimentation/slump/landslip is **not** part of a 'active process feature'. The obscuring cover is not likely to be removed by natural processes within 1-2 years.	**V, A**	0K	PA	V	A	S	NI	PD	NB
3.10		The feature is a 'hard rock'* feature and natural sedimentation/slump/landslip has significantly obscured the feature. The area of sedimentation/slump/landslip **is** part of a 'active process'* feature. A compromise will be required between management requirements for the two features.	**OK or V, A**	0K	PA	V	A	S	NI	PD	NB
3.11		The feature is a 'hard rock'* feature and artificially induced sedimentation/slump/landslip has significantly obscured the feature.	**V, A**	0K	PA	V	A	S	NI	PD	NB
3.12		The feature is an 'active process'* feature and natural sedimentation/slump/landslip has significantly obscured the rock/sediment outcrop.	**OK**	0K	PA	V	A	S	NI	PD	NB
3.13		The feature is an 'active process'* feature and the erosion/sedimentation rate is being artificially modified without consent.	**PD**	0K	PA	V	A	S	NI	PD	NB
3.14		The natural or artificially modified erosion of a slope/path/cliff is a safety hazard.	**S**	0K	PA	V	A	S	NI	PD	NB
3.15		A section of a tunnel/cave has collapsed significantly reducing visibility of the feature/inhibiting access to the feature/posing a safety risk to site visitors.	**V/A/S**	0K	PA	V	A	S	NI	PD	NB
3.16		A section of a tunnel/cave has collapsed destroying/altering part of an integrity or 'natural processes' interest feature. The instability is/was the result of non-natural processes.	**PA, PD**	0K	PA	V	A	S	NI	PD	NB

3.17		A section of a tunnel/cave is in danger of collapsing and destroying part of an integrity interest feature. The instability is caused by natural processes.	**OK**	0K	PA	V	A	S	NI	PD	NB
3.18		A section of a tunnel/cave is in danger of collapsing and destroying part of an integrity interest feature. The instability is the result of non-natural processes.	**NI**	0K	PA	V	A	S	NI	PD	NB
3.19		Another scenario, please specify: …… …… ……..…… ……..		0K	PA	V	A	S	NI	PD	NB
4.1	**Water**	The water quality is acceptable/ there is no sign of pollution.	**OK**	0K	PA	V	A	S	NI	PD	NB
4.2		The water appears as though it may be polluted (colour, clarity, smell) but the water can be avoided when accessing and studying the feature. (May be worth a repeat visit to check quality/appearance again and possibly alert SEPA)	**OK**	0K	PA	V	A	S	NI	PD	NB
4.3		The water appears as though it may be polluted (colour, clarity, smell) and it is impossible to avoid contact with the water when accessing or studying the feature (e.g. the water flows over outcrop, outcrop is exposed in the stream etc). (Requires a repeat visit to check quality/appearance again and/or to contact SEPA)	**S**	0K	PA	V	A	S	NI	PD	NB
4.4		Water levels have not been artificially altered and do not inhibit visibility of or access to the feature (although water levels may have changed since previous monitoring visit or base line survey).	**OK**	0K	PA	V	A	S	NI	PD	NB
4.5		Water levels inhibit visibility of and/or access to all or part of the feature but the water level is seasonably variable and will not inhibit visibility or access all year. (Suggest site visits for specified periods when water level appropriate for access).	**OK & NB**	0K	PA	V	A	S	NI	PD	NB
4.6		Water levels inhibit visibility of/access to all or part of the feature and will do so all year. Water level is not part of a notified 'active process feature' in the affected area.	**V/A**	0K	PA	V	A	S	NI	PD	NB
4.7		The feature is an 'active process feature'* and water levels have been artificially modified.	**PD**	0K	PA	V	A	S	NI	PD	NB
4.8		Water levels inhibit visibility of and/or access to all or part of the feature. Water level is part of a notified 'active process'* feature and has not been artificially modified. (This situation may require some compromise as management issues of two or more feature may be in conflict).	**OK**	0K	PA	V	A	S	NI	PD	NB
4.9		The site is not an 'active process'* site and water levels are maintained artificially to the benefit of the feature (e.g. water levels kept low exposing additional rock)	**OK**	0K	PA	V	A	S	NI	PD	NB

4.10		Another scenario, please specify: …… …… ……..…… ……..		0K	PA	V	A	S	NI	PD	NB
5.1	**Tipping**	Tipping has occurring within the site since the baseline/last monitoring visit. (If 'no tipping' is specified in the NI target then it is irrelevant whether this tipping covers rock exposure etc.).	**NI**	0K	PA	V	A	S	NI	PD	NB
5.2		Tipping has occurring within the site since the baseline/last monitoring visit which obscures part of the feature/inhibits access to the feature/causes a safety hazard (e.g. half buried cars on access route to feature, toxic debris, unstable piles of rubbish).	**V/A/S**	0K	PA	V	A	S	NI	PD	NB
5.3		Tipping has occurring within the site since the baseline/last monitoring visit which is inhibiting the natural evolution of an active process feature.	**PD**	0K	PA	V	A	S	NI	PD	NB
5.4		There is tipped material within the site but it is not recent (is pre baseline survey) and does not cover rock outcrop/sediment exposure or inhibit access or cause a safety hazard or inhibit natural evolution of the feature. (Recommend its removal)	**OK & NB**	0K	PA	V	A	S	NI	PD	NB
5.5		There is tipped material within the site. It is not recent (is pre baseline survey) but it partially or wholly covers the feature/inhibits access to the feature/is a safety hazard (e.g. half buried cars on access route to feature, toxic debris, unstable piles of rubbish)/inhibits the natural evolution of an 'active process'* feature.	**V/A/S/ PD**	0K	PA	V	A	S	NI	PD	NB
5.6		Erection of 'No tipping' signs may help prevent tipping.	**NB**	0K	PA	V	A	S	NI	PD	NB
5.7		Physical restriction of vehicle access may help prevent tipping.	**NB**	0K	PA	V	A	S	NI	PD	NB
5.8		Another scenario, please specify: …… …… ……..…… ……..		0K	PA	V	A	S	NI	PD	NB
6.1	**Coastal and river defences**	Unconsented coastal/river defences have recently (post baseline survey) been constructed within the site. (If they do not adversely affect the feature then 'retrospective permission' may return the site to a favourable condition)	**NI**	0K	PA	V	A	S	NI	PD	NB
6.2		Unconsented coastal/river defences have recently (post baseline survey) been constructed within the site, obscuring part or all of the feature.	**V & A +/- NI**	0K	PA	V	A	S	NI	PD	NB
6.3		There are recent consented coastal/river defence works within the site which do not obscure any of the feature (e.g. along sections of coast with no outcrop),	**OK**	0K	PA	V	A	S	NI	PD	NB

6.4		There are recent **consented** coastal/river defence works within the site which **do** obscure part of the feature/inhibit access to part of the feature/inhibit natural evolution of the feature, but are protecting 'valuable' assets. (It may be necessary to re-set the baseline for monitoring or update the SAT; to return the site to favourable condition)	**OK or V, A, PD (consult SAT and conditions of consent)**	0K	PA	V	A	S	NI	PD	NB
6.5		Existing coastal/river defences are crumbling into the SSSI and are obscuring part or all of the feature/significantly inhibiting access to part of all of the feature/causing a safety hazard for people studying the feature/ inhibiting the natural evolution of an 'active process'* feature.	**V/A/S/ PD**	0K	PA	V	A	S	NI	PD	NB
6.6		Existing coastal/river defences are crumbling into the SSSI and are likely in future to partly or wholly obscure the feature/significantly inhibit access to part or all of the feature/become a safety hazard for people studying the feature/inhibit the natural evolution of the (active process) feature.	**NI**	0K	PA	V	A	S	NI	PD	NB
6.7		Existing coastal/river defences are crumbling into the SSSI but are not obscuring or likely in future to obscure any part of the feature. The material crumbling into the SSSI may be viewed as 'tipping'. 'Tipping' is a negative indicator.	**NI**	0K	PA	V	A	S	NI	PD	NB
6.8		Existing coastal/river defences are crumbling into the SSSI but are not obscuring or likely in future to obscure any part of the feature. The material crumbling into the SSSI may be viewed as 'tipping'. 'Tipping' is **not** a negative indicator.	**OK**	0K	PA	V	A	S	NI	PD	NB
6.9		Crumbling coastal/river defences could/should be replaced with more suitable constructions. Specify/suggest: ……	**NB**	0K	PA	V	A	S	NI	PD	NB
6.10		There has been unconsented coastal reclamation.	**NI**	0K	PA	V	A	S	NI	PD	NB
6.11		There has been unconsented coastal reclamation which has covered part or all of the feature/inhibited access to all or part of the feature/compromised the safety of anyone studying the feature.	**V/A/S +/- NI**	0K	PA	V	A	S	NI	PD	NB
6.12		There has been unconsented coastal reclamation which has inhibited the natural evolution of the feature.	**PD +/- NI**	0K	PA	V	A	S	NI	PD	NB

6.13		There has been **consented** coastal reclamation which has covered part or all of the feature/inhibited access to all or part of the feature/compromised the safety of anyone studying the feature. (Investigate why the work was consented. It may be necessary to re-evaluate the scientific interest of the site and re-set the base line for monitoring (or the feature will never be favourable again)).	**V/A/S or OK (consult SAT)**	0K	PA	V	A	S	NI	PD	NB
6.14		Coastal reclamation has covered all or part of the feature but there is the potential for re-excavation by natural (e.g. erosion) or mechanical means.	**NB**	0K	PA	V	A	S	NI	PD	NB
6.15		Consented, managed retreat has been carried out without significant adverse effect to the feature.	**OK**	0K	PA	V	A	S	NI	PD	NB
6.16		Unconsented managed retreat has been carried out and has removed all or part of the feature/covered part or all of the feature/inhibited access to all or part of the feature/compromised the safety of anyone studying the feature.	**PA/V/A/S +/- NI**	0K	PA	V	A	S	NI	PD	NB
6.17		Consented managed retreat has been carried out and has removed all or part of the feature/covered part or all of the feature/inhibited access to all or part of the feature/compromised the safety of anyone studying the feature. (Investigate why the work was consented. It may be necessary to re-evaluate the scientific interest of the site and re-set the base line for monitoring.)	**PA/V/A/S or OK (consult SAT)**	0K	PA	V	A	S	NI	PD	NB
6.18		Another scenario, please specify: …… …… ……..…… ……..		0K	PA	V	A	S	NI	PD	NB
7.1	**Slope stabilisation**	Consented slope stabilisation has been carried out with no significant adverse effect on the feature.	**OK**	0K	PA	V	A	S	NI	PD	NB
7.2		Unconsented slope stabilisation has been carried out.	**NI**	0K	PA	V	A	S	NI	PD	NB
7.3		Unconsented slope stabilisation has been carried out and part or all of the feature has been removed.	**PA**	0K	PA	V	A	S	NI	PD	NB
7.4		Unconsented slope stabilisation has been carried out and has obscured part or all of the feature/inhibited access to part or all of the feature/caused a safety hazard to people studying the feature/inhibited natural evolution of an 'active process'* feature.	**V/A/S/PD**	0K	PA	V	A	S	NI	PD	NB
7.5		Consented slope stabilisation has been carried out and has damaged the feature. (Consult conditions of consent. May have to re-set baseline/re-asses earth science interest).	**OK or PA, V, A, S, PD**	0K	PA	V	A	S	NI	PD	NB

7.6		Another scenario, please specify: …… …… ……..…… ……..		0K	PA	V	A	S	NI	PD	NB
8.1	**Construction and stored material**	There are recent unconsented man-made constructions (including roads/tracks) and/or materials stored within the site but these do not affect the interest feature; or have a beneficial affect (e.g. tracks giving better access).	**OK or NI (consult SAT)**	0K	PA	V	A	S	NI	PD	NB
8.2		There are recent unconsented man-made constructions (including roads/tracks) and/or materials stored within the site and these obscure part or all of the feature/inhibit access to part or all of the feature/cause a safety hazard to people studying the feature/inhibit natural evolution of an 'active process'* feature.	**V/A/S/ PD**	0K	PA	V	A	S	NI	PD	NB
8.3		There are recent **consented** man-made constructions (including roads/tracks) and/or materials stored within the site which adversely affect part or all of the feature. (investigate why consent was given).	**OK or PA, V, A, S, PD**	0K	PA	V	A	S	NI	PD	NB
8.4		The construction(s) and/or the stored material may be removed, returning the site to a favourable condition.	**NB**	0K	PA	V	A	S	NI	PD	NB
8.5		Another scenario, please specify: …… …… ……..…… ……..		0K	PA	V	A	S	NI	PD	NB
9.1	**Collecting and research**	There is no evidence of recent collecting within the site.	**OK**	0K	PA	V	A	S	NI	PD	NB
9.2		There is evidence of **responsible** mineral/fossil/rock collecting/removal. (e.g. predominantly loose material removed, damage to *in situ* rock very minor at most, abundant resource material both loose and *in situ* still present).	**OK**	0K	PA	V	A	S	NI	PD	NB
9.3		There is evidence of **irresponsible** mineral/fossil/rock collecting/removal. (e.g. Hammer, rock-saw and/or chisel marks on areas of *in situ* rock exposure, large chunks of *in situ* rock hacked out or smashed up, area littered with collecting debris, Evidence of large scale or machine excavation, little or no resource (loose and/or *in situ* rock) left within the site).	**PA NI**	0K	PA	V	A	S	NI	PD	NB
9.4		The activities of collectors have significantly reduced the visibility of the feature/inhibited access to part or all of the feature/caused a safety hazard to people studying the feature.	**V/A/S**	0K	PA	V	A	S	NI	PD	NB
9.5		Physical restraints on access (e.g. fencing off or burial of the remaining resource) may help protect the site.	**NB**	0K	PA	V	A	S	NI	PD	NB

9.6		Erecting information and/or 'no collecting/no hammering' signs may help to protect the site.	**NB**	0K	PA	V	A	S	NI	PD	NB
9.70		The owner/occupier/other interested party has a record of visitors. This indicates small/large numbers. Specify:……	**NB**	0K	PA	V	A	S	NI	PD	NB
9.8		Consented research has been undertaken in a responsible manner and the feature has not been adversely affected.	**OK**	0K	PA	V	A	S	NI	PD	NB
9.9		Consented research has been undertaken but in an irresponsible manner (excessive numbers of samples taken, large areas of feature destroyed, site littered with collecting debris).	**PA NI**	0K	PA	V	A	S	NI	PD	NB
9.10		Consented research has been undertaken and has obscured part or all of the feature/inhibited access to part or all of the feature/caused a safety hazard to people studying the feature.	**V**	0K	PA	V	A	S	NI	PD	NB
9.11		Buried features or parts of the feature have been excavated with/without consent and have not been reburied.	**V NI**	0K	PA	V	A	S	NI	PD	NB
9.12		Another scenario, please specify: …… …… ……..…… ……..		0K	PA	V	A	S	NI	PD	NB
10.1	**Mining and extraction works**	The site is an exposure site. Minor (<1% volume of any outcrop/sediment resource) consented or unconsented loss of outcrop/sediment resource has occurred but the exposure lost has been replaced by equivalent or better quality/more extensive new exposure.	**OK & NB**	0K	PA	V	A	S	NI	PD	NB
10.2		The site is an exposure site. Minor (<1% volume of any outcrop/sediment resource) unconsented loss of outcrop/sediment resource has occurred and the exposure lost has not been replaced by equivalent or better quality/more extensive new exposure.	**PA NI**	0K	PA	V	A	S	NI	PD	NB
10.3		The site is an exposure site. Unconsented extraction/removal of rock, peat, sand, gravel or slag has occurred which cannot be considered minor (e.g. >1% volume of any outcrop/sediment resource removed).	**PA NI**	0K	PA	V	A	S	NI	PD	NB
10.4		Consented excavation (e.g. extraction/removal of rock/peat/sand/gravel/slag) has conserved outcrop/exposure/landforms as agreed under the terms of the consent.	**OK**	0K	PA	V	A	S	NI	PD	NB
10.5		The site is an exposure site. Consented excavation/removal has destroyed original exposure of Earth Science elements and has not replaced it; but this is in line with the consent given (e.g. the exposure lost was not considered critical)	**OK**	0K	PA	V	A	S	NI	PD	NB

10.6		The site is an exposure site. Non-minor consented excavation (e.g. >1% volume of any outcrop/sediment resource removed) has destroyed original exposure of Earth Science elements but has exposed equivalent/better examples of the same elements elsewhere.	**OK**	0K	PA	V	A	S	NI	PD	NB
10.7		The site is an exposure site. Consented excavation has destroyed original key exposure of Earth Science elements. The terms of the consent specify that equivalent/better examples of the same elements must be exposed elsewhere but this has not occurred.	**PA NI**	0K	PA	V	A	S	NI	PD	NB
10.8		The site is an exposure site. Exposure has been lost though excavation/mining work but there is the potential for re-exposure/new exposure of equivalent or better quality through natural (e.g. erosion) or (continuing) active working.	**NB**	0K	PA	V	A	S	NI	PD	NB
10.9		The site is an integrity site. Unconsented extraction of rock, peat, sand, gravel or slag has occurred (including e.g. removal of material from mine dumps).	**PA NI**	0K	PA	V	A	S	NI	PD	NB
10.10		The site is an integrity site. Consented excavation (e.g. consent was in place before designation) has removed all or part of the feature. (It will be necessary to re-evaluate the scientific interest of the site and re-set a baseline (or the site will never be favourable again))	**PA & NB**	0K	PA	V	A	S	NI	PD	NB
10.11		Another scenario, please specify: …… …… ……..…… ……..		0K	PA	V	A	S	NI	PD	NB
11.1	**Recreation**	Rock climbing has caused damage to the feature (e.g. glacial striations obscured, excessive number of fixed belay points)	**PA NI**	0K	PA	V	A	S	NI	PD	NB
11.2		Quad/mountain biking has caused significant erosion to key rock/landforms.	**PA**	0K	PA	V	A	S	NI	PD	NB
11.3		Quad/mountain biking will cause significant erosion to key rock/landforms if it continues at the current intensity.	**NI**	0K	PA	V	A	S	NI	PD	NB
11.4		Walking/scrambling has caused significant erosion to key rock/landforms.	**PA**	0K	PA	V	A	S	NI	PD	NB
11.5		Walking/scrambling will cause significant erosion to key rock/landforms if it continues at the current intensity.	**NI**	0K	PA	V	A	S	NI	PD	NB
11.6		Damaging fixings or waste has been left by cavers.	**PA NI**	0K	PA	V	A	S	NI	PD	NB
11.7		Cavers have left waste/debris/litter.	**NI**	0K	PA	V	A	S	NI	PD	NB

11.8		Fixings/waste/debris/litter left by cavers obscures visibility of part or all of the feature/inhibits access to part or all of the feature/causes a safety hazard to people studying the feature.	**V/A/S**	0K	PA	V	A	S	NI	PD	NB
11.9		Another form of recreational use has caused damage to the site. Specify:…… ……....	**NB & PA, V, A, S, or NI**	0K	PA	V	A	S	NI	PD	NB
11.10		Another scenario, please specify: …… …… ……..…… ……..		0K	PA	V	A	S	NI	PD	NB
12.1	**Protective measures**	The 'No Hammering'/'No collecting' sign is intact and legible.	**OK**	0K	PA	V	A	S	NI	PD	NB
12.2		The 'No Hammering'/'No Collecting' sign is illegible/damaged/has been removed.	**NI**	0K	PA	V	A	S	NI	PD	NB
12.3		The 'No Hammering'/'No collecting' sign is legible but may need replaced in < 6 years (e.g. are weathering slowly).	**NB OK or NI**	0K	PA	V	A	S	NI	PD	NB
12.4		The 'No Tipping' sign is intact and legible.	**OK**	0K	PA	V	A	S	NI	PD	NB
12.5		The 'No Tipping' sign is illegible/damaged/has been removed.	**NI**	0K	PA	V	A	S	NI	PD	NB
12.6		The 'No Tipping' sign is legible but may need replaced in < 6 years (e.g. are weathering slowly).	**NB OK or NI**	0K	PA	V	A	S	NI	PD	NB
12.7		Safety warming signs are intact and legible.	**OK**	0K	PA	V	A	S	NI	PD	NB
12.8		Safety warming signs are legible but may need replaced in < 6 years (e.g. are weathering slowly).	**NB OK or NI**	0K	PA	V	A	S	NI	PD	NB
12.9		Safety warning signs are illegible/damaged/have been removed (and are still considered to be necessary).	**S**	0K	PA	V	A	S	NI	PD	NB
12.10		Parts of the feature buried for protection are still buried and have not been disturbed (except with consent).	**OK**	0K	PA	V	A	S	NI	PD	NB
12.11		Parts of the feature buried for protection are still buried but have been disturbed without consent.	**NI PA**	0K	PA	V	A	S	NI	PD	NB
12.12		Parts of the feature buried for protection are partly or wholly uncovered.	**V PA**	0K	PA	V	A	S	NI	PD	NB
12.13		Parts of the feature buried for protection have been disturbed and/or are partly or wholly uncovered and the apparent cause is …….. …….. (specify).	**NB**	0K	PA	V	A	S	NI	PD	NB
12.14		It is considered necessary for specimens to be removed to a collection for preservation.	**NB**	0K	PA	V	A	S	NI	PD	NB
12.15		Specimens should have been removed to a collection for preservation and this has been done.	**OK**	0K	PA	V	A	S	NI	PD	NB
12.16		Specimens should have been removed to a collection for preservation but this has not been done.	**PA NI**	0K	PA	V	A	S	NI	PD	NB

12.17		The roof/shelter protecting part or all of the feature is intact.	**OK**	0K	PA	V	A	S	NI	PD	NB
12.18		The roof/shelter protecting part or all of the feature is damaged/has been removed.	**NI PA**	0K	PA	V	A	S	NI	PD	NB
12.19		Access restraints for vehicles are intact.	**OK**	0K	PA	V	A	S	NI	PD	NB
12.20		Access restraints for vehicles are damaged but still functional.	**NB OK or NI**	0K	PA	V	A	S	NI	PD	NB
12.21		Access restraints for vehicles are damaged and no longer functional/have been removed.	**NI A**	0K	PA	V	A	S	NI	PD	NB
12.22		Access restraints for people imposed on safety grounds are intact.	**OK**	0K	PA	V	A	S	NI	PD	NB
12.23		Access restraints for people imposed on safety grounds are damaged but still functional.	**NB OK or NI**	0K	PA	V	A	S	NI	PD	NB
12.24		Access restraints for people imposed on safety grounds are damaged and no longer functional/have been removed (and are still considered to be necessary).	**S**	0K	PA	V	A	S	NI	PD	NB
12.25		Access restraints for people have been imposed for reasons other than safety. Specify reasons if known: ……	**A V OK**	0K	PA	V	A	S	NI	PD	NB
12.26		Another scenario, please specify: …… …… ……..…… ……..		0K	PA	V	A	S	NI	PD	NB

Appendix 5: Current SNH Earth Science Site Check Guidance

SITE CHECK GUIDANCE FOR EARTH SCIENCE FEATURES IN SSSIs

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About this guidance note

This Guidance note provides guidance on conducting a Site Check on Earth science features in SSSIs. It assumes that you are familiar with SNH Earth Science guidance for full SCM , in particular the guidance on 'Practical Monitoring of Earth Science sites'.

SNH Earth Science site condition monitoring guidance can be found on the SNH Earth Science Site Condition Monitoring microsite
http://10.200.1.39/objective/?B101028

Site Check method

'Site Check is proposed to provide a simple overview of all, or part of, a site to confirm (or otherwise) that management and wider influences have not changed since the last SCM assessment or Site Check visit'[27]. These 'wider influences' might include third party damage to the feature or natural events such as erosion, landslip and vegetation growth. Checking for ALL management changes and wider influences for Earth Science features would effectively be replicating full SCM. Therefore, it is proposed that Site Check will aim to record a minimum of all likely damage to the feature and any change in management regime. This is NOT as thorough as full SCM and it is accepted that unexpected/unlikely damage may go unrecorded. The method proposed for Site Check of Earth Science features can be summarised as:

Sufficient of the feature should be viewed from an appropriate distance for you to determine whether or not likely damage has occurred to the feature since the last SCM/Site Check visit, and to identify any change in management regime that might affect the feature. Any other damage to the feature, changes in wider influences etc. noted during the site visit should also be recorded in the Site Check.

The following sections give guidance on what this means in practice.

Damage and Likely Damage

Damage is defined as any change that would cause the feature to be assessed as 'unfavourable' or 'partially destroyed' in a full SCM assessment. What constitutes this change, therefore, will depend on the wording of the monitoring Targets specified for the feature; but in general, it is likely to involve removal of part of the feature, obscuring of part of the feature, or interference with any of the processes forming the features (for active features). Note that these are usually not considered damaging if they have been consented (baseline effectively re-set).

Likely Damage is

- any damage caused by an activity that has previously occurred and may be repeated/extended (e.g. irresponsible specimen collecting, dumping of rubbish, river dredging, coastal and river bank protection, vegetation growth etc),
- damage that has been flagged up as 'likely to occur' in a previous SCM assessment ('Negative Indicators' section),
- irresponsible specimen collecting in fossil or mineral sites with visual appeal[28].

[27] Quote from SCM Cycle 3 proposals paper.
[28] This is a known problem that SNH is attempting to quantify and address.

Appropriate distance

An appropriate distance is one at which it is possible to see if Likely Damage has occurred and/or to spot changes in management. It is NOT necessary to get close enough to detect all possible damage to the feature, only that which is thought likely to occur as discussed in 3 above.

Note that this will mean that all fossil and mineral GCR sites with a history of collecting, or with no collecting history but with visual appeal, need viewed close enough for any collecting to be identified.

Sufficient of the feature - Key Locations

The area of an Earth Science feature within an SSSI is defined by the associated GCR site boundary or boundaries. GCR site boundaries are available on Geoview and externally through SNHi 'Natural Spaces'.

When carrying out Site Check, as with full SCM, each individual GCR site that forms the feature MUST be considered as a separate site. So if an SSSI feature is made up of two GCR sites you must visit both in order to complete a Site Check on the feature.

Small GCR sites

For small GCR sites that can be viewed from an appropriate distance (see section 4 above) entirely from a single viewpoint or by a <15-30 minutes walk-round, this should be done.

Large GCR sites

For the purposes of 'Site Check' a large GCR site is one that cannot be viewed entirely from a single viewpoint or by a <15-30 minutes walk-round. For large GCR sites you will need to view the following **Key Locations** to cover sufficient of the feature when conducting a Site Check:

1) **Locations of Likely Damage**
See 'Likely Damage' in section 3 above.

2) **Locations of known management change**
For example where

- remedies are in place
- management has been reviewed or management review was recommended in a previous full SCM or Site Check
- consents have been granted/work carried out since last SCM/Site Check visit.

3) **Geological type 'hot spots'**.
For example (from 'hot spot' list in SCM 'Practical Monitoring Guidance[29]'):

- Historic/famous outcrops or landforms (e.g. 'Hutton's unconformities');
- Classic student teaching outcrops/landforms (e.g. localities listed in field guides);
- Rare/best/unique exposure/occurrence of something the site is particularly noted for (particular rock/landform type, mineral vein, particularly fossiliferous horizon etc),

[29] Note that the following non-geological type 'hot spots' listed in the SCM 'Practical Monitoring Guidance' are NOT essential to view if no damage to the feature has previously been associated with them: Roads, tracks or paths; Areas near human habitation or obvious landmarks; active and disused quarries; land adjacent to forestry plantations; coastal or river edges.

including all limited fossil/mineral resources. (There should be at least one area of this type in each GCR site)

Where 'crucial' and 'context' zones are defined for the GCR site, Geological type 'hot spots' will lie in the 'crucial' zones. Therefore all 'crucial' zones may be considered Key Locations, thus covering all Geological type 'hot spots'. However, where 'crucial' zones are very extensive or are not defined, Geological type 'hot spots' may be located more specifically from information in the Site Documentation Report (often photographs and descriptions) and/or the GCR volume text (grid references often given, but note that not all given grid references will necessarily qualify as 'hot spots'). If in doubt, please contact SNH Earth Science Group.

Examples

1) You are carrying out a Site Check of a large upland SSSI with a 'Structural and Metamorphic Geology' feature comprising a similarly large stream-section and inland outcrop GCR site. The feature has no previous recorded damage or likely damage. You therefore only need to check for any management change, such as changes in grazing regime, increased tracking by off-road vehicles, unconsented tree planting etc affecting the Key Locations. The only Key Locations are Geological 'hot spots' (as no previous or likely damage), and all of these can be seen from a view point on the other side of the valley. Therefore, you can complete the Site Check from this view point with a pair of binoculars. **Note**, however, that if a Key Location had been over the ridge of the hill, it would have been necessary to find another view point for this part of the feature (e.g. top of hill, next valley etc)

2) You are carrying out a Site Check on a 'Palaeontology' feature made up of 2 small GCR sites on a hillside. One GCR site contains fossil-bearing material in a small disused quarry and there has been previously recorded irresponsible collecting, the other has fossil material in a spoil heap and has no previously recorded damage. You can see both sites clearly from a nearby viewpoint, however you need to visit both GCR sites and view the fossil-bearing rock/spoil heaps close enough to identify whether any irresponsible collecting has occurred. There is, however, no need to count or otherwise record the abundance of fossil material in the spoil heaps.

Summary

In order to carry out a Site Check of an Earth Science feature, you need to:

- view all Key Locations in the GCR site(s) that make up the SSSI feature from a distance at which it is possible to
    - see damage of a type previously recorded that may be repeated
    - see damage of a type thought likely to occur on that site type,
    - identify any management changes
- record any damage, and any changes in management or wider influences (include description and grid refs, and also photos where possible).

Appendix 6: Standard Pressures list for Site Condition Monitoring in Scotland

Pressure Group	Standard Pressure
Agricultural operations	Agricultural operations
Air pollution	Pollution - air-based sources (inc. greenhouse gases)
Burning	Burning
Climate Change	Climate change
Development	Beach replenishment
Development	Development with planning permission
Development	Energy production - at sea (wind & wave turbines)
Development	Energy production - on land (power stations, inc. nuclear)
Dumping/ storage of materials	Dumping/spreading/storage of materials
Dumping/ storage of materials	Waste disposal - munitions (chemical & conventional)
Dumping/ storage of materials	Waste disposal - navigational dredging (capital, maintenance)
Dumping/ storage of materials	Waste disposal - quarrying (geological material)
Extraction	Extraction - dredging (capital, maintenance)
Extraction	Extraction - maerl
Extraction	Extraction - oil & gas
Extraction	Extraction - quarrying
Extraction	Extraction - sand & gravel
Extraction	Extraction - water (freshwater catchment; industrial, e.g. power station)
Extraction	Geological Core extraction
Extraction	Mineral extraction
Flood defence/coastal defence works	Flood defence/coastal defence works
Forestry operations	Forestry operations
Game/ fisheries management	Aquaculture - finfish
Game/ fisheries management	Aquaculture - shellfish
Game/ fisheries management	Fishing - benthic trawling
Game/ fisheries management	Fishing - hydraulic dredging
Game/ fisheries management	Fishing - pelagic trawling
Game/ fisheries management	Fishing - potting/creeling
Game/ fisheries management	Fishing - recreational
Game/ fisheries management	Fishing - set netting
Game/ fisheries management	Fishing - shellfish harvesting
Game/ fisheries management	Game or fisheries management
Game/ fisheries management	Harvesting - seaweed
Game/ fisheries management	Waste disposal - fish waste (land-based processing; processing vessels)
Grazing - other	Grazing - appropriate level
Infrastructure	Infrastructure - cables & pipelines
Infrastructure	Infrastructure - coastal (ports, marinas, leisure facilities)
Infrastructure	Infrastructure - coastal defence & land claim
Infrastructure	Infrastructure - offshore (artificial reefs)
Infrastructure	Infrastructure - offshore (oil & gas platforms)
Infrastructure	Infrastructure - offshore (wind turbines)
Inter-specific competition	Inter-specific competition
Invasive species	Presence/changing extent invasive species - NATIVE
Invasive species	Presence/changing extent invasive species - NON NATIVE
Maintenance activities	Maintenance activities carried on site by an organisation

Maintenance activities	Mechanical beach cleaning
Military activities	Military activities
Military activities	Seismic survey (military, exploration, construction)
Natural event	Natural event
Natural event	Tree regeneration
No proactive management	Non intervention
Not to be reported	Assured management expiring
Other	No on-site activities related to feature condition noted
Other	Shipping
Over grazing	Grazing - over
Plant pests and diseases	Plant Pests and Diseases
Proactive on-site management	Proactive on-site management
Recreation/disturbance	Fossil Collection
Recreation/disturbance	Graffiti/defacing of site
Recreation/disturbance	Recreation/disturbance
Recreation/disturbance	Tourism & recreation
Statutory undertaker	Statutory undertaker
To be identified	Pressure to be identified
Trampling	Trampling
Under grazing	Grazing - under
Water management	Water Dependant Pressure- abstraction
Water management	Water Dependant Pressure- artificial recharge
Water management	Water Dependant Pressure- diffuse source pollution
Water management	Water Dependant Pressure- flow regulation
Water management	Water Dependant Pressure- morphological alteration
Water management	Water Dependant Pressure- point source pollution
Water management	Water Dependant Pressure- pressure to be identified
Water management	Water management
Water quality	Pollution - land-based sources
Water quality	Pollution - sewage
Water quality	Water quality
Wildlife crime	Wildlife Crime

Appendix 7: Geological specimen collecting Guidance and Application Form being trialled by SNH

Contents

GUIDANCE ON APPLYING FOR CONSENT TO COLLECT GEOLOGICAL SAMPLES FROM SITES OF SPECIAL SCIENTIFIC INTEREST (SSSI)

What permissions/consents are needed for geological sample collecting in Scotland?

The historical right, codified in law with the Land Reform (Scotland) Act 2003, which means that you can walk almost anywhere in Scotland without the need to ask permission or keep to paths **does not extend to collecting geological samples**.

To extract, collect and retain geological samples that are either loose or form part of any rock of sediment exposure, **requires permission from the owner of the mineral rights**, even if it is undertaken as a recreational or educational activity. In addition, you are likely to **also require permission to access the land** in order to collect geological samples.

Permission is very likely to be required, from the landowner, occupier or manager of the land, to access land in order to collect geological specimens. You always require **landowner, occupier or land manager** consent to access land if any of your activities do not fall under your access rights as defined in the Land Reform (Scotland) Act 2003. The Act states that you may access land for recreational purposes (such as pastimes, family and social activities, and more active pursuits like horse riding, cycling, wild camping and taking part in events) and for educational purposes (concerned with furthering a person's understanding of the natural and cultural heritage) but you must do so responsibly. Exercising your access rights responsibly includes not causing damage to property, crops, or the natural heritage, or causing damage or distress to livestock. Access rights only apply if you exercise them responsibly, so if you do not (e.g. you cause damage to property or the natural heritage) you do not have access rights unless you have appropriate permissions and consents for your activities. As **geological sample collecting of any type, could potentially be considered damaging to the natural heritage**, it is advisable to obtain appropriate landowner, occupier or land manager consent for your activities (as well as permission from the owner of the mineral rights) to ensure you are acting within the law.

Special rules apply to Sites of Special Scientific Interest (SSSI). For any activity that might damage the protected natural features of the site, consent must be obtained in advance from **Scottish Natural Heritage (SNH),** as the statutory body for regulating controlled activities on SSSIs. This is **in addition to landowner, occupier or land manager** consent, and permission from the **owner of the mineral rights**.

In summary, **you are acting within the law if you obtain permission to collect geological samples.** But note that permission or consent from one body or person does not imply permission or consent from any other body or person. For example consent from SNH does not imply permission from the mineral rights owner, landowner or any other party.

Who to contact

In many cases the land owner is also the mineral rights owner; so contacting the landowner to request permission for your sample collecting is advised as an essential step for any site.

For SSSIs you should contact both SNH and the landowner or occupier. If you are unable to find contact details for the owner or occupier, SNH may be able to initiate contact with them on your behalf. However, this does not mean that consent from SNH for your proposed activities implies landowner or occupier consent.

Applying for consent to collect geological samples from a SSSI

What requires consent

It is an offence for any person to intentionally or recklessly damage the protected natural features of an SSSI. Therefore **it is advisable to seek consent from SNH to collect any type of geological sample from an SSSI**, unless you are absolutely certain that your activity will not damage any of the geological or biological protected features. This applies to collection of loose rock, soil and sediment and water samples, as well as samples of rock removed from in situ outcrops, boulders or scree.

To avoid intentionally or recklessly damaging the protected natural features of an SSSI, consent should be obtained from SNH to collect geological samples from any SSSI where either of the following is listed as an Operation Requiring Consent (ORC):

ORC no.	Standard wording (this may be tailored to the specific site)
20	Extraction of minerals including peat, shingle, sand and gravel, topsoil, sub-soil, chalk, lime, limestone pavement, shells and spoil [specify where possible].
25	Removal of geological specimens, including [delete as appropriate] rock samples, minerals and fossils.

Consent should also be obtained from SNH if your proposed sampling or mode of access is of a scale or type that may fall under one or more of any of the other ORCs listed for that site. ORC lists for SSSIs can be found via the SNH website's Sitelink pages. Some of the ORCs that may be relevant to geological sample collecting are listed below.

ORC no.	Standard wording (this may be tailored to the specific site)
7	Dumping, spreading or discharge of any materials.
11	The destruction, displacement, removal or cutting of any plant or plant remains, including [specify as appropriate e.g. tree, shrub, herb, hedge, dead or decaying wood, moss, lichen, fungus, leaf-mould, turf etc.].
13b	Modification of the structure of water courses (e.g. [specify] rivers, streams, springs, ditches, drains), including their banks and beds, as by re-alignment, regrading and dredging [specify where possible].
15	Infilling of ditches, drains, ponds, pools, marshes or pits [specify].
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.
24	Modification of natural or man-made features (including cave entrances), clearance of boulders, large stones, loose rock or scree and battering, buttressing or grading rock-faces and cuttings, infilling of pits and quarries.
23	Erection of permanent or temporary structures, or the undertaking of engineering works, including drilling.
26	Use of vehicles or craft [as appropriate] except [for vehicles as appropriate] on established/ recognised/ existing tracks
27	Recreational activities, other than those carried out responsibly in keeping with the Scottish Outdoor Access Code, or other activities [specify].

If any of the above applies, and you do not have consent to collect geological samples, and you hammer or otherwise damage rock outcrops or sediments, you may be considered to be intentionally or recklessly damaging the protected natural features of an SSSI, and in breach of wildlife crime laws. Therefore, if you plan to take a hammer or other collecting tools with you, please seek consent for your project!

Time scales for obtaining consents from SNH

SNH's statutory timescale for responding to applications for consent to undertake regulated activities on SSSIs is **3 months**. While we will endeavour to process applications as quickly as possible, we may not always be able to process applications submitted with a tight turn-around time.

You may submit an application before exact visit dates are confirmed by giving an appropriate date range for the visit. So please consider submitting an application for consent to collect as early as possible.

The process

There are two pathways by which SNH may grant consent for regulated activities on SSSIs:

1. When Public Bodies are applying for consent, SNH can grant consent directly to the Public Body or its representative. (13(1) Nature Conservations Act (Scotland) 2004).
2. In all other cases, SNH grants consent to the landowner or occupier to permit the activity to be carried out. (16(1) Nature Conservation Act (Scotland) 2004)

This means that, unless you represent an organisation that may be considered as a public body, consents received from SNH for geological sample collecting will be addressed to the landowner or occupier, giving consent for them to grant permission to you, as a specified third party, to undertake the specified activity. You therefore also need landowner or occupier permission for the consent to apply. **The consent from SNH does not automatically imply permission from the landowner or occupier.**

Guidance on likely conditions of SNH consent

Who can collect samples

Consent to collect samples will be given to specified individuals for specified dates. Therefore you need to give details of everyone in your party who needs to collect samples, and ensure the dates you give cover all dates you will be collecting.

Sample localities and methods

Sampling at classic localities, and localities frequently used for teaching purposes, should be avoided where possible. Sampling by mechanical means (e.g. rock drill, rock saw) should also be avoided.

Sample volumes

All consents will stipulate the maximum volume of rock that may be taken from any locality. You must not remove more than this volume, and rock other than the sample volumes specified and consented to must not be moved or removed. So you must not break off large amounts of rock that you are not intending to, or do not have permission to, remove as samples.

Photo recording

All consents for geological sampling now include a requirement for photo-recording. This is in order to obtain a more accurate record of what samples have been taken from where with consent. This will allow pressures on specific locations to be assessed better, and also to help identify unconsented sampling more easily.

Photo-recording must include 'before' and 'after' photos of the sample location, photos of all samples taken, and also wider-view photos enabling sample locations to be re-visited and identified clearly. Grid references of 8 or 10 figures should be taken. However, experience

has shown that there is variation between GPS devices and over time, so a grid reference alone is frequently not enough for a location to be re-found. This is why location photographs are now required. It is recognised that bad weather (low cloud, low light, rain) may make photographing wider 'location' views difficult, but experience shows that even a murky photo is better than none. Try to get as wide a view as possible and include any distinctive boulders, slabs, or rock face. Do consider re-visiting the location in better weather and re-taking locations shots, but it is recognised that this will not always be practical or possible.

A good written description of the site location, and how to reach it from an easily located point, can also help mitigate poor photographic conditions. The key point is that someone not present when the sampling occurred must be able to locate the sample point with confidence.

Field reports

All consents will include the requirement for a field report to be sent to SNH within 6 months of the last consented collecting date. The report should include brief background to the project (e.g. similar to the information requested in the application for consent form), and all the information recorded on sample locations, including 'before' and 'after' photos, sample photos, grid refs, location photos and descriptions, and the volumes of the samples taken. If any instances of irresponsible collecting/sampling are encountered, it is requested that these are also photo-recorded with as much detail as possible, and included in the report. A map with all relevant locations clearly identified must also be included with the report. The report should ideally be sent electronically by e-mail and the consent will specify whom in SNH to send it to.

APPLICATION FOR PERMISSION TO COLLECT ROCK SAMPLES FROM SITES OF SPECIAL SCIENTIFIC INTEREST (SSSI)

Application reference no.	To be completed by SNH

1. Applicant details

This should be the details of the person completing this form, who is agreeing to be responsible for the actions of all members of the field party

Name of applicant	
Institute or affiliation	
E-mail address	
Contact telephone no.	

2. Field party details

Please list all members of the field party that will be carrying out the sampling (including the Applicant if relevant). Any consent granted will only apply to those listed here.

Name	**Institute or affiliation**	**Contact during fieldwork (E-mail or tel. no.)**

3. Visit dates

The dates you wish permission to collect samples on.

From:	To:

4. Project description

Please include a brief description of the project for which the samples are required. If the project is expected to require more than one field visit involving sample collecting (e.g. a PhD with 3 seasons of fieldwork anticipated), or if permission has previously been granted to collect samples for the same project, please include details here.

Project description
Number of field visits involving sample collecting anticipated for this project:

5. Sampling method
Samples will be taken using the following method(s). Please tick all that apply.

Loose rock material	Spade/ trowel	Soft sediment/ soil core	Geological hammer	Geological hammer and chisel	Rock drill (coring)	Rock saw	Other

If 'other' please specify:

6. Sample locations recording
Please complete one set of details for each proposed sample location, and include as much detail as possible. Please also attach a map with sample locations clearly marked.

Note that you will be required to record images of all rock exposure sampled both in close-up and in wider context, with 'before' and 'after' images of the sampled face, to aid location in the future for condition monitoring purposes.

1	**Sample location reference no./name:**	
Name of SSSI:		
Grid reference (8 or 10 figure):		
Description of location/directions to location:		
Is this a location described in any geological guide book? Y/N	If 'yes' please give guide book & location number.	
Mean of access (e.g. on foot, by vehicle) and access route:		
Sampling method(s) to be used (if all those ticked in section 5 above write 'as above'):		
Rock/sediment type(s), geological unit name, & maximum number and size (in cm^3) of samples to be taken:		
Maximum volume of samples to be taken from this location (cm^3):		

2	**Sample location reference no./name:**	
Name of SSSI:		
Grid reference (8 or 10 figure):		

Description of location/directions to location:	
Is this a location described in any geological guide book? Y/N	If 'yes' please give guide book & location number.
Mean of access (e.g. on foot, by vehicle) and access route:	
Sampling method(s) to be used (if all those ticked in section 5 above write 'as above'):	
Rock/sediment type(s), geological unit name, & maximum number and size (in cm^3) of samples to be taken:	
Maximum volume of samples to be taken from this location (cm^3):	

3	**Sample location reference no./name:**	
Name of SSSI:		
Grid reference (8 or 10 figure):		
Description of location/directions to location:		
Is this a location described in any geological guide book? Y/N	If 'yes' please give guide book & location number.	
Mean of access (e.g. on foot, by vehicle) and access route:		
Sampling method(s) to be used (if all those ticked in section 5 above write 'as above'):		
Rock/sediment type(s), geological unit name, & maximum number and size (in cm^3) of samples to be taken:		
Maximum volume of samples to be taken from this location (cm^3):		

7. Agreement to conditions

I agree and confirm that:

1. All members of the field party will at all times follow the Scottish Geodiversity Forum Ethical Rock Collection guidelines and the Geological Association's fieldwork code.
2. All members of the field party will follow all conditions of any consent issued by SNH relating to this application.

3. Rock other than the sample volumes specified and consented to, will not be moved or removed.
4. The field party will photo-record all sampling, including taking ‘before’ and ‘after’ photos, and photos enabling sample locations to be re-visited and identified clearly.
5. A field report (including sampling log with photo-record of exposures sampled) will be provided to SNH within 6 months of the sampling dates consented to in relation to this application.
6. I understand that the issue of any consent by SNH relating to this application does not absolve me from any contractual or legislative responsibility I may have to inform or obtain the permission of any other party prior to carrying out the proposed operation.
7. I understand that if consent conditions are not fulfilled, consent is withdrawn, consent is likely to be withheld on future occasions, and members of the field party may be in breach of wildlife crime laws.

Signed:	**Date:**

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