Environment and Rural Affairs Monitoring & Modelling Programme (ERAMMP)

ERAMMP Document-71: Field-Survey Handbook (Procedures) Soil Erosion and Damage Recording

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[1] UK Centre for Ecology & Hydrology, [2] British Geological Survey

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1.1	Sabine Reinsch	01/04/2025	Added information where data input request was changed

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Series Environment and Rural Affairs Monitoring & Modelling Programme (ERAMMP)

Title ERAMMP Document-71:
Field-Survey Handbook (Procedures) - Soil Erosion and Damage Recording

Client Welsh Government

Client reference C210/2016/2017

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Approved by

Abbreviations Used in this Document

BGS	British Geological Survey
DTM	Digital Terrain Model
ERAMMP	Environment and Rural Affairs Monitoring & Modelling Programme
GAEC	Good Agricultural and Environmental Condition
GIS	Geographic Information System
GMEP	Glastir Monitoring and Evaluation Programme
OS	Ordnance Survey (maps)
RHS	River Habitat Survey
UKCEH	UK Centre for Ecology & Hydrology
VESS	Visual Evaluation of Soil Structure

Abbreviations and some of the technical terms used in this document are expanded on in the programme glossaries: https://erammp.wales/en/glossary (English) and https://erammp.cymru/geirfa (Welsh)

Contents

1 RATIONALE FOR SOIL EROSION & DAMAGE MONITORING

Identifying the extent of soil erosion and compaction features is an important first step to a statistical assessment of the vulnerability of the soils of Wales to physical degradation and reductions in their capacity to undertake normal soil function.

Not all soil erosion and compaction is considered in this analysis, only that which can be detected from aerial photographs. As a result, it is limited to a number of features such as erosion scars, gullies, and animal and vehicle compaction around gateways or livestock poaching features. As such, it might be considered a lower bound in terms of the extent of damage. On the other hand, some features identified as erosion or damage from aerial photographs may in fact be "false positives" – e.g. they turn out to be vegetation instead.

We also recognise that at present features such as rills, or erosion under vegetation, can't be detected from the air.

Hence the purpose of the field survey is to validate major features identified by the aerial survey and to record any features that might have been missed, or are new. In doing so we can determine how many features the aerial survey detects and its reliability.

1.1 Good Agricultural and Environmental Condition

Soils in Wales are to be kept in Good Agricultural and Environmental Condition (GAEC):

> *"Cross Compliance sets out the important regulatory baseline standards that all farmers must meet to receive Common Agricultural Policy payments including Basic Payment Scheme or Rural Development land based schemes (e.g. Glastir) support in Wales. It lays firm foundations upon which Welsh farmers can produce world class food and also provides an important mechanism to protect and safeguard the Welsh countryside."*[1]

GAEC 4 is titled 'Soil and Carbon stock – minimum soil cover', and states that, *"You must protect soil by ensuring that all land is covered by crops, stubbles, residues or other vegetation at all times, except where establishing a cover would conflict with requirements under GAEC 5."*

GAEC 5: is titled, 'Soil and Carbon Stock – Minimum land management site specific conditions to limit erosion'. A breach for example would be, *"Signs of soil run off down a slope, off site (field) or into watercourses."*

Hence the soil erosion and damage monitoring work is specifically designed to obtain information on the reliability of monitoring GAEC 4 and 5 using airborne and field survey approaches.

[1] https://gov.wales/sites/default/files/publications/2020-01/cross-compliance-verifiable-standards-2020.pdf

2 DESIGN OF SURVEY

The design of the survey builds on the ERAMMP statistical design. 240 1km^2 squares were assessed for soil erosion and damage features using aerial photography. This provides a stratified random statistical sample of features. Analysis of photography from 2018 identified about 2500 features; about 10% of which would be considered erosion and 90% damage.

The purpose of the field survey is to validate the major features identified by the aerial survey and to record any features that might have been missed, or are new. In doing so we can determine how many features the aerial survey detects and the reliability. Surveyors will only confirm and record new features in a statistical sample from the 240 squares.

The erosion survey is divided into three parts:

1. Aerial photograph analysis to identify features
2. Field survey or validation of features and recording of new features
3. Head water stream surveyor assessment of river bank erosion

2.1 Aerial photographs

The first step in assessing soil erosion and damage is conducted using aerial photographs. The methodology used aerial images collected mostly over the spring / early summer of 2018.

Areas of soil erosion and compaction were interpreted as GIS polygons from a combination of aerial photography, Ordnance Survey (OS) maps, Google Earth, Digital Terrain Model (DTM) derived landscape characteristics, and importantly, analyst knowledge of landscape features. Using the polygon approach enables us to approximate areas of erosion or compaction so that an estimate of extent can be calculated.

Some typical images are presented in Figure 2.1.1 with the corresponding feature assessment. While some features are relatively obvious from the air, such as gate damage and poaching (a, b & c) and scree (d) others are not such as terracettes (e).

Figure 2.1.1: Examples of features recorded using polygons and aerial data.

a) Gateway soil damage from machinery and livestock and poaching around feeder
b) Poaching in fields where livestock access to farm yards is required
c) Gateway soil damage
d) Area of soil erosion on very steep slope
e) Area of terracettes

2.2 Field survey

A sample of 130 squares has been selected for resurvey. Within each square there are 5 X-plots where soils and vegetation are sampled. 200m circles are drawn around the X-plots and features marked within these zones.

This generates a subset of features that the field survey teams will locate, confirm presence or absence, record what these features are and will photograph. Survey teams will be constrained to recording features on land where the survey has permission to record. An example of the design is shown in Figure 2.2.1

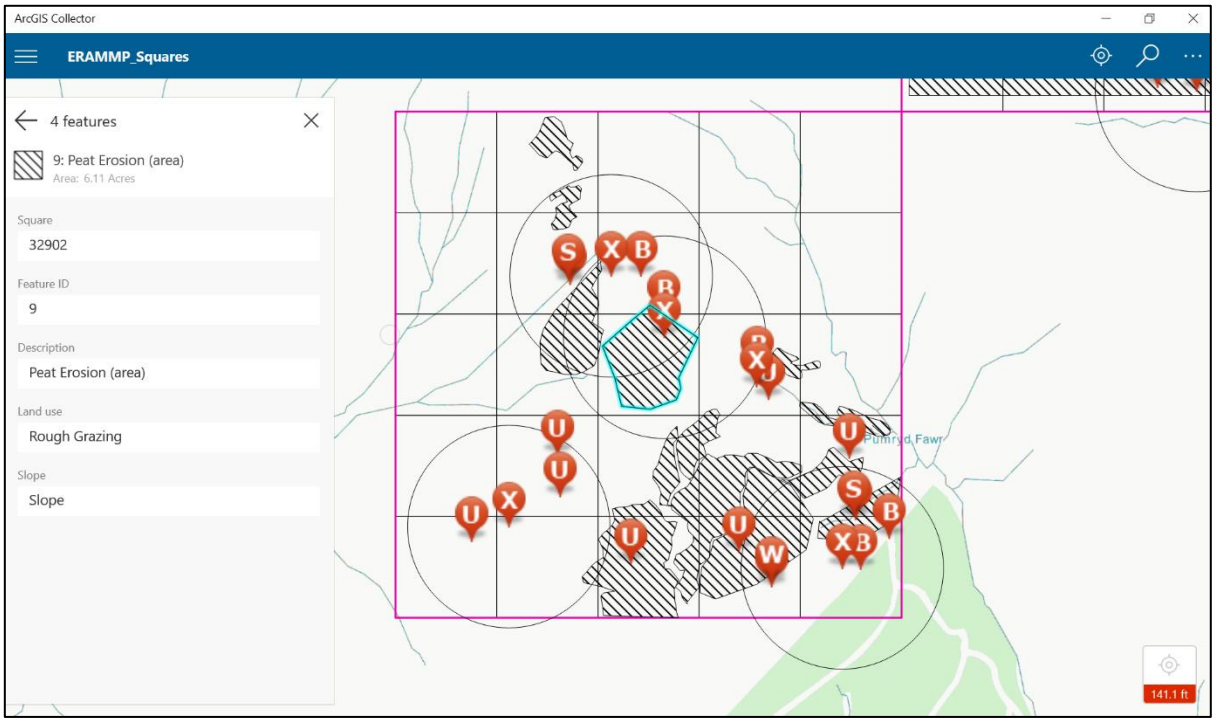


Figure 2.2.1: An example of the style of map that the surveyors will use to validate and record features detected by aerial survey. 200m circles are where to check, record from within those. X marks the X-plots at the centre of those circles. Check each hashed feature and record with its British Geological Survey (BGS) number.

These records will allow us to:

A. Obtain an initial measure of the area of soil damage that can be obtained from air photos and validated on the ground by surveyors;
B. Identify false positives from the aerial survey and the number of missing features, and hence, determine the reliability of an earth observation approach;
C. Create a training data set that can be used to test automation of soil degradation feature detection across Wales.

2.3 Headwater stream assessment for erosion

The location of the headwater stream sampling site within a square is generally chosen to maximise the length of River Habitat Survey (RHS) that can be conducted within the square, while also being as close as possible to the exit-point from the square. The length of the headwater stream sampling site is 500m of watercourse. This 500m defines the limits of the RHS survey area. As part of the survey, assessment of the hydromorphological and physical characteristics of the watercourse is undertaken (amended River Habitat Survey).

For more information on streams see the ERAMMP headwater stream survey handbook[2].

[2] www.erammp.wales/50

3 FEATURES FOR RECORDING

The aim of the survey is to record major features. In general, these features will cover an area >10m^2. The primary purpose of the survey is to confirm features identified by the airborne survey to determine if they are correct or not. In addition, we would like any extra, easily visible, features recorded within the 200m radius circles around the X-plot that the aerial survey might have missed.

Some features are hard to identify from the air, this includes some poaching features and terracettes, for example, or features that are under trees.

DO NOT record tramlines in fields, road cuttings, grips on peat or field drainage channels.

The recording software and key are designed to help the surveyor narrow down the type of feature to be recorded. There are 4 main categories for recording;

1. Features that are erosion on organic / peat soils
2. Features caused primarily by human or animal damage
3. Features that are caused by gravity
4. Features that are erosion on mineral soils

DO NOT spend lots of time trying to key out a feature: our primary interest is having features confirmed and photographed or identifying ones we missed. We can go back to the aerial imagery or your photos to classify features.

3.1 Peat soils

The main criteria for this category is that you must be on peat / organic soil.

The types of features you may encounter include areas where peat is exposed and has eroded, leaving hags or deep gullies. Large soil pipes in the peat may also be visible. The first 3 photos in the **key** show peat hags and soil pipes. Peat slumps also occur and should be recorded here rather than mass movement.

3.2 Damaged soils

The main criteria for this category is that the soil has been damaged by human, animal or environmental damage such as trees being blown over.

Poaching by animals is probably most common in this category. Over stocking on wet soil will lead to poaching. Poaching often occurs around animal feeders that have been left in the same place too long.

Trafficking: vehicles travelling over wet soil can churn up large areas, especially around pinch points leaving soil churned and bare. These features often occur around gates, classed as gate damage or around farm buildings.

Footpath erosion: this is most likely in the uplands where pressure by walkers may have caused extensive damage, see photo in **key**.

Tree root scars occur when large trees are blown down tearing up the soil around which is subsequently eroded. Only record large trees (>7m) where soil damage is substantial, see photo in key.

Do not spend a lot of time trying to categorise the type of damage, knowing if its animal poaching or machinery is helpful. The important bit is that we want to know if it is there.

3.3 Mass movements

The main criteria for this category is that gravity is the main cause of the feature, through falls, slips and slides.

As failure under the force of gravity is the main cause of these features they tend to occur on steep slopes, along the coast or in the uplands.

Scars are particularly common in the uplands and are often exacerbated by animals seeking shelter and referred to as sheep scars (see photo).

Creep and terracettes are hard to see from the air. They only occur on slopes and are exacerbated by animals following the tracks. They are easily spotted from the side on. We are interested in areas with multiple tracks appearing like steps, not single animal tracks (see photo in key).

Scree: large areas of scree in the uplands are generally easy to spot from images, so confirmation and a photo is helpful. We're interested in large areas e.g. 1ha

Landslides occur in the uplands and along the coast and are sometimes hard to spot from the air, but easily identified side on. Again we are interested in large features, 10m^2 and bigger.

3.4 Soil erosion

The main criteria for this category is true soil erosion, the main cause of which in Wales is by water, especially on sloping land.

Soil erosion features are most commonly associated with arable agriculture. Given arable agriculture is minor in Wales the number of erosion features like this will be low. Rain splash on bare soil can lead to rills (small channels in the soil that get bigger, becoming gullies when more than 30cm – or between ankle and knee-height – deep). Alternatively, a thin layer of soil might be washed away as a sheet. You are most likely to see these features where maize is planted.

Muddy outwash from fields and erosion into drainage ditches commonly occurs if soil is being eroded from fields. This is not to be confused with mud left behind from vehicles going in and out of fields.

Tillage erosion occurs where the soil has been ploughed so much that the subsoil or parent material (which will look like rock fragments) becomes visible.

River bank erosion is common, especially after heavy rain or where animals get too close to river banks. Record river banks where lengths of erosion and bare soil are easily seen. Record the entire stretch where it occurs, not individual exposures.

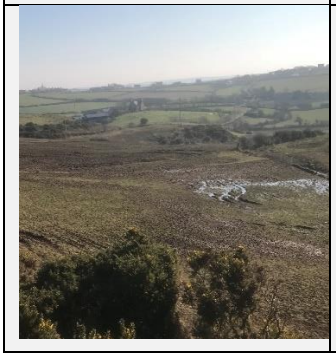
Coastal erosion, only occurs along the coast where the ocean undermines the soil, washing it away. We are not collecting information on eroding rock cliffs, only where soil is being lost.

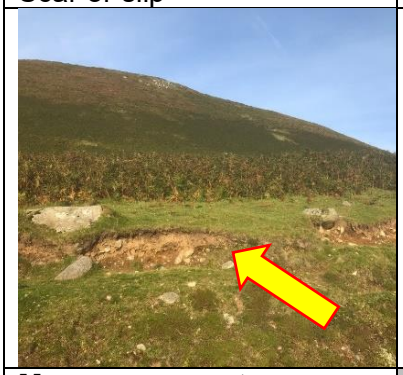
4 SURVEYOR KEY TO FEATURES

The surveyor key with photos is also provided as a PDF and as a printed copy in your pack for reference.

1) Peat: Are you on peat, if not go to soil damage		
Peat hags	Peat hag	Peat pipes
		

ERAMMP Soil erosion and damage key: Use the key in order to determine which category to report in: Start with **1 Peat**; if not on peat then determine if there is **2 Soil Damage** by animals or machines; if not damaged, is the feature caused by gravity or **3 Mass Movement**; if not, then it's **4 Erosion**, usually by water.

2) Soil damage: Has machinery, human activity, animal activity or tree uprooting caused the damage, if not go to mass movement		
Poaching sheep	Machinery damage (not individual tramlines)	Footpath damage
		
	R. Smith EA	
Poaching horses	Gate or machinery damage from above	Tree root scars
		

3) Mass movement: Has the soil moved by gravity or slipped, if not go to erosion		
Scar or slip	Creep or terracettes	Scree
		
Mass movement	**4) Erosion: usually by water in Wales**	
landslide	Sheet erosion	Rills less than 30 cm deep
		
Gullies more than 30 cm deep	Tillage erosion, soil thinning	Drainage ditch erosion
		
Muddy outwash	Riverbank erosion	Coastal erosion by waves
		

Acknowledgement: Thanks to Richard Smith at the Environment Agency for the reuse of some of the photos (as marked).

5 SOFTWARE RECORDING

Important information to collect:

- Presence or absence
- Location
- Assignment to 1 of the 4 categories
- Photo

In order to simplify the data collection we have created an app that runs in ***surveyor123***.

The following section uses screen shots to walk you through the data collection process. The screenshots are from a phone app, but this is similar to the computer version on the surveyor laptops.

5.1 At the X-plot

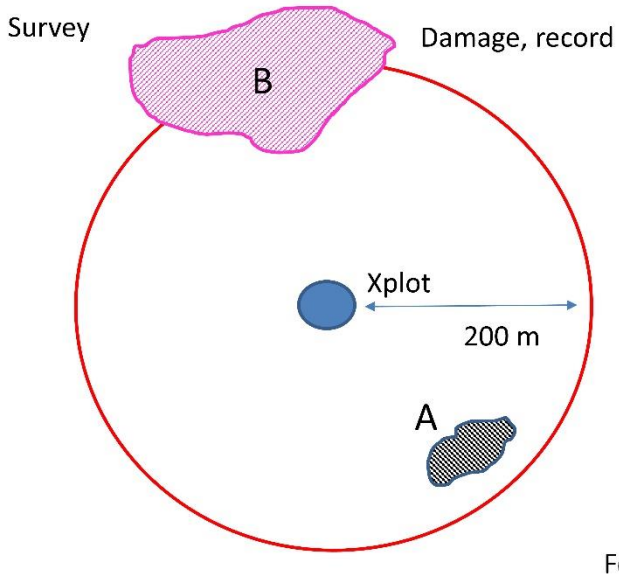
Stand at the X-plot and look out to see if you can see any obvious features based on the 200m circle.

Use the OS map with the features on to locate any marked features and record. If you need to get a bit closer to photograph then do so. If your view is obscured, move to a location that acts as a vantage point enabling you to see the 200 m around the X-plot. Use the aerial images in ***surveyor123*** to help you determine feature locations.

You don't need to worry about exact distances as we will determine what's in and out based on GIS, simply record features you see. We don't expect more than 5-10 features to be in a square and many will have none.

We do not expect recording to take longer than 25 minutes for a square.

2) Conduct a field survey



Stand in the xplot and look out to 200m

See if you observe any obvious features not recorded by pink hashes in the circle. E.g. grey hashed area (A).

If you see something record it.

If you can't fully see move to a position where you can

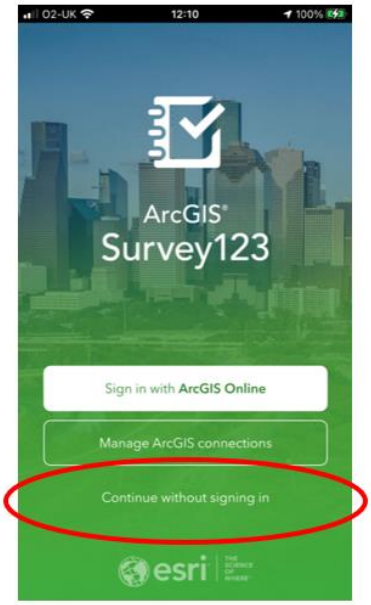
Finally, go and check any pink hashed areas, record presence/absence and photograph (B)

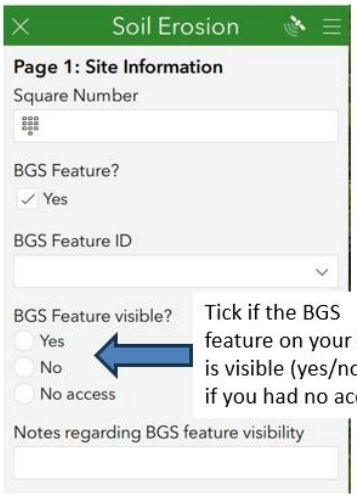
Feature to check out, record, if nothing, write nothing in the notes

British Geological Survey

Funded by:

Recording software





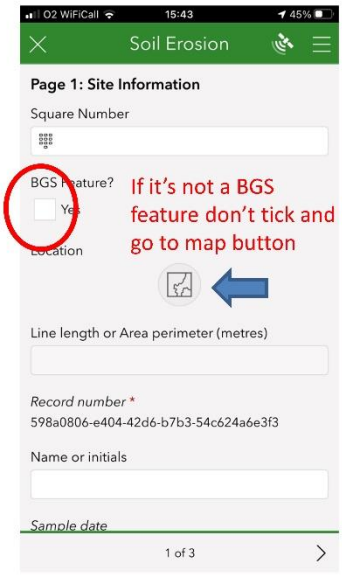
Tick if the BGS feature on your map is visible (yes/no) or if you had no access.

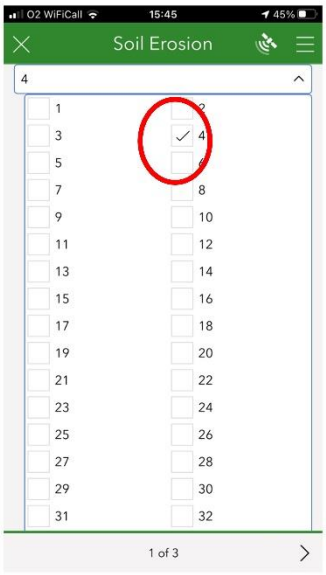
British Geological Survey

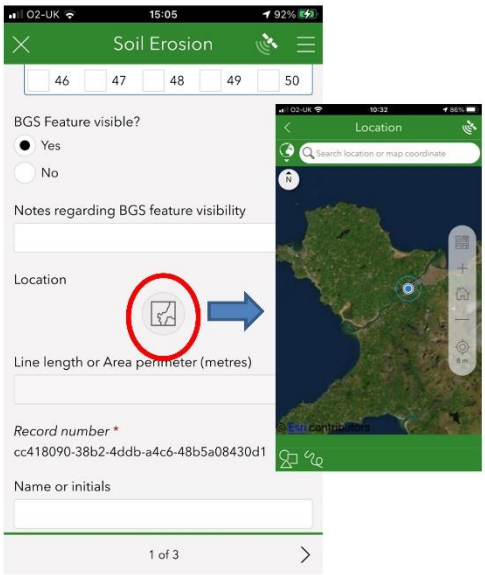
Funded by:

Selecting BGS features

Add square number, tick if BGS feature





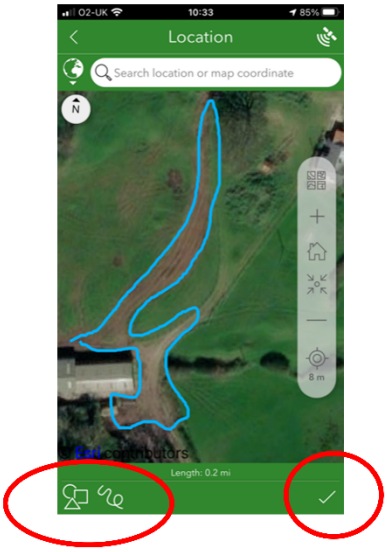


Record BGS number, you can select more than one of the same type of feature

Funded by:

Location

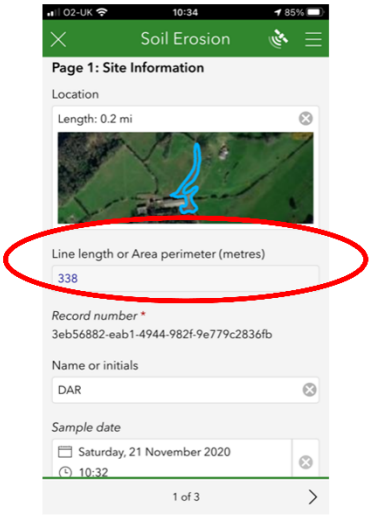
Draw the shape of the feature



Shape of free draw

After outline is complete, tick this box

This screen appears once the drawing is in



We are interested in the location and general extent, if there are a group of features, include them in altogether.

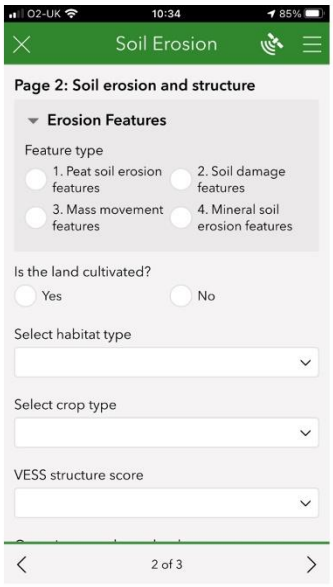
Do not spend lots of time recoding individual features!

Helpful in case we need to ask questions

Funded by:

Recording the type of feature

Page 2 is about adding a feature



Main feature category

Is it cultivated? Unlikely

Broad habitat

Crop type, arable or ley only

Don't record VESS (Soil structure score)

The order of the key is a logical sieve to help you narrow down the type of feature

1) Organic soil, no next…

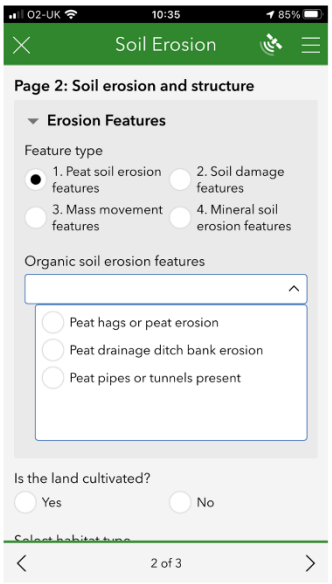
2) Soil damage, no next…

3) Mass movement, e.g. land slide, no next…

4) Erosion……..

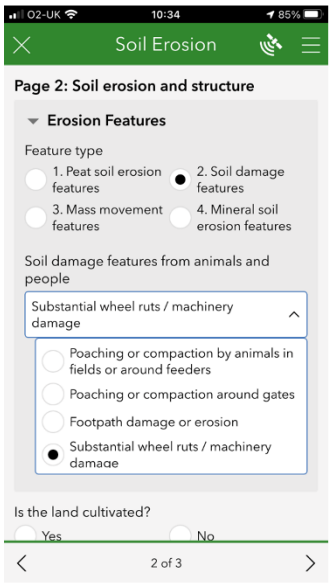
Funded by:

1) Organic soils and 2) soil damage



Features 1-2%

- Organic soil

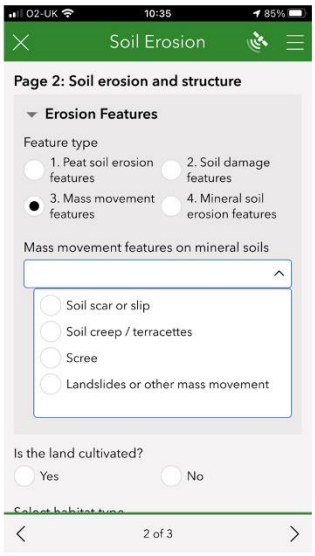


Features 90%

- Animal poaching
- (Especially bare soil)
- Footpath erosion
- Machinery
- Trees

Funded by:

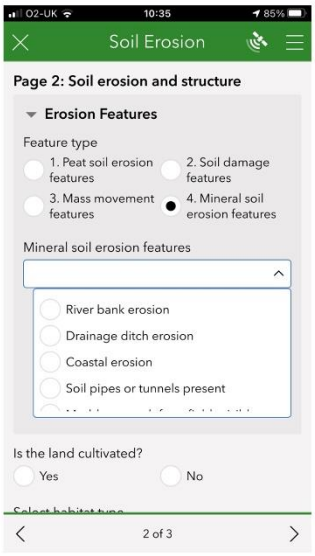
3) Mass movement 4) Erosion features



Features 3%

- Soil movement by gravity

Mostly uplands



Features 10% of features

Types of erosion

- Rain splash (No)
- Sheet
- Rill (possible)
- Gully
- Tillage
- River banks (Yes)
- Drainage ditch (Possible)
- Coastal (Yes)
- Soil pipes
- Muddy outwash onto roads etc (Yes)

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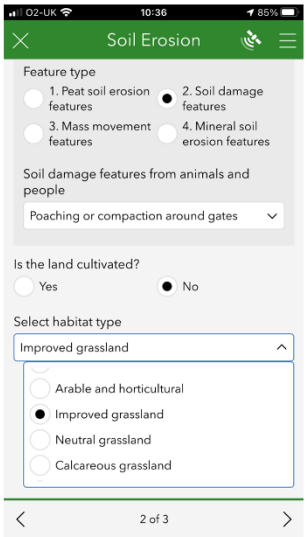
Add the broad habitat it's in



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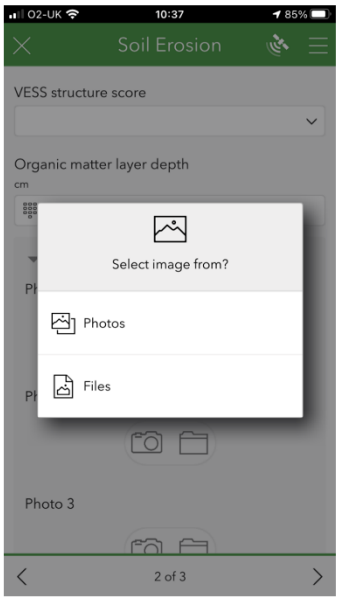
Take a photo

Take a photo of the feature, or several

You can take a photo, or you can save to a file and upload later. Better to do it at the time



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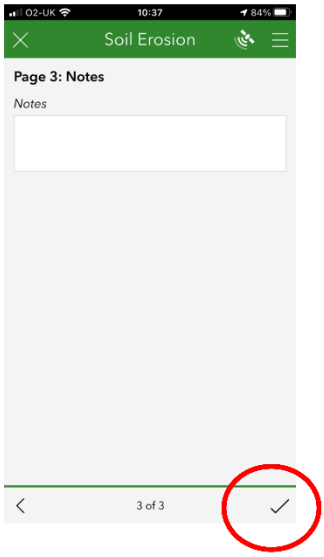
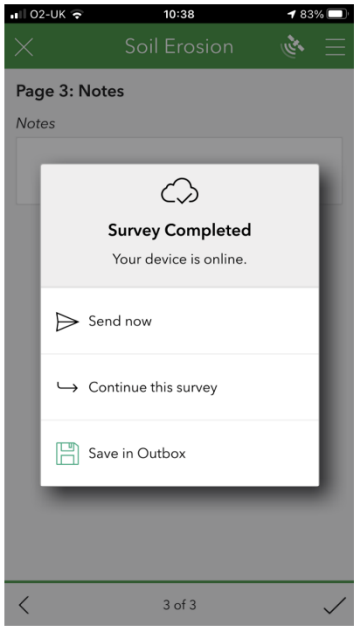
Submit

Page 3 is for notes in case there's something you want to tell us.



After feature is complete, tick this box



You can send then and there, or save in the outbox and upload when you have internet, which is generally quicker.

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