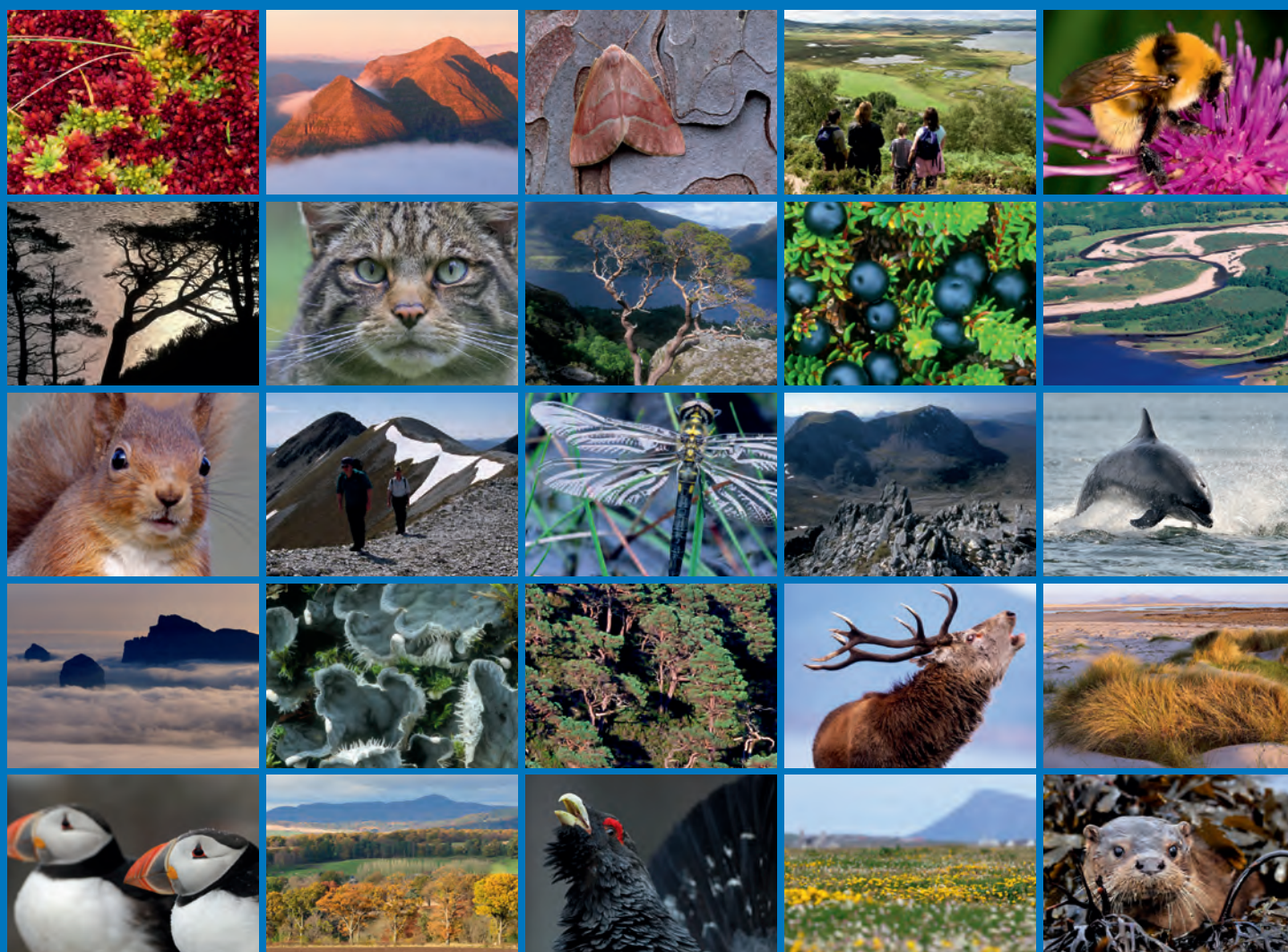


Investigation of Standing Water and Wetland SSSIs thought to be under Diffuse Pollution Pressure: Carrick Ponds





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COMMISSIONED REPORT

Commissioned Report No. 717

Investigation of Standing Water and Wetland SSSIs thought to be under Diffuse Pollution Pressure: Carrick Ponds

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COMMISSIONED REPORT

Summary

Investigation of Standing Water and Wetland SSSIs thought to be under Diffuse Pollution Pressure: Carrick Ponds

Commissioned Report No. 717
Project No: 13700
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Keywords

Diffuse pollution; SSSIs; wetland; water; soil; samples; recommendation.

Background

SNH contracted EnviroCentre to look at a number of Sites of Special Scientific Interest across Scotland thought to be adversely affected by diffuse pollution. EnviroCentre was asked to carry out a number of tasks to help SNH understand better whether sites are being affected by diffuse pollution and if so, what activities might be contributing to this pressure and how SNH could improve the condition of the sites.

If sites are identified as being affected by diffuse pollution, SNH hope that the results of this report will inform their work with managers of the sites to improve their condition.

Main findings

- The desk study and site walkover identified potential existing and historical land use practices within the catchment that could adversely affect water quality and soil nutrient status. This included long-term changes resulting from agricultural management practices within the catchment.
- Analytical data confirmed the presence of elevated nutrients but given the size of the site relative to the pre-determined sample locations, this may not be representative of the site as a whole, as samples are located mainly in the central and northern part of the site and no sampling was undertaken in the south or east. It should further be noted that the sampling assessment was undertaken as a single visit and the limited scoped dataset and a lack of historical data constrains the ability to draw accurate conclusions to fully inform current site conditions.
- A series of recommendations are proposed to seek to aid the understanding of the site and afford a greater insight into the perceived changes taking place within the SSSI.

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Table of Contents	Page
1. INTRODUCTION	1
1.1 Site Location	1
1.2 Site Description	1
1.3 Site Hydrology	1
1.4 Site History	1
1.5 Recent Site Management Practices	2
2. METHODOLOGY	3
2.1 Pre-site Attendance Desk Study	3
2.2 Site Attendance	3
2.3 Sampling Approach	3
2.4 Sample Equipment	3
2.5 Health and Safety	4
2.6 Water Samples	4
2.7 Soil Samples	5
2.8 Field Observations	5
3. STUDY LIMITATIONS	6
4. ANALYTICAL DATA	7
4.1 Water Quality Field Data	7
4.2 Laboratory Results	8
5. SITE OBSERVATIONS	10
5.1 Desk Study	10
5.2 Catchment Walkover	10
5.3 Summary	11
6. INTERPRETATION OF RESULTS	12
6.1 General Summary	12
6.2 Atypical Results	12
6.3 Additional Considerations	12
7. CONCLUSIONS	14
8. RECOMMENDATIONS	15
8.1 Monitoring	15
8.2 Other Commissioned Studies	15
8.3 Management	15
8.4 Landowners	15
8.5 External Consultations	16
9. REFERENCES	17
ANNEX 1: FIGURES	18

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Thanks are also extended to the site landowners for affording access to the site to enable the agreed scope of work to be undertaken.

1. INTRODUCTION

EnviroCentre Ltd was contracted by Scottish Natural Heritage (SNH) in August 2012 to deliver the 'Investigation of Standing Water and Wetland SSSIs under diffuse pollution pressure' project. The data collected from the project will be used to inform management decisions on wetland and standing water Sites of Special Scientific Interest (SSSI).

1.1 Site Location

Carrick Ponds consists of a series of pools and mires lying on the Solway coast, approximately 6km south of Gatehouse of Fleet. The site is accessed via a track from an unnamed road at Knockbrex, off the A75(T). See Figure 1.1 in Annex 1.

1.2 Site Description

Carrick Ponds SSSI consists of a series of pools and mires set in hollows between low rocky ridges with semi improved neutral grassland. Carrick Ponds comprises a series of 10 ponds or damp hollows of which 8 are included within the SSSI boundary (SNH, 2011a).

The ponds have been designated for the basin fen community, combined with beetle assemblages that are present on site. The site comprises an area of 44.83 hectares and rises to some 40m above sea level at Castle Hill and Knockbrex Hill. The ponds lie within the ridges and are not directly interconnected (SNH, 2011a).

On site, open water grades into swamp and fen, to wet willow woodland and grassland. There is a wide range of growing conditions, from acidic to quite strongly basic. The wide range of fen habitats, the undisturbed nature of the pools and the mild winter climate result in the site having a greater number of water beetle species than any other site in Scotland. Eighty one species have been recorded. The site is described as being the best in the Stewartry district for its range of physical characteristics and fen plant communities within a small area, with a range of habitats, which include open water at pH 9.5. Great crested newts also breed in some of the ponds (SNH, 2010c).

The bedrock geology on site takes the form of Wacke, from the Kirkmaiden Formation. Felsite dykes are present along the coastal fringes, these are orientated north west – south east. There are no superficial deposits present on site (British Geological Survey, n.d.).

1.3 Site Hydrology

Carrick Ponds SSSI includes the coastal topographic highs of Castle Hill and Knockbrex Hill. The site hydrology is dominated by rainfall and localised surface runoff; pooled water is associated with hollows in the underlying bedrock. The main outflow from the north west of the site is through an unnamed watercourse which flows along the northwestern site boundary before entering the sea at Carrick Bay. The eastern slopes of Castle Hill drain towards an unnamed tributary of Goat Strand which flows along the eastern site boundary towards the coast at Knockbrex. The site receives an annual average rainfall of 1107mm (Centre for Ecology and Hydrology, 2009).

1.4 Site History

The site is currently used for, and appears to have had a long history of, grazing, with drystone dykes separating fields. The owner manages the land for grazing of cattle and sheep, with supplementary feeding of hay, silage and liquid feeds being carried out when necessary. Thistles, nettles and docks are controlled and some control of scrub has also been carried out (SNH, 2010c). Application of compound fertiliser has been consented in the past (SNH, n.d.).

1.5 Recent Site Management Practices

Carrick Ponds SSSI is under one ownership, and there have been SNH Management Agreements on the SSSI for several years. The latest agreement was drawn up and signed off in September 2011 and expires in 2013 (SNH, 2011a).

Some pest control also takes place. Lime is spread on the grassland areas with the aim of maintaining a pH of between 5.5 and 6.0. Fallen wood is removed from the site. Existing drainage ditches are maintained (SNH, 2010c).

2. METHODOLOGY

The following sections outline the approach undertaken to fulfil the scope of works established by SNH in the Statement of Requirements (SOR).

2.1 Pre-site Attendance Desk Study

Before the initial site visit was undertaken the local SNH officer was contacted and a meeting held at the corresponding local office to discuss the local understanding of the site and review SNH records.

The meeting was also used to provide an insight into any health and safety constraints not readily apparent from the site maps.

Landowners of the site were notified of the planned site visit a week before the proposed visiting date. This allowed landowners the opportunity to ask any questions and also gave EnviroCentre staff a chance to gain a greater understanding to the workings of the site and the site surrounds. Landowner details are provided in Annex 2.

2.2 Site Attendance

The site was accessed and samples collected over a one day period – termed Visit 1. A follow up visit to the wider catchment – Visit 2 was undertaken once the analytical data was available and was appraised in context with the information obtained from the desk based exercise.

Table 2.1 below shows site conditions on the day of each visit.

Table 2.1: Site Conditions

Carrick Ponds	Date of Visit	Weather Conditions	Grid References
Visit 1	25 October 2012	Dry, sunny and cold	NX 581506
Visit 2	19 February 2013	Clear, cold and sunny	NX 581506

2.3 Sampling Approach

SNH had determined the preferred locations for the collection of soil and water samples – as detailed in Figure 2.1 in Annex 1. EnviroCentre was not involved in determining these locations and had not assessed the suitability to access such before Visit 1. Due to certain restrictions, the locations of samples that EnviroCentre collected had to be changed and are as detailed in Figure 2.2 in Annex 1. Changes to locations were kept to a minimum and are generally not deemed to have a significant impact on the sampling or conclusions.

All sampling methods were carried out by trained personnel. Photographs of each sampling location were taken (see Figure 2.3 in Annex 1) and grid references for each location recorded.

2.4 Sample Equipment

The following sample kit was used to undertake site field work:

- Handheld GPS to record specific grid references;
- Handheld soil augers;
- Plastic bailers;
- Sample bottles (all sample bottles were written on to record locations, date and time); and

- Personal Protection Equipment (in line with the requirements of the site specific health & safety risk assessment).

All samples were given unique identification names and packaged in cool boxes with ice packs so as to keep samples at appropriate temperatures prior to being despatched to a United Kingdom Accreditation Service (UKAS) accredited laboratory for analysis.

2.5 Health and Safety

Site specific risk assessments were carried out before attending site. The assessment was based on information obtained from the meeting with the local officer and from EnviroCentre's extensive experience of undertaking previous work of this nature.

The risk assessment, which was carried by staff attending the site visit, included details of the landowner, nearest emergency services and identified risks and proposed means of mitigation. Field operatives notified EnviroCentre head office when entering and leaving site and wore the following appropriate PPE at all times:

- Warm and waterproof clothing;
- Waders;
- Waterproof footwear; and
- Hi-vis vest.

Biosecurity measures were implemented when entering and leaving site. Boots and equipment were washed when leaving site so as not to cross contaminate subsequent sites.

2.6 Water Samples

Surface water samples were collected from strategic locations within the site boundary to provide an understanding for the whole site. As the site does not confirm to inflows and outflows, collections were made from standing water areas only.

Groundwater samples were collected using plastic bailers from slotted pipes installed with hand augered holes where soil samples were originally collected. The sampling methodology employed a geosock membrane for coarse filtration so as to minimise samples being heavily loaded with suspended solids and organic material.

Samples underwent initial on-site field tests using an OTT Quanta Handheld probe for the following parameters:

- pH;
- Temperature;
- Electrical Conductivity (EC);
- Dissolved Oxygen (DO);
- Oxidation-Reduction Potential (ORP); and
- Salinity.

The water samples were submitted for the following analyses to a UKAS accredited laboratory:

- Total calcium (Ca), magnesium (Mg) and sodium (Na);
- N Species – total nitrogen, nitrate and ammonium;
- P Species – orthophosphate and total phosphorus; and
- Total iron (Fe).

Dissolved and ferrous iron analyses were scheduled in but could not be undertaken by the laboratory due to insufficient sample. This data would have supported interpretation of results if available but is not considered critical for determining the presence or potential sources of diffuse pollution.

2.7 Soil Samples

Soil samples were collected from specific locations on site by hand augering holes into the ground. The soil samples were collected at two depths:

- The rooting zone; and
- A depth of approximately one metre below the rooting zone.

NB - In the corresponding results tables the samples are differentiated by the suffix 'A' for the rooting zone; and 'B' for below the rooting zone.

Soil samples were analysed for the following suite:

- Moisture Content;
- Extractable nitrogen and phosphorus;
- Total nitrogen and phosphorus; and
- Total calcium (Ca); magnesium (Mg) and potassium (K).

Bulk density analysis was scheduled in but could not be undertaken by the laboratory due to insufficient sample. Total sodium (Na) and total organic carbon (TOC) were not scheduled in properly and analyses were not undertaken. The lack of this data is not considered to affect interpretation of results in terms of determining the presence and potential sources of diffuse pollution.

2.8 Field Observations

On accessing the site for the first visit, and the wider catchment for the second visit, the following field observations were noted:

- Geo-referenced photograph locations of surrounding land use (refer to Figure 2.4 in Annex 1) ;
- Adjacent land use;
- Identified and potential pollution sources; and
- Atypical or unusual site features (e.g. fly tipping, vandalism, etc.).

In addition, mapping of the immediate surrounding catchment was completed following the second site visit (see Figure 2.5 in Annex 1). This process utilised the Flood Estimation Handbook (Centre for Ecology and Hydrology (CEH), 2009) catchments and Land Cover data (Land Cover Map 2007) to populate GIS mapping. The output was used to aid the interpretation of results and further inform the study conclusions.

3. STUDY LIMITATIONS

The scope of the commissioned study presented a series of limitations which should be borne in mind when reviewing this report. These are outlined below:

- Sampling was undertaken on a single visit. Whilst this afforded consistency for the samples collected, the weather conditions preceding and at the time of the visit may have directly influenced the observations made and the analytical results obtained.
- For the same reasons outlined above, access to certain parts of the site may have been restricted and limited access to the predetermined sampling location.
- Sampling comprised a single set of samples from each of the pre-determined locations. Repeat or continuous sampling over an extended (seasonal) period would be preferred to enable a greater dataset to be collected. This would present a more representative assessment of the site and allow for seasonal/climatic variations.
- The dataset provides a 'snapshot' of the site condition. Due to the limited availability of historical data (see section 1.4) there is very limited scope for comparisons to be made with previous records or allowance for assessment of seasonal or climatic factors.
- The scope of work did not include the assessment of rainfall within the catchment, measured water levels or the inflow(s)/outflow(s) of associated watercourses.
- The limited dataset does not allow for any statistical analysis of the results to be undertaken. No adjustment has been made for anomalous results or to determine trends over time.
- The sampling methodology used to obtain groundwater samples (obtained from a circa. 1m depth coupled with geosock membrane for coarse filtration) typically results in these samples being heavily loaded with suspended solids and organic material meaning that the samples appear 'dirty' to the naked eye. To avoid interference with the laboratory analytical instrumentation and erroneous results, on receipt at the laboratory these are processed on a x10 dilution. It is this dilution process which explains why some of the results are reported as a less than value rather than the equivalent level of detection of 'clean' samples. The same dilution approach is applied to heavy silted surface water samples.
- The weather conditions prior to and during the site visit should be taken into consideration when reviewing the results. According to the Met Office (n.d.) the seasonal rainfall totals for summer, autumn and winter 2012 in western Scotland were 144%, 104% and 128% respectively of the annual average rainfall levels for the period 1981-2010. This should be taken into consideration when reviewing the results as it could result in bias when compared with years where average rainfall levels were recorded. The higher rainfall will directly influence runoff, dilution and catchment water levels/throughput which have not been assessed.
- Due to limitations in the mapping data used to compile the Flood Estimation Handbook (FEH) catchment boundary, the area defined in the Annex 1 maps does not necessarily present an accurate reflection of the hydrological catchment for the site. Whilst this affords a valuable tool for the purposes of this study, the mapped boundary should be viewed as an indicative guide only and be subjected to detailed verification to be considered definitive.

4. ANALYTICAL DATA

The following tables show the results obtained from the initial site visit (Visit 1) in which samples from the pre-determined locations (or as close to as practically possible) were collected. Where the pre-determined locations were not accessible comparable alternative locations with the same habitat features were sampled.

Table figures in red indicate relative atypical (e.g. high or low values) or anomalous results relative to the remaining dataset or which would typically have been expected to be observed from a site of this nature. These are discussed further in section 6.2.

4.1 Water Quality Field Data

The following data was collected by a suitably qualified operative using the methods outlined in section 2.

Table 4.1: Field Data

Sample ID	Nat. Grid Reference		Temp (°C)	pH	Sal (%)	DO (%)	DO (ppm)	ORP (mV)	EC (mS/cm)	Comments
CPSW1	NX 58053	50327	9.38	6.75	0.03	41.7	4.76	286	0.083	Surface water - dark cloudy brown with fine brown suspended solids; no odour
CPSW2	NX 58101	50389	9.41	6.33	0.04	44.4	5.72	252	0.077	Surface water - clear with some minor suspended solids and some leaves; no odour
CP01	NX 58065	50324	9.92	6.22	0.11	42.3	6.28	189	0.230	Groundwater - dark cloudy brown with fine brown suspended solids; no odour
CP02	NX 58108	50386	9.06	6.5	0.04	50.0	5.54	142	0.087	Surface water - clear with only few minor suspended solids; no odour
CP03	NX 58391	50592	10.39	6.77	0.23	51.8	6.07	151	0.481	Surface water - clear with only a few very minor suspended solids; no odour
CP04	NX 58256	50655	10.17	6.98	0.06	58.4	6.45	162	0.127	Surface water - clear with some pond weed and leaves; no odour
CP05	NX 58110	50590	10.36	7.03	0.10	41.9	4.75	164	0.207	Surface water - very slightly cloudy with pond weed on surface; no odour
CP06	NX 58503	50706	11.27	6.86	0.24	29.8	3.41	162	0.508	Groundwater - dark brown with brown fine suspended solids; no odour

4.2 Laboratory Results

The data in the following tables was collected by a suitably qualified operative using the methods outlined in section 2.

Table 4.2: Water Analysis

Sample ID	Nat. Grid Reference		Flow Type	Total Ca (mg/ l)	Total Mg (mg/ l)	Total Na (mg/ l)	Total Fe (mg/ l)	Amm N (mg/ l)	Nitrate as N (mg/ l)	Phosphate as P (mg/ l)	Total P (mg/ l)	Total N as N (mg/ l)
CPSW1	NX 58053	50327	SW	54	<10	<10	14.9	<0.01	<0.2	<0.01	1.8	2
CPSW2	NX 58101	50389	SW	109	19	11	76.8	<0.01	0.8	0.05	2.6	4
CP01	NX 58065	50324	GW	33	7	15	0.12	0.04	0.5	<0.01	<0.10	<1
CP02	NX 58108	50386	GW	25	6	12	<0.01	0.08	<0.2	0.02	<0.10	<1
CP03	NX 58391	50592	SW	69	11	12	<0.01	0.03	3.6	0.01	<0.10	4
CP04	NX 58256	50655	SW	52	8	13	<0.01	0.09	1.8	<0.01	<0.10	2
CP05	NX 58110	50590	SW	32	7	16	0.03	0.01	<0.2	<0.01	<0.10	<1
CP06	NX 58503	50706	GW	84	12	18	0.97	0.60	1.0	<0.01	<0.10	2

+ As no known inflows or outflows were observed, all Surface water samples are designated SW
Red figures denote samples that are above typical ranges for the observed dataset.

Table 4.3: Soil Sample Analysis

Sample ID	Nat. Grid Reference		Soil Type ⁺	Extractable N (mg/Kg)	Total Ca (mg/Kg)	Total Mg (mg/Kg)	Total P (mg/Kg)	Total K (mg/Kg)	Tot Moisture** (105°C (%))	Total N (mg/Kg)	Nitrate (mg/l)	Nitrogen (%)	Extractable P (mg/l)
CP01A	NX 58065	50324	Organic rich peat	<0.5	30800	2100	453	1600	90.8	<0.9	<0.2	0.75	2.32
CP01B	NX 58065	50324	Organic rich peat	1.5	20500	1440	98	168	87.0	<0.7	<0.2	1.86	<2.0
CP02A	NX 58108	50386	Organic rich peat	<0.5	8820	1020	547	532	90.4	<1.3	<0.2	2.35	<2.0
CP02B	NX 58108	50386	Organic rich peat	4.5	27900	1670	146	202	77.7	<2.4	<0.2	2.10	5.51
CP06SA	NX 58503	50706	Organic rich peat	1.2	17000	2400	915	908	78.8	<2.4	<0.2	2.66	2.04
CP06B	NX 58503	50706	Organic rich peat	0.7	11900	13600	467	3160	58.7	<0.9	<0.2	0.30	<2.0

* Soil types are field observations

** Total Moisture = Water content

A/B suffix: **A** = Rooting Zone and **B** = Below Root Zone

Red figures denote samples that are above typical ranges for the observed dataset.

5. SITE OBSERVATIONS

To enhance the understanding of Carrick Ponds and the surrounding area, preliminary research was undertaken and complemented with a second site walkover to further understand the landforms, drainage configurations, potential environmental sensitivities and possible diffuse pollution sources influencing the site.

5.1 Desk Study

The Site Management Statement (SNH, 2010c) records an 'Objective for Management' of maintaining suitable water levels within the ponds and wetlands; maintaining the range of fen and grassland habitats; maintaining the water within the site at current nutrient levels; maintaining the ponds which support beetle populations and breeding amphibians; maintaining pools with luxuriant marginal vegetation with deep, but vegetation free areas; maintaining the wetland transition from open water, through fen to grassland; and maintaining the appropriate grazing regime.

Two site condition monitoring assessments were undertaken at the site in 2002 and 2010, which concluded that the beetle assemblage is in a favourable maintained condition. The condition of the basin fen has not been monitored to date (SNH, 2010c).

The beetle assemblage Site Condition Monitoring Management Note (SNH, 2010a) makes reference to the presence of several farm effluent treatment ponds on the site.

The SCM survey note (SNH 2011a) notes that the SNH Management Agreement expires in 2013. It also notes that Scottish Agricultural College staff have drafted up a plan for a Scottish Rural Development Programme (SRDP) application which would reduce the grazing on site (no winter grazing) and cease the application of fertiliser on site. It goes on to state that this regime would be beneficial for the site and that the landowner should be encouraged to enter SRDP.

5.2 Catchment Walkover

From the second site visit post-receipt of the analytical results, the following observations of the surrounding catchment were made:

- The site was free of litter. No visible pollution sources were observed within the site boundary.
- Undulating site with extensive rock outcrops and thin shallow soils.
- Bounding the entire eastern boundary are unimproved grazed fields with notable areas of dense gorse. The northern part of the site is bordered by woodland and the far western part of the site slopes down gradient to a small development of holiday cottages. These residential properties are at a lower level than the SSSI.
- No discernible inflows or outflows were observed on the site. All water was standing water.
- There are vehicle tracks within the site where access has been gained by assumed farm vehicles, and stock feeding areas where vegetation cover is limited. It was considered that this would lead to accelerated sediment transport into the lower parts of the site.
- Minor evidence of Gorse burning and cutting within the central parts of the site.

- Apparent silting up and drying out of ponds was observed in some areas. This could be associated with soil erosion resulting from agricultural practices.
- Although a detailed survey of the site ponds was not undertaken as part of the study scope, the extent of these did not appear to be as significant as the SNH mapping (SNH, 2011b) which was used to aid orientation whilst on the site. This may in part be due to the time of year the site was visited and the prevailing weather conditions.
- No evidence of point source pollution was observed during the site visit however evidence of silage and pellet feed for livestock was noted.
- No evidence of any buffer zones within the neighbouring fields was noted. However these fields did not appear to be subject to more intensive agricultural management practices than the site itself and the undulating nature of the site would mean there were minimal advantages for the inclusion of such.

5.3 Summary

The following table provides a summary of the key site features which were observed during both site visits or identified in the desk study undertaken as part of the initial works.

Table 5.1: Summary of key observations

Activities	Observations
Fencing	Entire boundary of site is fenced – although integrity of fencing not confirmed during scope of works.
Fishing	Not applicable - small and limited areas of open water.
Grazing	Site is grazed by both sheep and cattle (and is managed under an SNH Management Agreement until December 2013).
Monitoring	Condition monitoring was carried out in 2002 (not reviewed) and 2010. No previous water data is available.
Public Access	No formal access routes are present on the site although site is open and was used by dog walkers at the time of the visits.
Shooting	None understood to take place on site.
Point Pollution Sources	None observed within the SSSI boundary.
Properties in Catchment	There are no properties on the site or within the defined catchment. There are a series of residential (holiday let) properties due west of the site at Carrick Shore.
Unusual, Distinctive or Atypical Features	Evidence of burning of Gorse; known history of fertiliser, herbicide and lime applications and stock feeding.

A mapped summary of the perceived catchment pressures is detailed in Figure 5.1 (see Annex 1).

6. INTERPRETATION OF RESULTS

The following assessment is based on the field tests and laboratory analytical results only.

6.1 General Summary

The sample data indicates moderate nutrient contents within surface water, groundwater and soil samples obtained. No clear evidence of nutrient enrichment was observed on the site although there could be an influence from agricultural practices in the site catchment.

The standing water quality at the site was typically deemed to comprise moderately elevated concentrations of bioavailable nutrients with nitrate (as nitrogen) ranging between <0.2mg/l and 3.6mg/l. Groundwater samples recorded lower levels for this parameter. This could be attributed to the shallow soils and the site being sat on bedrock with minimal drift deposit. It is considered that the nutrient rich locations act as a sink with surface runoff channelled to this point. Phosphate (as phosphorus) levels ranged between <0.01mg/l and 0.05mg/l in surface water and were below the detection level in groundwater.

With the exception of iron concentrations in CPSW02, none of the analysed metals were recorded as being particularly elevated. There is no clear distinction between inorganic concentrations of bioavailable nutrients in the groundwater samples when compared to the surface water samples with no obvious trends evident. This may simply be explained by the limited number of groundwater samples collected (see section 3).

Nutrient levels in the soils samples were observed to be elevated in CP02B and this could be attributed to the agricultural applications and management of the site. Extractable phosphate levels were marginally elevated with the higher values generally aligning with the higher extractable nitrogen and total nitrogen values.

Despite the stated applications of lime (SNH, 2010c) there did not appear to be any significant variations in the pH values recorded. It should be noted that the limited spatial distribution (*i.e.* 'clumping') of the sample locations within the middle- western part of the site and no provision for the southern or eastern boundaries, does not aid the assessment as to whether these observations are localised or representative across the whole of the SSSI.

6.2 Atypical Results

No consistent atypical or anomalous results were recorded from the soil or water samples at Carrick Ponds. Of the limited data set the only observations of note are discussed below:

- The elevated iron in surface water sample CPSW2 indicates groundwater influence or direct connectivity with the underlying geology.
- The elevated ammonia value in CP06 of 0.60mg/l coupled with low dissolved oxygen is indicative of organic decomposition.
- Elevated nitrate and total nitrogen at surface water sample CP03 indicates nutrient enrichment most probably from artificial fertiliser and nitrification taking place.

6.3 Additional Considerations

See study limitations presented in section 3.

No records or reports (anecdotal or otherwise) of algal blooms or fishing records were reviewed during this study. Information of this nature could be of value in understanding long-term trends and changes within the site.

SEPA visits the site during farm inspections as the area drains to Carrick Bathing Beach.

7. CONCLUSIONS

The analytical results highlight moderate levels of nutrients in the soil, surface and groundwater samples with no clear evidence of nutrient enrichment. The beetle assemblage on the site is in a favourable maintained condition and there is no indication of any effects from diffuse pollution.

There could be however an influence from agricultural practices in the site catchment. The desk study and site walkovers indicate that there have been changes in land use management in the immediate catchment, namely the application of soil conditioners and plant control measures which will have directly influenced such. As the SSSI is used for the grazing of cattle and sheep, these present a threat to changes to the natural vegetation through overgrazing (particularly in winter) and the associated effects of dunging and trampling. This is heightened when combined with the intensive management approach of changing the soil composition through fertiliser and lime applications. It is unclear whether the variable pH conditions in the pond are due to natural conditions (e.g. geology) or management (i.e. lime application).

Changes to the local hydrology can result from the removal of trees as permitted through the existing management agreement, and through the burning of gorse – the latter also leading to the recycling of nutrient within the site. This could be also leading to sediment runoff and silting-up of some ponds. It would appear from the desk study that there are no controls over the frequency and extent of these activities. It is anticipated that over time these apparently small changes will have an appreciable effect on the site as a whole. There will be some runoff from the access tracks which pass through the site and the trampled feeding stations. The track is used by farm vehicles which will have a heightened impact due to the tyre configurations, and like the feeding areas, be rutted in wet weather conditions. Both will result in the loss of vegetation and accelerate both nutrient and sediment runoff.

Given the undulating topography and mainly impervious geology, the site catchment area is only slightly larger than the actual site and the site is therefore mainly rainfed. There would be therefore minimal influence from the wider farming area.

Residential dwelling at Carrick shore are located within the catchment and in close proximity (c.300m respectively) of the site boundary. Given the remote location of the site it is expected that these dwellings will be served by septic tanks however due to these being down gradient of the site, it is considered unlikely that these will impact on the site.

8. RECOMMENDATIONS

Based on the limited understanding gained from the sampling exercise and catchment visits, the following recommendations are proposed:

8.1 Monitoring

- i. Undertake a long-term targeted monitoring study at selected locations within the site for key nutrients – to include orthophosphate and bioavailable (extractable) nitrogen. Ideally this would be undertaken over the course of several seasons (ideally for a minimum of one year). This should be compared alongside rainfall data and seasonal abnormalities to seek to understand the nutrient dynamics taking place within the site.

8.2 Other Commissioned Studies

- ii. Review the loss of (or variations to) standing water within the site over time. If such were routinely quantified, over a period of time this would further the understanding of the hydrology at the site and aid the resulting management to control such at a stable level (if this were deemed desirable).
- iii. Review the historical beetle assemblage data using one of the known macroinvertebrate intolerance to pollution indices. Unlike 'spot' monitoring, the beetles are present all the time and so provide a consistent indicator of the prevailing environmental conditions. Given that 80+ water beetle species have been identified at the site, it is expected that through using the variations in the community composition and population numbers, and known variations to pollution tolerance between genus/species, it may be possible to gain a further insight into the likely changes to the site, and particularly water quality, over time.
- iv. Undertake a detailed library review, including historical mapping and local data sources, to seek to understand historical land use and information relating to the site.

8.3 Management

- v. Review the policy for permitting the addition of compound fertiliser and for the unquantified removal of trees as permitted through the management agreement. The former is a significant addition of nutrients to the site whilst the latter may lead to changes in the site hydrology and soil erosion.
- vi. Review the policy for the removal of site vegetation and the methods used to control/manage such. Where future management practices require such, vegetation should be cut and removed from site instead of chemical applications (*i.e.* herbicide - SNH, 1999) or burning. Consideration should be given to the removal at the root zone rather than the cutting of above ground stem and should be followed by appropriate off-site disposal. This approach will lead to a net reduction in nutrients from the catchment, minimise regrowth and avoid the need for the use and reapplication of potentially harmful chemicals. This is particularly applicable to marginal and aquatic vegetation.

8.4 Landowners

- vii. Proactively engage with catchment landowners to understand the historical land use practices to determine changes which are likely to have influenced the site. The use of ponds for treatment of farm effluent (SNH, 2010a) should be further investigated.

- viii. Proactively engage with local landowners to understand the existing and (foreseeable) proposed changes to the immediate catchment including field usage, crop type and fertiliser/soil conditioning approaches. This should include quantification of grazing; an assessment of the storage and disposal of animal waste within the site; burning of vegetation (Gorse) activities which take place across the site; and an understanding of the existing and (foreseeable) proposed changes to the immediate catchment including field use and soil conditioning approaches. Consider appropriate management strategies accordingly - for example (but not exclusive to) nutrient management planning, exclusion zones, buffer strips, fencing of sensitive areas, location of feed areas, limiting stock numbers, routine spot monitoring *etc.*
- ix. Take the opportunity of the SNH Management Agreement expiring in 2013 to encourage the landowner to enter into a new agreement which excludes grazing in the winter, ceases application of fertiliser and stock feeding on site.
- x. Engage with surrounding households to ensure septic tanks are adequately maintained.
- xi. Review the use of lime applications at site and the timings, methods and reasons for their application.

8.5 External Consultations

- xii. Engage with SEPA to request information obtained during farm inspections (site drains to Carrick Bathing Beach) and understand the regulatory controls on the use of nutrients in the catchment for agricultural purposes. Seek to draw on comparisons of sites where a nitrate vulnerable zone has been introduced.

From the stated conclusions, the key actions to address pressures from the agricultural activities within the site catchment should be primarily focussed on the application of fertilisers and lime, stockfeeding and controlling the removal of trees (v - xi).

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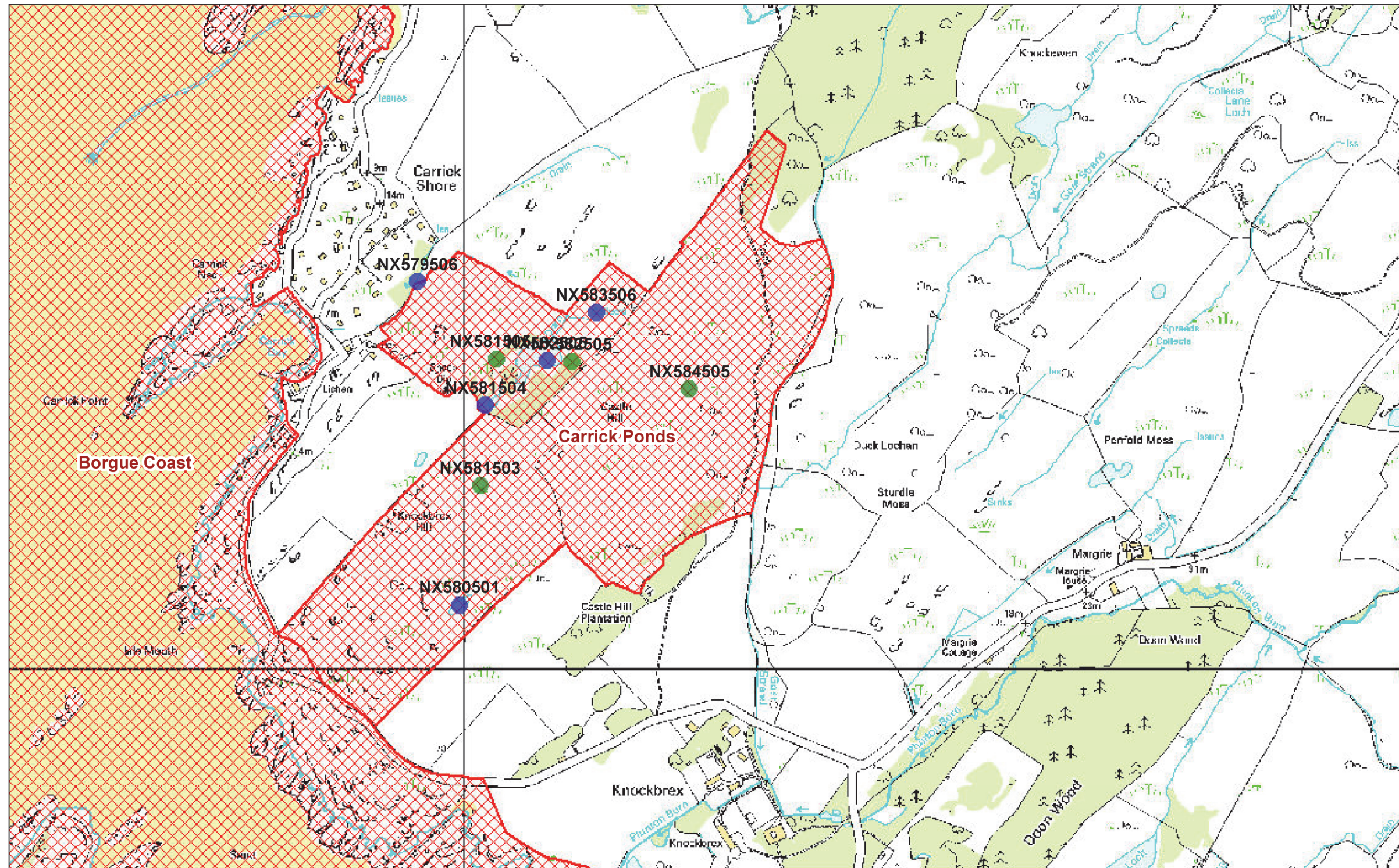
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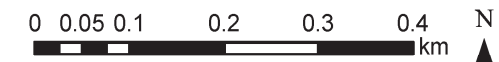
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Carrick Ponds



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Notes: Note locations on this site are very vague Choose soil sampling points where there are wetlands!



Map produced using geo.View 3.0
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Figure 2.1: SNH Proposed Sampling Location Plan

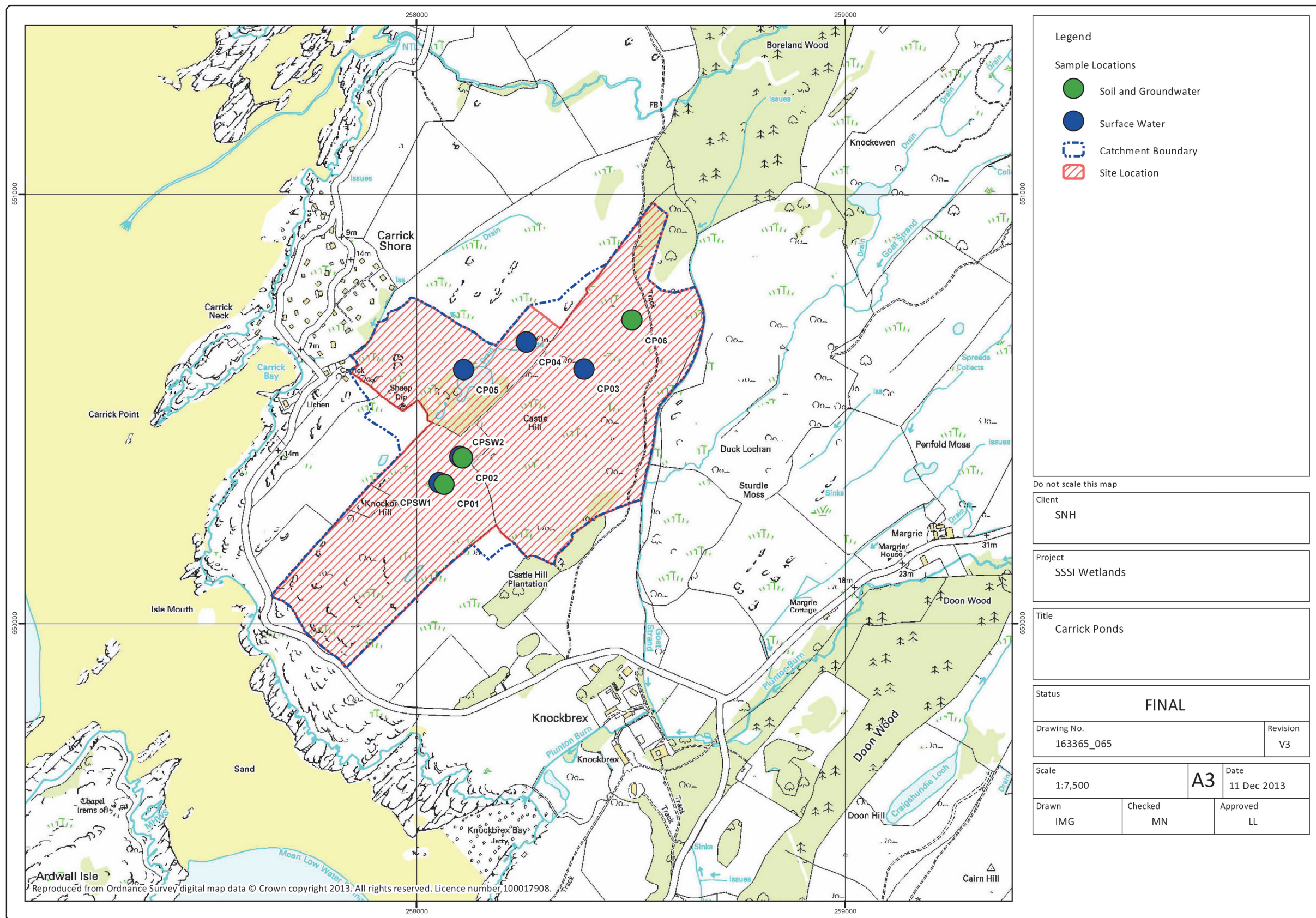
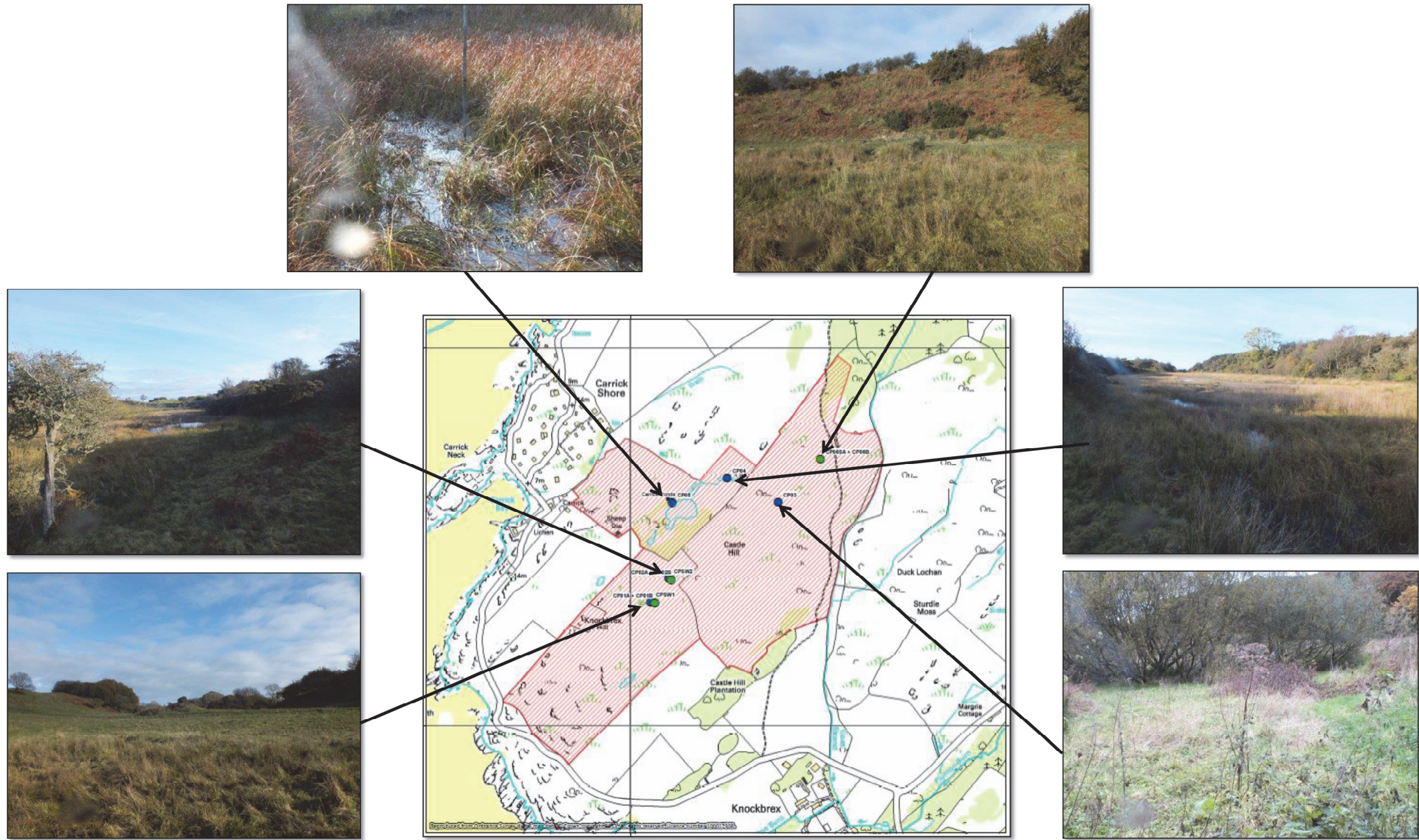


Figure 2.2: Plan of Actual Sampled Locations



Photograph Log - Sample Locations
 (Photographs taken on 25th October 2012)

Figure 2.3: Photographs of each Sampling Location

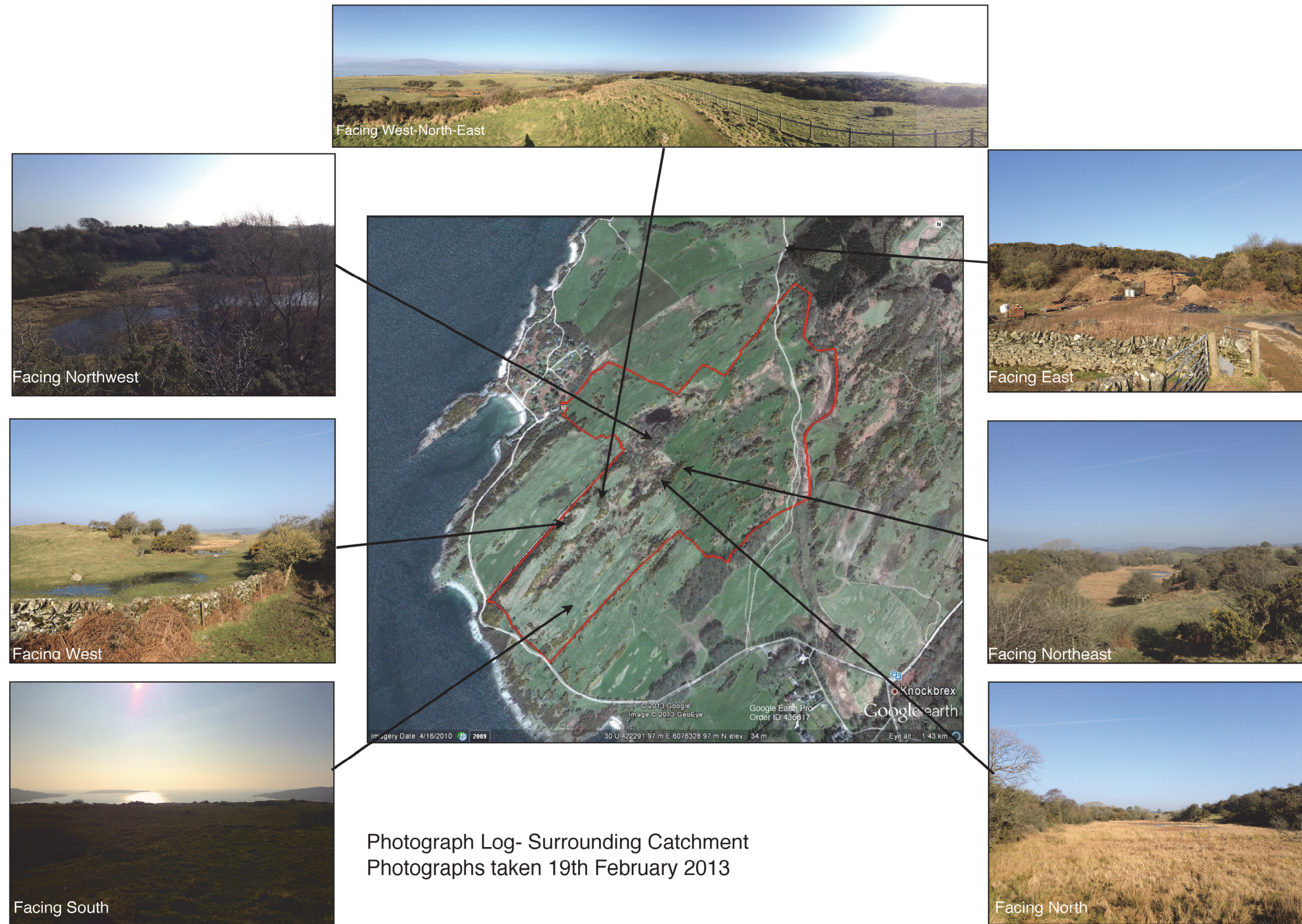


Figure 2.4: Photographs of Surrounding Land Use

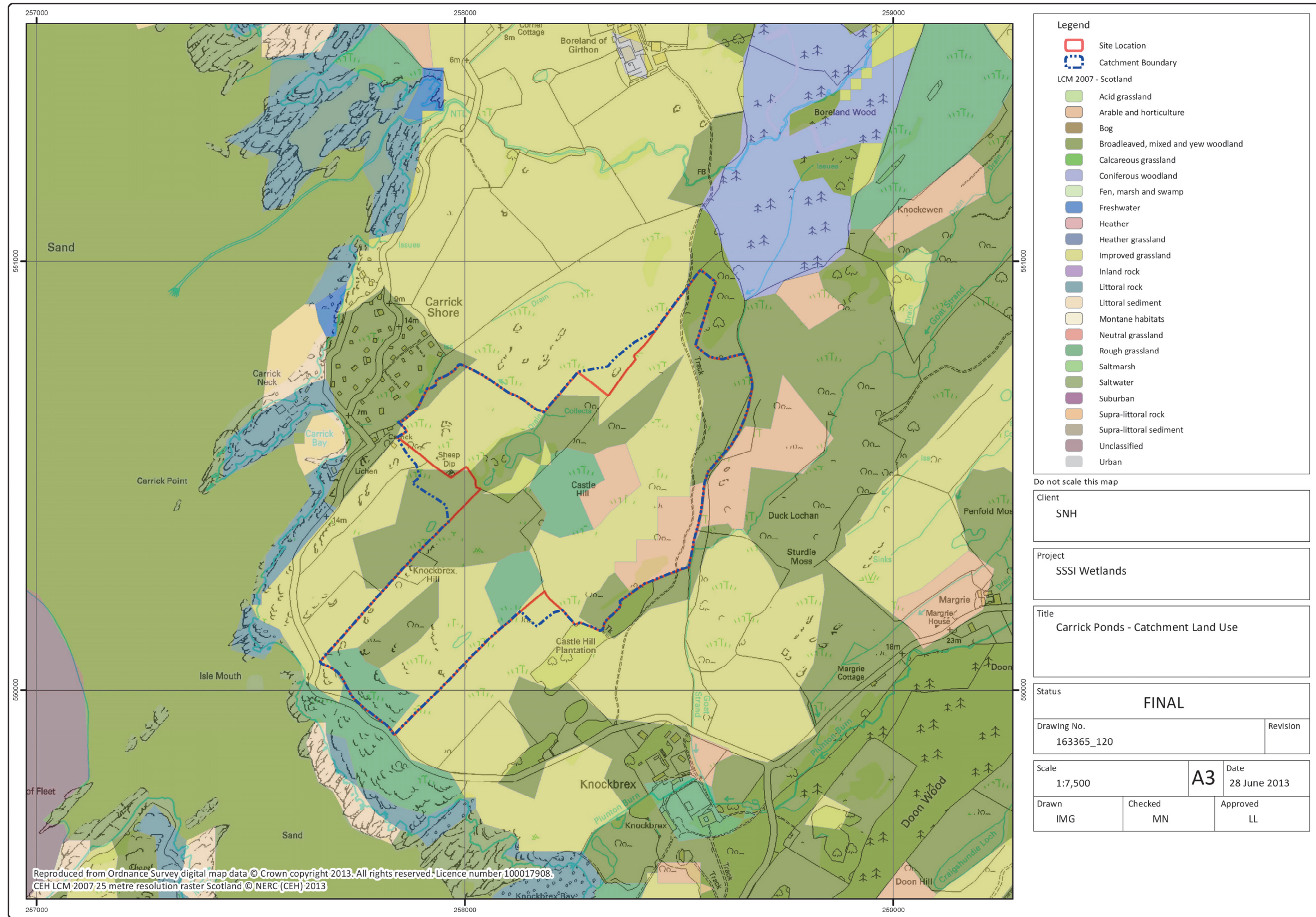


Figure 2.5: Catchment Land Use Characteristics

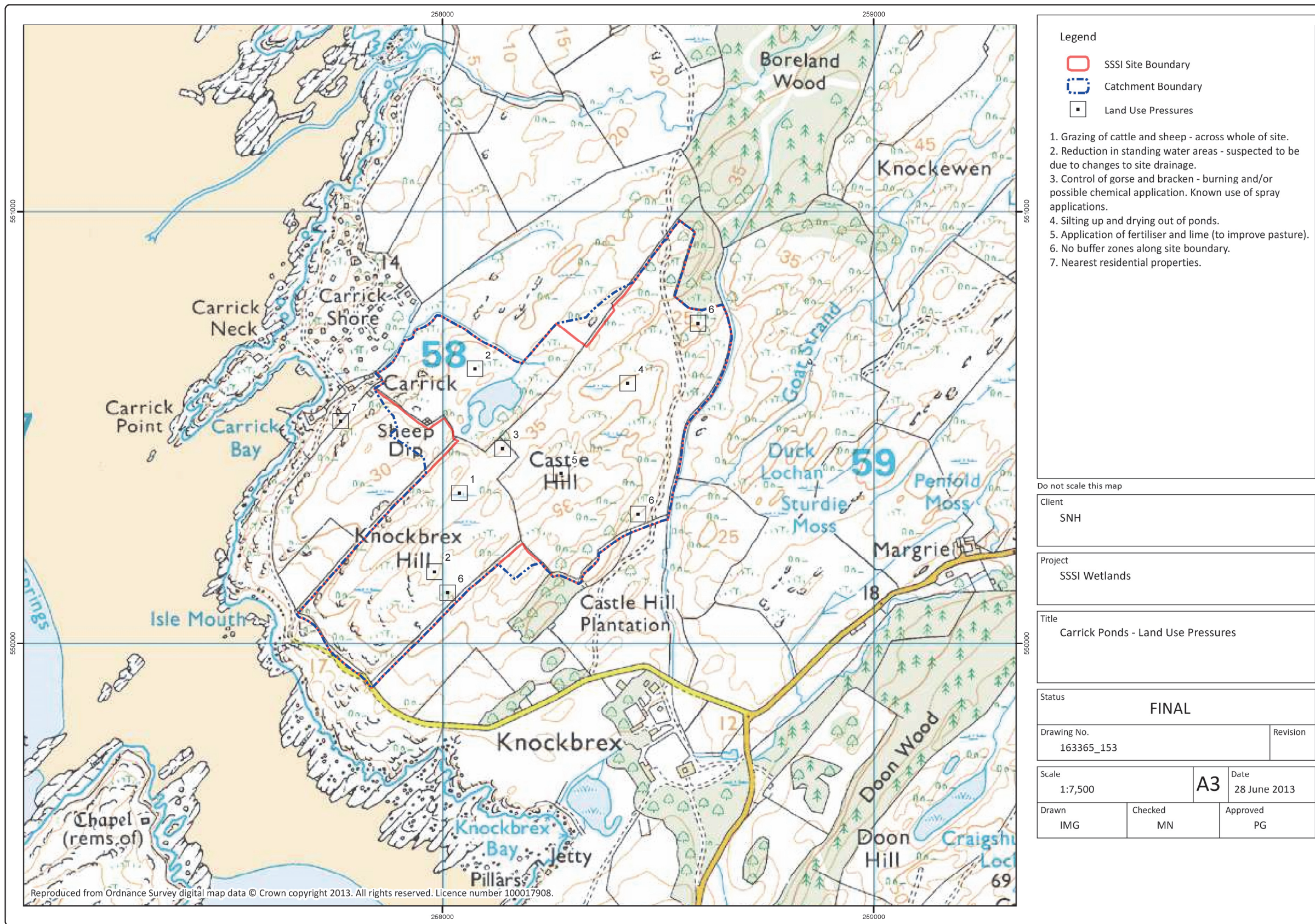


Figure 5.1: Catchment Pressures Summary

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