



National Land Data Programme (NLDP): Land Cover and Use Map Specification

Version 5.0

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Glossary of Terms

Term	Definition
DAERA	Department of Agriculture, Environment and Rural Affairs
Fusion	OSNI Fusion. The most detailed spatial mapping dataset produced by Ordnance Survey of Northern Ireland
Fusion ID	Globally unique identifier, an attribute within OSNI Fusion
GIS	Geographical Information Systems
LGD	Local Government District. Northern Ireland has 11 LGDs, also known as local council areas
LiDAR	Light Detection and Ranging. A technology which uses laser light to create a 3D representation of the earth's surface
LPIS	Land Parcel Identification Scheme
LPS	Land and Property Services. Ordnance Survey Northern Ireland is a part of LPS who is responsible for rating, valuation, land registration and mapping
NI	Northern Ireland
NICS	Northern Ireland Civil Service
NLDP	National Land Data Programme
NLUD	National Land Use Database
OSNI	Ordnance Survey Northern Ireland, the official mapping agency of NI
Pointer	The address database for Northern Ireland, maintained by LPS with help from local councils and Royal Mail
SOE	Skin of the Earth, OSNI Fusion's base layers
Vector	A GIS data format which can comprise of points, lines or polygons
Z Order	Stacking order of features in a map layer to denote its vertical relationship to other features

1. Executive Summary

In order to make effective decisions about what we do with our land, we need a consistent baseline of what is on the land surface (land cover) and what the land is being used for (land use). Information on land cover and land use is often held in disparate datasets which vary in accessibility, availability and format. This can lead to duplication of information gathering by decision makers and ultimately inefficient use of land due to a lack of data and evidence. Addressing these data challenges can help decision makers identify where change is beneficial and feasible to best optimise land use and manage competing demands. For example, helping rural landowners identify areas of agricultural land not currently used for high value crops that could instead become a site for renewable energy or enabling urban planners to determine how buildings and green spaces are being used to support new housing developments.

As part of the Geospatial Commission's National Land Data Programme, Ordnance Survey Northern Ireland (OSNI) has developed a specification for a land cover and land use map of Derry City and Strabane Local Government District which can help address these challenges. The map brings together a number of existing, authoritative public sector datasets which are already available across Northern Ireland (NI), rather than using remotely sensed data. OSNI are using their OSNI Fusion product as the basis of the map, Fusion is the most detailed spatial mapping dataset produced by OSNI, creating a fully polygonised 'skin of the earth' coverage of Northern Ireland, with each polygon having a unique identifier. The methodology utilises the National Land Use Database land use and land cover classifications as a baseline given the detailed list of classifications and definitions it provides. The map methodology also allows for classifications to be refined to reflect the availability of data and the needs of end users.

This methodology was used to address challenges faced by stakeholders who cited a lack of accessible high resolution land cover data in NI. Land cover mapping outputs can be costly to produce and those that are lower cost, are typically coarser resolution and have fewer classification types. Additionally, land use maps are difficult to create from remotely sensed data given that some land uses cannot easily be determined from a birds-eye view. This method has the potential to be more cost effective and more efficient as a result of combining disparate land datasets into one unified land cover and land use map.

Through stakeholder engagement with a range of land data users across the UK, it was identified that the map has the potential to be used in assessing land use change over time, comparing land cover and use together and assisting in policy development and decision making in a range of areas such as planning, environmental modelling, green space access, identifying land for regeneration, housing, net zero and biodiversity.

Due to the success of the pilot and positive feedback from stakeholders, further funding from OSNI has been secured to roll out the land cover and land use map across NI. The timing of this means it has great potential to support activities in response to the Northern Ireland Climate Change Act¹, both in developing a strategy and monitoring change. Provided that data owners are willing to continue to share data outside of the proof of concept area, and that technical resources continue to be available, a Northern Ireland land cover and land use map will be ready for release across government and council areas by early 2024.

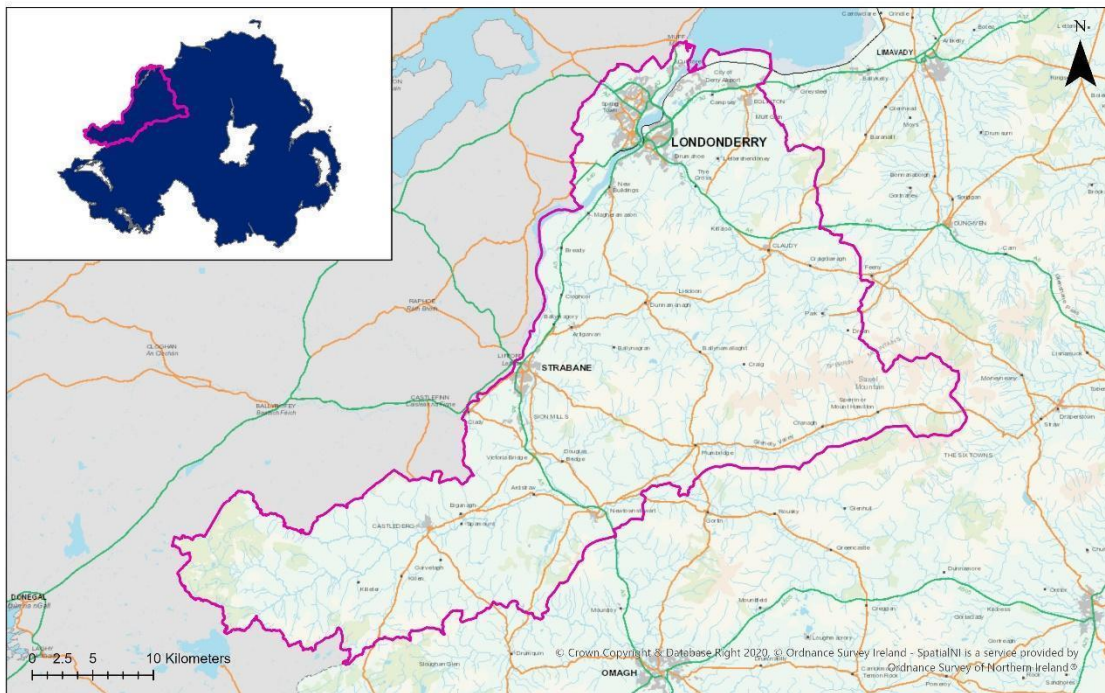
¹ Northern Ireland Climate Change Act 2022

2. Introduction

In August 2021 the Geospatial Commission granted funding that enabled OSNI to establish a small standalone team with the aim of completing a proof of concept into creating a land cover and use map of Northern Ireland. This was part of their UK wide National Land Data Programme to improve how data about land is used across the UK. OSNI’s work in the programme completed in March 2023.

This project was centred on assessing the feasibility of populating all OSNI Fusion Skin of the Earth (SOE) polygons with a land cover and land use classification, primarily using authoritative data sources as the input, followed by remote sensing infill if required. Derry City and Strabane Local Government District was chosen as the study area due to the wide range of land cover and use types present within its boundary across both the built and natural environment. It is an area containing 146,255 SOE polygons, approximately 1250km² in size, 96% of which is classed in OSNI Fusion as land parcels, 3% as transport and 1% as water.

Study Area - Derry City and Strabane Local Government District



This approach to use existing authoritative data was chosen to reduce duplication of work in data acquisition across organisations, obtain a greater granularity of data, and help overcome some of the known issues in identifying land characteristics from satellite imagery, that is:

- Cost of purchasing imagery at the required resolution
- Time taken to record adequate training samples for each land classification
- Processing power needed for deep learning
- Acquiring skills required in deep learning
- Limited range of land cover classifications that can be identified from imagery
- Difficulty in identifying land use from imagery

Due to limited availability of either a detailed land cover or use map in Northern Ireland, it was proposed a single map containing attribution for both would be tested, supporting the growing understanding that key decisions on land need to be informed by both its cover and use.

This map specification was not aimed at creating an extensive list of all land cover and use types across the study area, nor was it developed with the intention of requiring a large resource or expertise to replicate in other areas. **At the core of these decisions has been the intention to create an indicative map layer fit for purpose in supporting strategy and policy development in land use.**

This document outlines the key methodology decisions that have been made throughout the project. A summary of UK wide stakeholder feedback and future recommendations have also been included.

3. Map Specification

3.1 Base map

OSNI Fusion’s Skin of the Earth (SOE) layers were used as the base polygons of the map i.e.

- Land Parcels
- Transport Casings
- Water Polygons – Water Course and Water Standing

There were various reasons for this:

1. Together the SOE layers provide fully polygonised coverage of Northern Ireland i.e. no gaps
2. Fusion is the most detailed spatial mapping dataset produced by the organisation, with polygons divided along clear boundaries such as perimeters, structures, roads and water.
3. It’s a product already widely used and recognised across the country, available through various data sharing agreements such as the Northern Ireland Mapping Agreement and the Local Government Mapping Agreement, making it accessible to the nine NICS Departments, which includes the Departments themselves, their Executive Agencies, Non-Departmental Public Bodies, Arm’s-Length Bodies and North-South Implementation Bodies, and Local Councils. These are largely the intended audience for the proof of concept, that is policy advisors and decision makers for land use.
4. Building the land cover and use dataset on a foundation of OSNI Fusion mapping makes use of the globally unique identifiers which have been created for every feature and polygon within OSNI Fusion. These provide links between the datasets, improving compatibility, interoperability, and enabling notifications to be created where change occurs to support reusability of data and reduce the need for multiple capture. It also allows users to link additional data internal to their organisations.

3.2 Classifications

In order to reduce considerable time identifying the land cover and use classifications that should be identified within the map, the [National Land Use Database v4.4](#) (NLUD) was used as a starting point with the intention to add or remove classifications where required.

Released in 2006 by the UK Cabinet Office, it was intended to *“provide a framework for harmonising existing classifications; to facilitate consistent collection and reporting of land use and land cover information; and to provide the basis for the creation of national data sets. It has been designed to serve as a standard classification available for adoption by bodies involved in the routine collection of land use and land cover data”*.

This was a useful starting point for the project due to the range of classifications for both land cover and land use, the detailed definitions outlined for each and its hierarchy level of both group and description, giving end product users the opportunity to analyse from two levels of detail, which is common in existing land cover maps.

3.3 Authoritative Datasets

As the key theme of this proof of concept was to utilise as much existing authoritative data as possible rather than creating new information and duplicating work from others, a range of datasets were used from within OSNI, Land and Property Services and external organisations. These were:

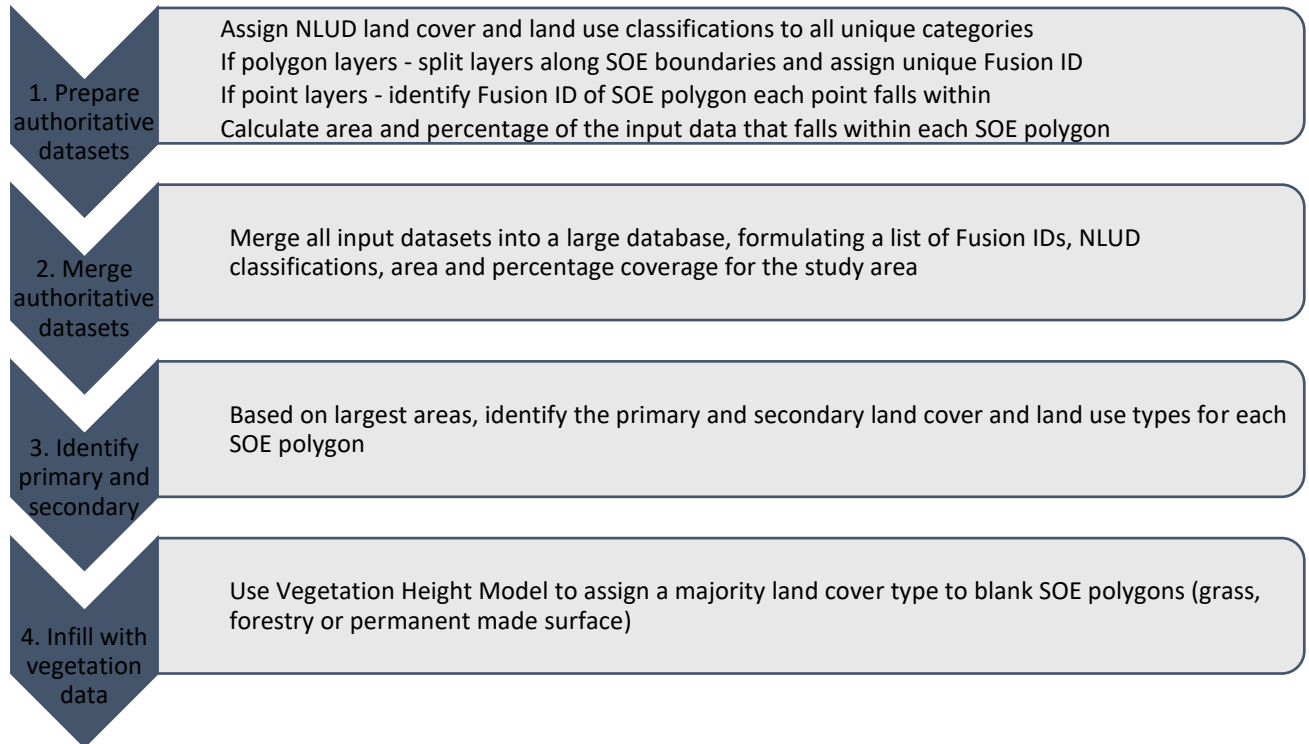
Owner	Dataset
British Geological Survey	Britpits (quarries)
Department of Agriculture, Environment and Rural Affairs	Authorised Waste Sites Inland Fisheries (PAE) NI LPIS Fields and Features WoodlandBasemapV1_1
Department for Infrastructure	Roads Service depot locations
Historic Environment Division	Listed Buildings
Local Council	Council owned or maintained sites
Land and Property Services	Pointer LPS Property Data OSNI Fusion: <ul style="list-style-type: none"> o Buildings o Groundcover o Non-vehicular transport layer o Standing Water o Structures o Transport Casings o Water Course Government Land and Property Register Vegetation Height Model Change Detection Buildings
Northern Ireland Water	Sites
Environmental Non-Governmental Organisations	Sites – Woodland Trust, National Trust, Ulster Wildlife Trust, RSPB

3.4 Methodology

3.4.1 General

Desktop GIS software was used throughout the project due to its availability to OSNI staff, known spatial analysis capabilities and common skills within the team. Future improvements to the methodology may require upskilling in terms of automation and deep learning.

An overview of the final method used was as follows:



The method was automated where possible to enable more efficient production. Such method would then allow for frequent and less intensive future updates as revised or additional datasets become available.

3.4.2 Attribution

Due to the nature of OSNI’s SOE polygons varying in size, there were many instances where more than one land cover or use type was identified within. In order to provide a clearer picture of each polygon, a secondary land cover and use classification was assigned where identified. Attribution was limited to two classifications due to what could be practically delivered within the project timescales, but also because a large number of tertiary classifications would have covered very small proportions of the polygons. The method however does allow for additional classifications if supported by the source data.

The Fusion ID is present within the table to allow users to join their own data and to enable future versions of the map to be analysed and show change over time. NLUD group and description classifications were added to give users a choice in the level of detail they wished to analyse.

Area and percentage cover were then added to show how much of a polygon is designated as the assigned land use or cover classification. Finally, the data source and date were added so users are aware of where the data has originated, who is responsible for it, and when it was published.

		Detail				Detail	
<i>Primary Land Use</i>	LU_Group Code1	Group code		<i>Secondary Land Use</i>	LU_Group Code2	Group code	
	LU_Group1	Group			LU_Group2	Group	
	LU_D_Code1	Description code			LU_D_Code2	Description code	
	LU_Des1	Description			LU_Des2	Description	
	Area_LU1	Area			Area_LU2	Area	
	Per_LP_LU1	Percentage cover			Per_LP_LU2	Percentage cover	
	Source_LU1	Data source			Source_LU2	Data source	
	SourceDate_LU1	Date of source			SourceDate_LU2	Date of source	
<i>Primary Land Cover</i>	LC_Group Code1	Group code		<i>Secondary Land Cover</i>	LC_Group Code2	Group code	
	LC_Group1	Group			LC_Group2	Group	
	LC_D_Code1	Description code			LC_D_Code2	Description code	
	LC_Des1	Description			LC_Des2	Description	
	Area_LC1	Area			Area_LC2	Area	
	Per_LP_LC1	Percentage cover			Per_LP_LC2	Percentage cover	
	Source_LC1	Data source			Source_LC2	Data source	
	SourceDate_LC1	Date of source			SourceDate_LC2	Date of source	

An attribution of Unknown was used when only part of the NLUD classification could be identified from the source data e.g. a Group code of CO20 Grass, but Description recorded as unknown between improved, unimproved or recreational. An attribution of null was given when all datasets were merged and there was still no information e.g. no secondary land use identified.

3.4.3 Gaps in authoritative data

It was found that 92% of the SOE polygons located within the study area could be assigned at least one land cover and one land use classification from authoritative data sources. Of the unidentified polygons, a proportion related to private industrial areas. A large number were green, communal spaces around housing such as alleyways, woodland between housing rows, grass verges between a house and a road or larger open green areas within housing developments. It is hoped this could be addressed to an extent by ground maintenance data from local council and Northern Ireland’s Housing Executive.

Other unidentified polygons were due to how some SOE polygons have been divided, on occasion for example dividing what is likely a piece of private land – one polygon being a house and driveway, another being a green space. A Pointer address will be attributed to the building but as there will be no data from agriculture or forestry for the green space, in the current methodology it will be left as unknown when in fact it’s an extension of the land belonging to the residential dwelling.

It may prove difficult to identify land use and cover of any remaining polygons from authoritative data. Land ownership data can only help if it is also attributed by land cover and use, which was found not always to be the case. Data owners can also have concerns around confidentiality in sharing land ownership data.

3.4.4 Data infill

One large land cover and use type within the study area that was not present in authoritative data sources but was able to be manually identified from orthophotography was golf courses. As they tend to be distinctive and low in number this was a feasible task.

OSNI’s Vegetation Height Model (VHM) is a product derived from 4-band orthophotography and height data to identify areas of land that are vegetated, attributed with an approximate height. In order to help populate the 8% of polygons with neither land cover or land use identified, VHM was used to identify at least whether it largely contained vegetated or hard surface areas, assigning a land cover of grass, woodland and shrub, or permanent made surfaces. This product is unable to provide information on land use, therefore those attributes remained as null.

3.4.5 Adding classifications to NLUD

As the project developed, it became necessary to add minor updates to some definitions and add additional classifications. This was in order to reflect the source data being supplied and avoid forcing it into a particular classification that did not fit or cause unnecessary generalization. Secondly a mixed buildings classification was added to address the common situation where more than one building type is present within one polygon, rather than having to prioritise one type and lose detail and an appreciation of the land use.

Classifications added during the proof of concept were:

Order		Group	
U010	Agriculture and Fisheries	U013	Nature Conservation
U140	Mixed Landuse	U141	Mixed Buildings
C030	Woodland and Shrub	C035	Open Ground Woodland
		C036	Regenerating Woodland
		C037	Short Rotation Coppice
		C038	Grazed Woodland
C080	Buildings and Structures	C083	Listed building or structure

3.4.6 NLUD classifications with no source data

Out of the original 73 land cover and land use NLUD classifications, five had no authoritative source data identified within the timescale of the project:

- Vacant buildings and land
- Defence
- Freshwater marsh
- Salt marsh
- Sea and Coastal Waters

In addition, there was difficulty in identifying fallow land and bare surfaces.

Further discussion will be required to identify vacant buildings and land. Whilst vacant buildings could potentially be identified through rate payments, whether this is deemed appropriate information to be published in a map would need to be decided by the data provider. Vacant land would be more difficult to gather and require input from all land owners of which there are many. Defence data would also need further consideration on appropriateness within a map due to security concerns, and until an end user agreement is in place, it is difficult to predict willingness to share.

Fallow land and bare surface also requires further study. A source may be available within DAERA for fallow land, salt and freshwater marsh, however bare surface will require additional development work as currently within VHM data, a non-vegetated surface may be a field or a non-permeable surface. If however, such data was to become available in the future, then the NLUD specification will accommodate

Missing information on Sea and Coastal Waters is a reflection of OSNI Fusion boundaries not extending past the coastline and therefore there are no polygons located within sea and coastal waters to attribute.

3.4.7 Overlapping source datasets

After joining classified input datasets to SOE polygons, those with an area less than 5% of the land cover or use classification were removed. This was to reduce any error introduced by datasets created at a different scale to OSNI Fusion and extended into a neighbouring polygon e.g. an area of forestry extending into a water polygon.


There are also instances when the primary and secondary land classifications together have an area greater than the size of the polygon, implying there are errors in the input data. On occasions where more than one source dataset has identified the same land cover or use type within a SOE polygon, duplicates are removed based on the Fusion ID, leaving one entry per polygon.

Some errors are due to input data being joined to the wrong Z order. Within Fusion, SOE polygons can overlap (for example a road continuing over a river via a bridge) meaning when joining an external dataset it can attach to the incorrect layer. This can require manual correction.

There are then situations where overlaps in the data may be valid. An example is a field can be recorded as entirely agricultural with grassland, but also associated with renewable solar or wind energy production. For this reason, the map specification allows areas greater than 100%.

Other overlaps however may be due to errors in the source data, the level of land classification detail or the age of the data and may require a hierarchy system to be put in place, for example based on known update frequency where you rank the most recently updated sources higher when required. To illustrate, take a large farm building being built, replacing an area of grassland– this new building will not be recorded within Pointer as it does not have an address therefore no notification of change will be triggered. It is however likely to have been identified within DAERA's agricultural dataset and therefore ranked higher up the hierarchy list.

The following hierarchy was applied to the proof of concept where overlaps and conflicts in the data occurred. As only datasets that were deemed reasonably accurate and up to date were included, it aimed to give priority to the more informative datasets in terms of land use. For example, labelling a water body as an inland fishery, a woodland area as a nature conservation area, or a building as a listed building. The less informative datasets were ranked lower, for example government owned buildings and land which currently contains little attribution on land use, and vegetation height model from which vegetation type can only be estimated as grass or woodland.

END PRODUCT	LAND COVER AND USE MAP		
SKIN OF EARTH FEATURE	LAND PARCELS		WATER POLYGONS
			TRANSPORT CASINGS
SOURCE DATA PRIORITY ORDER 	WASTE SITES, GOLF COURSES, NI WATER SITES, OSNI STRUCTURES		INLAND FISHERIES
	BUILDINGS: BGS QUARRIES HED LISTED BUILDINGS LOCAL COUNCIL NI WATER BUILDINGS LPS PROPERTY DATA POINTER FUSION BUILDING TYPECODE GLPR BUILDINGS	<u>AGRICULTURE/WOODLAND/GREEN SPACE:</u> WOODLAND TRUST NI WOODLAND BASEMAP LPIS FOREST AND AGRICULTURE ATTRIBUTES LOCAL COUNCIL GLPR AND OSNI GROUNDCOVER LPIS RECREATIONAL ATTRIBUTES VEGETATION HEIGHT MODEL	FUSION WATER

3.4.8 Calculating area for point datasets

Not all authoritative datasets are polygonised, for example Pointer and Listed Buildings, however this map methodology requires all inputs to have an area attached in order to identify primary and secondary land cover and use types by size. Depending on the dataset, it may be possible to combine with polygon map layers and calculate an area e.g. Pointer and Listed Buildings to Fusion building polygons. For others it may be feasible to digitize using orthophotography if they are relatively low in number e.g. active quarries or golf courses.

Some however may be high in number and a decision needed on what level of accuracy the end user requires and whether it's better to withhold the information completely until a time when the area can be accurately represented, or to use an estimate in order to ensure the NLUD classified data can be incorporated into the final map. For example, a wind turbine is often recorded as a single point within OSNI Fusion and for the proof of concept an estimated average area was applied. For end users aiming to use the land cover and use map to identify where they are located in more general terms and get an appreciation of renewable energy locations across the country, a highly accurate area isn't needed and the resource required to accurately digitize their footprints may be better used elsewhere. For those users wanting to complete a more in-depth analysis of specific wind turbine locations, including their exact location then this estimation and map specification will not fully meet their needs. What the map could bring on this occasion however is an awareness of authoritative data producers and who to contact to request the original data.

This principle was also applied in the proof of concept on occasions where the point location of buildings was provided but they had not yet been surveyed. OSNI creates building change detection map layers, identifying where buildings appear to have been recently demolished or built. Whilst these are used internally to the organization to inform where map updates may be required, they have also been used to calculate an estimated area of buildings not yet surveyed.

3.4.9 Additional analysis

Where authoritative source data is not recorded exactly as required in the NLUD classifications, some assumptions have been made. For example, in order to differentiate between inland and coastal rock classes, a buffer zone of 150m from the Northern Ireland coastline was used.

As mentioned previously, a mixed buildings classification has been added to overcome the difficulty of having a number of building types within one SOE polygon. The designation of the mixed category has had a few caveats applied, again with the intention not to dilute the land use classification. Unclassified buildings have not been included in the mixed classification, and those with an area less than 5% of the polygon have also not been included. This is to reduce the number of times outbuildings or blocks on large sites takes away from the main land use which is for example agricultural or a hospital.

3.5 Output

The methodology created a single vector map layer with attribution covering the primary and secondary land cover and use types within each SOE feature.

Example of primary land use within Derry City and Strabane LGD



Simple statistics that can be identified from the draft layer include 82% of the land in the study area is primarily used for the purpose of agriculture, 8% forestry, 3% transport and 3% residential. In terms of land cover, 60% is primarily classified as grass, 17% heathland and bog and 8% woodland and shrub. With the output containing both land cover and use attribution, it is possible to carry out more detailed analysis across the two, for example it's possible to identify of the land primarily classified as agricultural use, 72% is covered by grass. Or of the land cover classified as building, 70% are used as dwellings.

Users have flexibility on how they best analyse the map. Figures can be derived based on the SOE polygon areas to give indicative values or the area land use/land cover columns for actuals. A typical example to explain this is a land parcel indicating the outline of an urban semi-detached residential dwelling. This will have been classified as residential use from Pointer and the area based on the Fusion building polygon, typically under 50% of the land parcel. In reality, the entire land parcel will be under residential use – the house, driveway and garden will all be located within the land parcel boundary. Users can therefore consider either the total land parcel area or the building polygon area depending on their needs.

An example of the methodology being applied to a single SOE polygon is as follows:



Image 1



Image 2

Image 1 shows a typical land parcel (red boundary) in a commercial area with orthophotography suggesting it contains a mixture of buildings, car parking and vegetation. Image 2 shows how Fusion building polygons (orange) provide information on area, Pointer (blue markers) provides detail on building use (retail, restaurant etc), Fusion ground cover (grey) provides the classification and area of car parking, and finally Vegetation Height Model (green) provides the area of vegetated surface. The land cover and use map output from this is a single polygon identifying the primary classification of buildings, which are mixed and secondary classifications of car parks and other made surface.

The detailed attribute table for the single SOE polygon example is as follows:

	Attribute Name	Detail
	Fusion ID	b1e037e5-eb2a-435b-8fe4-a30a82ca45f0
<i>Primary Land Use</i>	LU_Group Code1	U140
	LU_Group1	Mixed Landuse
	LU_D_Code1	U141
	LU_Des1	Mixed Buildings
	Area_LU1	30788.12
	Per_LP_LU1	63.69
	Source_LU1	LPS
	SourceDate_LU1	26/07/2022
<i>Primary Land Cover</i>	LC_Group Code1	C080
	LC_Group1	Buildings and Structures
	LC_D_Code1	C081
	LC_Des1	Building
	Area_LC1	30788.12
	Per_LP_LC1	63.69
	Source_LC1	LPS
	SourceDate_LC1	26/07/2022
<i>Secondary Land Use</i>	LU_Group Code2	U050
	LU_Group2	Transport
	LU_D_Code2	U053
	LU_Des2	Car Parks
	Area_LU2	14595.29
	Per_LP_LU2	30.19
	Source_LU2	OSNI Fusion
	SourceDate_LU2	26/07/2022
<i>Secondary Land Cover</i>	LC_Group Code2	C090
	LC_Group2	Permanent Made Surfaces
	LC_D_Code2	C094
	LC_Des2	Other Made Surface
	Area_LC2	14595.29
	Per_LP_LC2	30.19
	Source_LC2	OSNI Fusion
	SourceDate_LC2	26/07/2022

Vegetation has not been included in the final attribution due to its smaller area compared to the buildings and car park. If vegetation cover is an important attribute required by users, this could be addressed by adding an additional column called 'Percentage Vegetation' i.e. the percentage of the polygon covered in vegetation identified using VHM.

3.6 Coordinate Reference System

As OSNI Fusion is supplied to users in Irish Grid TM65 (EPSG code 4299), this was used throughout the project. This proposed no issue as all source datasets provided were also using the same projection.

3.7 Suitability for UK and Ireland

Testing has shown the map specification can be analysed alongside other land cover and use maps (see OS work as part of the NLDP for more detail). Providing the required authoritative datasets are recorded and made available this methodology could be replicated both locally and nationally where required. The use of a standard classification enables data from different regions to be combined, it and if a bespoke IT workbench is created, it is also possible to translate data between classifications.

3.8 Quality Assurance

Due to the reason it would be a very large task to extensively quality assure all data sources used in this proof of concept, the map specification was developed with the assumption that all authoritative data sources are released with reasonable levels of accuracy. This meant that the quality of data rested with the owner, and any quality assurance of the end map focused ensuring the input data has been translated correctly using the outlined method.

4. Stakeholder Analysis

4.1 Overview

Once a draft map had been created it was shared with potential future users to gather insight as to how useful a product this could be to support land use decisions. In order to reach a wide range of stakeholders across the UK, feedback on the map was gathered through workshops, webinars, a web viewer and an online questionnaire.

4.2 Strengths

All respondents saw the benefit of a consistent UK wide land use classification and the majority stated they would choose a joint land cover and use map over individual ones. Feedback for the OSNI map itself was very positive overall – highlights included comments that the NLUD classifications are detailed, it saves time for users currently analysing the separate data sources, it reduces duplication of effort across Departments, and it has good potential to allow analysis of change over time if reproduced.

This approach delivers a product that is based on existing data, and does not rely on any additional data capture. An update process will allow the core data sets to be upgraded and additional datasets can be included as they become available. Furthermore, the use of national mapping and unique identifiers from OSNI Fusion and Pointer allow additional data sets to be more easily incorporated.

Lastly, it was noted this methodology can also save money for organisations availing of mapping agreements with OSNI, as it utilises data largely already being paid for and is available to them, rather than purchasing satellite imagery and any resource required to develop their own individual product.

4.3 Limitations

In addition to the positive feedback, there were also some comments on the limitations in using this methodology compared to a satellite derived product. These are summarised into the following:

- Some land use or cover detail is lost through generalising polygons into two classifications of each, particularly due to polygons varying in size
- The specific location of the land use and cover occurrence within each polygon is lost
- The standard of the output is fully dependant on the accuracy and currency of the source data
- It relies upon data owners being willing to share their data
- Data from various source dates being used in one map may lead to inconsistencies
- The data source reflects when the data was last released rather than when it was last updated.

It was also noted that this approach relies upon data providers continuing to capture data at this level of detail, and if that changes or stops, it may impact future updates to the map and the ability to track change over time.

Finally, there were suggestions of data not included in the product that, if included, would make it more useful for their own work such as land ownership, habitats, underground assets, hedges and brownfield sites.

5. Further Recommendations

At the time of the project there were some datasets in development that, if once completed were made accessible and included in the specification, could be valuable in improving the land cover and use classifications. These include:

- Outdoor Recreation Northern Ireland's Greenspace map – a vector layer identifying green and blue areas across NI, quality assured by local councils with the intention of establishing an annual review
- DAERA's Living Map – a satellite derived detailed land cover product
- NI LiDAR coverage – to improve OSNI's Vegetation Height Model product and vegetation classifications
- Land and Property Services non-addressable data – a point dataset of locations unable to receive mail such as masts, stores, yards, turbines and sports pitches that can inform land use

Going forward, there may also be a requirement for data owners and experts to be included in the classification stage, ensuring source data is reclassified into the NLUD correctly.

A feedback system should also be in place to allow any errors in data to be registered with owners and updated. This may also provide any required justification to allocate resource to updating and improving data through seeing how much and why it is being used.

Finally, whilst this project demonstrated how NLUD classifications could be adjusted to reflect the detail in the source data, it may be necessary to agree a classification specification across the UK if it were to be rolled out, and this may need to be mandated to ensure all the required data is captured and maintained for future updates.

6. Conclusion

In summary, this map specification outlines how a land cover and use map could be created for Northern Ireland largely using data already in existence. In order to be successful in achieving the project aim, the following actions or decisions were required:

- Adding extra NLUD classifications to better reflect the source data available and user requirements
- Limiting the attribution to primary and secondary classifications
- Applying a hierarchy to rank input datasets in order of inclusion based on detail, accuracy and currency
- Estimating areas of point data to inform land cover or use when an authoritative source was unavailable
- Removing source data covering less than 5% of a SOE polygon to reduce errors caused by overlapping datasets
- Use of VHM to estimate land cover where require, leaving blank polygons where there was no data for land use
- Leaving responsibility for data source accuracy with their owners

OSNI have demonstrated that the creation of a land cover and use map based on authoritative data sources is possible and that there is a requirement for such a product from stakeholders. By providing the product specification, the strengths and limitations are communicated clearly, to encourage data owners to be open to sharing information. In addition, by helping decision makers understand how it has been produced, then the joining of spatial information from multiple authoritative data sources to create an indicative land cover and use map of NI can be achieved. This is a map which could be used to support important policy and decision making across government in key areas such as net zero, climate change and land use planning.