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LUCAS Land Use Map Data Description			
Dataset	Acquisition or Development Date	Original Format	Short Description
LUCAS LUM	2016	Esri ArcGIS Enterprise Geodatabase	Land use classification using Kyoto-compliant land use definitions (see Table 1). Data is provided for mainland New Zealand and divided into 16 regions.
Caveats			
Land Use Map Data		<div><div>1.</div><div>The data released by the Ministry for the Environment is not finalised and undergoes continuous improvement.</div></div> <div><div>2.</div><div>The 2016 Land Use Map has a nominal mapping date of 31 December 2016; however mapping is based on satellite imagery captured over a range of dates.</div></div> <div><div>3.</div><div>The primary objective of LUCAS mapping programme is to accurately map four key ‘woody’ land use classes i.e. Natural forest, Pre-1990 Planted forest, Post-1989 forest, and Grassland with woody biomass. This is to ensure accurate international reporting of carbon stock changes due to changes in land use across New Zealand. Other non-woody land uses have been largely derived from pre-existing datasets such as the New Zealand Land Cover Database (LCDB) versions 1, 2, 3 and 4 and New Zealand Land Resource Inventory (NZLRI). Therefore LUCAS mapping of these classes should not necessarily be deemed to supersede or improve upon these source data sets.</div></div> <div><div>4.</div><div>The mapping of forest loss (deforestation) occurring between 2008 and 2016 has been verified using aerial photography. However the mapping of forest gain (afforestation) may be incomplete owing to the time it takes for new planting to become evident in satellite imagery. No comparison should therefore be made between the total areas of afforestation and deforestation mapped between 2008 and 2016.</div></div> <div><div>5.</div><div>The LUCAS land use map has an overall map accuracy of 92.5% (Poyry Management Consulting, 2014).</div></div> <div><div>6.</div><div>Access to this data is provided on the understanding that the dataset held by LUCAS and published on the MfE Data Service remains the authoritative master copy.</div></div>	
Lineage			

	<p>The LUM data layer includes land use classifications for 1990, 2008, 2012 and 2016. Select a LUC field to symbolise on to display one of the 1990, 2008, 2012 or 2016 land use maps.</p> <p>1990 land use mapping</p> <p>The 1990 land-use map was derived from 30 m spatial resolution Landsat 4 and Landsat 5 satellite imagery taken between November 1988 and February 1993. In addition to orthorectification and atmospheric correction, the satellite images were standardised for spectral reflectance using the Ecosat algorithms documented in Dymond <i>et al</i>, (2001), Shepherd and Dymond (2003) and Dymond and Shepherd (2004). These standardised images were used for the automated mapping of woody biomass and the classification of woody land use classes. These land-use classes at 1990 included natural forest, pre-1990 planted forest and grassland with woody biomass.</p> <p>This classification process was validated and improved using 15m resolution Landsat 7 ETM+ imagery acquired in 2000-2001, and SPOT 2 and 3 data acquired in 1996-1997. The use of this higher-resolution imagery (coupled with the use of concurrent aerial photography) enabled more certain land-use mapping decisions to be made.</p> <p>To determine the spatial location of the other land-use classes as at 1990, 2008 and 2012, information from three land cover databases, LCDB1 (1996), LCDB2 (2001) (Thompson <i>et al</i>, 2004) and LCDB3 (2008), the New Zealand Land Resource Inventory (Eyles, 1977) and hydrological data from Land Information New Zealand were used (Shepherd and Newsome, 2009a,b).</p> <p>The NZLRI database was used to better define the area of high and Low-producing grassland. Areas tagged as ‘improved pasture’ in the NZLRI vegetation records were classified as Grassland – high producing in the land-use maps. All other areas were classified as Grassland – low producing.</p> <p>An interpretation guide for automated and visual interpretation was prepared and used so that all mapping processes were undertaken on a consistent basis (Ministry for the Environment, 2012). Independent quality control was undertaken for all mapping. This involved an independent agency looking at randomly-selected points across New Zealand and using the same data as the original operator to decide what land use the point fell within. The two operators were in agreement at least ninety-five percent of the time.</p> <p>2008 land-use mapping</p> <p>The 2008 land-use map (land-use as at 1 January 2008) was derived</p>
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	<p>from 10 m spatial resolution SPOT 5 satellite imagery which was processed into standardised reflectance images, using the same approach as for the 1990 imagery. The SPOT 5 imagery was taken during the summer periods between November 2006 and April 2008, to establish a national set of cloud-free imagery. Where the SPOT 5 imagery pre-dated 1 January 2008, a combination of aerial photography, Landsat satellite imagery and field verification was used to identify where deforestation has occurred, so that the snapshot of land use at 1 January 2008 would be as accurate as possible.</p> <p>2012 land-use mapping</p> <p>SPOT 5 satellite imagery was again used in 2013 to create the 2012 land use map. This map was based on imagery acquired primarily in the summers of 2011/12 and 2012/13. Landsat 7 satellite imagery was used subsequently to supplement change detection up to the end of 2012.</p> <p>All imagery was pre-processed as for the 2008 map; however, in this instance, the 2008 and 2012 standardised imagery was then combined into an image stack in order to detect areas of change.</p> <p>Areas of forest loss were extracted and underwent a separate deforestation mapping process (Indufor Asia Pacific, 2013), while the remaining areas of change were mapped directly into the 2012 LUM (Newsome <i>et al</i>, 2013). Finally areas of confirmed deforestation were integrated into the 2012 land use map.</p> <p>2016 land-use mapping</p> <p>Sentinel 2 satellite imagery was used in 2018 to create the 2016 land use map. This map was based on imagery acquired in the summer of 2016/17.</p> <p>All imagery was pre-processed and the 2012 (SPOT 5) and 2016 (Sentinel 2) standardised imagery was analysed in a stack to detect areas of change.</p> <p>Areas of forest loss were extracted and underwent a separate deforestation mapping process (Indufor Asia Pacific, 2018), while the remaining areas of change were mapped directly into the 2016 LUM (Newsome <i>et al</i>, 2018). Finally areas of confirmed deforestation were integrated into the 2016 land use map.</p> <p>Improvements were made to the mapping of high and low-producing grassland at 2008, 2012 and 2016 using data fusion techniques developed by Manaaki Whenua – Landcare Research as part of the Innovative Data Analysis project (Manderson <i>et al.</i>, 2018). This</p>
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	<p>technique involved combining a range of environmental and land use data sources to infer the likely type of grassland (high or low-producing) present at each mapping date.</p> <p>References</p> <p>Dymond JR, Shepherd JD, Qi J, 2001. A simple physical model of vegetation reflectance for standardising optical satellite imagery. <i>Remote Sensing of Environment</i>, 37, 230-239.</p> <p>Dymond JR, Shepherd JD, 2004. The spatial distribution of indigenous forest and its composition in the Wellington region, New Zealand, from ETM+ satellite imagery. <i>Remote Sensing of Environment</i>, 90, 116-125.</p> <p>Eyles, GO, 1977. NZLRI worksheets and their applications to rural planning. <i>Town Planning Quarterly</i> 47: 38-44.</p> <p>Indufor Asia Pacific, 2013. New Zealand Deforestation Mapping 2012 – Final Report. Contract report prepared for the Ministry of the Environment.</p> <p>Indufor Asia Pacific, 2018. New Zealand Deforestation Mapping 2015 – 2016 - Final Report. Contract report prepared for the Ministry for the Environment.</p> <p>Ministry for the Environment, 2012. Land-Use and Carbon Analysis System: Satellite imagery interpretation guide for land-use classes (2nd edition). Wellington: Ministry for the Environment.</p> <p>Manderson A, Hoogendoorn C, Newsome P, 2018. Grassland improvement mapping using Innovative Data Analysis (IDA) techniques. Contract report prepared for the Ministry for the Environment.</p> <p>Newsome P, Shepherd J, Pairman D, 2013. Establishing New Zealand’s LUCAS Land Use and Land Use-Change and Forestry 2012 Map. Contract report prepared for the Ministry for the Environment.</p> <p>Newsome P, Shepherd J, Pairman D, Belliss S, Manderson A, 2018. Establishing New Zealand’s LUCAS 2016 Land Use Map. Contract report prepared for the Ministry for the Environment.</p> <p>Poyry Management Consulting (NZ) Ltd, 2014. Accuracy Assessment of the 2012 Land Use Map. Contract report prepared for the Ministry for the Environment.</p> <p>Shepherd JD, Dymond JR, 2003. Correcting satellite imagery for the variance of reflectance and illumination with topography. <i>International Journal of Remote Sensing</i>, 24, 3503-3514.</p>
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	<p>Shepherd JD, Newsome P, 2009a. Establishing New Zealand's Kyoto land use and Land-use Change and Forestry 1990 Map. Contract Report prepared for Ministry for the Environment.</p> <p>Shepherd JD, Newsome P, 2009b. Establishing New Zealand's Kyoto land use and Land-use Change and Forestry 2008 Map. Contract Report prepare for Ministry for the Environment.</p> <p>Thompson S, Gruner I, Gapare N, 2004. <i>New Zealand Land Cover Database Version 2. Illustrated Guide to Target Classes</i>. Report for the Ministry for the Environment: New Zealand.</p>
Other metadata	
Source Projection	New Zealand Transverse Mercator 2000 (NZTM 2000)
Geographic extent	New Zealand land area including Stewart Island, but excluding other offshore islands.
Custodian	New Zealand Ministry for the Environment
Licensing	Creative Commons Attribution 4.0 International by Ministry for the Environment
Point of contact	lucas@mfe.govt.nz

Table 1: LUCAS Land Use Classes

Land Use Class		Description	Subclasses
FOREST LAND	Natural forest ID= 71	<p>Areas that, on 1 January 1990, were and presently include:</p> <ul style="list-style-type: none"> • tall indigenous forest • self-sown exotic trees, such as wilding pines and grey willows (where managed as forest) • broadleaved hardwood shrubland, mānuka–kānuka (<i>Leptospermum scoparium</i>–<i>Kunzea</i> spp.) shrubland and other woody shrubland (≥30 per cent cover, with potential to reach ≥5 metres at maturity <i>in situ</i> under current land management within 30-40 years) • areas of bare ground of any size that were previously forested but, due to natural disturbances (eg, erosion, storms, fire), have temporarily lost vegetation cover • areas that were planted forest at 1990, but are subsequently managed to regenerate with natural species that will meet the forest definition • roads and tracks less than 30 metres in width and other temporarily unstocked areas associated with a forest land use. 	<p>0 - Unknown</p> <p>120 - Shrubland</p> <p>121 - Tall forest</p> <p>122 - Wilding trees</p>
	Pre-1990 planted forest ID= 72	<p>Areas that, on 1 January 1990, were and presently include:</p> <ul style="list-style-type: none"> • radiata pine, Douglas-fir, eucalypts, or other planted species (with potential to reach ≥ 5 m height at maturity <i>in situ</i>) planted before 1 January 1990, or replanted on land which was forest land as at 31 December 1989 • exotic forest species that were planted after 31 December 1989 into land that was natural forest • riparian or erosion control plantings that meet the forest definition and that were planted before 1 January 1990 • harvested areas within pre-1990 forest land (assumes these will be replanted, unless deforestation is later detected) • roads/tracks/skid sites and other temporarily unstocked areas less than 30m in width associated with a forest land use • areas of bare ground of any size which were previously forested at 31 December 1989 but, due to natural disturbances (e.g. erosion, storms, fire) have lost vegetation cover 	<p>0 - Unknown</p> <p>201 - Pinus radiata</p> <p>202 - Douglas fir</p> <p>203 - Unspecified exotic species</p>
	Post-1989 forest	<p>Includes post-1989 planted forest, which consists of:</p> <ul style="list-style-type: none"> • exotic forest (with the potential to reach ≥5 metre height at maturity <i>in situ</i>) planted or established on land that was non-forest land as at 31 December 	<p>0 - Unknown</p> <p>122 - Wilding trees</p> <p>201 - Pinus radiata</p>

	ID= 73	<p>1989 (eg, radiata pine, Douglas fir, eucalypts or other planted species)</p> <ul style="list-style-type: none"> riparian or erosion-control plantings that meet the forest definition and that were planted after 31 December 1989 harvested areas within post-1989 forest land (assuming these will be replanted, unless deforestation is later detected). <p>Includes post-1989 natural forest, which consists of:</p> <ul style="list-style-type: none"> forests arising from natural regeneration of indigenous tree species as a result of management change after 31 December 1989 self-sown exotic trees, such as wilding conifers or grey willows, established after 31 December 1989 (where managed as forest) <p>Includes areas within post-1989 natural forest or post-1989 planted forest that are:</p> <ul style="list-style-type: none"> roads, tracks, skid sites and other temporarily unstocked areas associated with a forest land use areas of bare ground of any size that were previously forested (established after 31 December 1989) but, due to natural disturbances (eg erosion, storms, fire), have lost vegetation cover. 	<p>202 - Douglas fir</p> <p>203 - Unspecified exotic species</p> <p>204 - Regenerating natural species</p>
GRASSLAND	<p>Grassland – with woody biomass</p> <p>ID= 74</p>	<ul style="list-style-type: none"> grassland with matagouri and sweet briar, broadleaved hardwood shrubland, manuka/kanuka shrubland, coastal and other woody shrubland (< 5 m tall and any per cent cover) where, under current management or environmental conditions (climate and/or soil), it is expected that the forest criteria will not be met over a 30–40 year time period above timberline shrubland vegetation and intermixed with montane herbfields (does not have the potential to reach > 5 m height <i>in situ</i>) grassland with tall tree species (< 30 per cent cover), such as golf courses in rural areas (and except where the Land Cover Databases (LCDB1 and LCBD2) have classified these as settlements) grassland with riparian or erosion control plantings (< 30 per cent cover) linear shelterbelts that are > 1 ha in area and >30 m mean width areas of bare ground of any size which previously contained grassland with woody biomass but, due to natural disturbances (e.g., erosion, fire) have lost vegetation cover 	0 - Unknown
	Grassland – high producing	<ul style="list-style-type: none"> grassland with high quality pasture species includes linear shelterbelts which are <1 ha in area or <30 m mean width (larger shelterbelts are mapped separately as grassland – with woody biomass) areas of bare ground of any size which were previously 	<p>0 - Unknown</p> <p>502 - Grazed - dairy</p> <p>503 - Grazed - non-dairy</p> <p>504 - Ungrazed</p>

	ID= 75	grassland but, due to natural disturbances (e.g., erosion) have lost vegetation cover	
	Grassland – low producing ID= 76	<ul style="list-style-type: none"> • low fertility grassland and tussock grasslands • mostly on hill country • montane herbfields at either an altitude higher than above timberline vegetation or where the herbfields are not mixed up with woody vegetation • includes linear shelterbelts which are <1 ha in area or <30 m mean width (larger shelterbelts are mapped separately as grassland – with woody biomass) • other areas of limited vegetation cover and significant bare soil including erosion and coastal herbaceous sand dune vegetation 	0 - Unknown 502 - Grazed - dairy 503 - Grazed - non-dairy 504 - Ungrazed
CROPLAND	Cropland – perennial LUC_ID= 77	<ul style="list-style-type: none"> • all orchards and vineyards • linear shelterbelts associated with perennial cropland 	0 - Unknown
	Cropland – annual ID= 78	<ul style="list-style-type: none"> • all annual crops • all cultivated bare ground • linear shelterbelts associated with annual cropland 	0 - Unknown
WETLAND	Wetland – open water ID= 79	<ul style="list-style-type: none"> • all open water, i.e. lakes, rivers, dams, reservoirs, estuaries (where within the defined coastline of New Zealand) 	0 - Unknown 901 - Naturally occurring 902 - Human induced
	Wetland – vegetated non forest ID= 80	<ul style="list-style-type: none"> • herbaceous and/or non-forest woody vegetation, including trees of any stature, in a wetland context (periodically or permanently flooded) • areas under peat extraction • estuarine/tidal areas including mangroves 	0 - Unknown 1001 - Peat mine
SETTLEMENTS	Settlements ID= 81	<ul style="list-style-type: none"> • built-up areas and impervious surfaces • grassland within settlements including recreational areas, urban parklands and open spaces which do not meet the forest definition • major roading infrastructure • airports and runways • dam infrastructure • urban subdivisions under construction 	0 - Unknown
OTHER LAND	Other ID= 82	<ul style="list-style-type: none"> • montane rock/scree • river gravels, rocky outcrops, sand dunes and beaches, coastal cliffs, eroded gullies with no vegetation, mines (including spoil), quarries • permanent ice/snow and glaciers • any other remaining land that does not fall into any of 	0 - Unknown

		the other land-use categories	
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Table 2: LUCAS Land Use Map Field Descriptions

(Land use class and sub class codes are as described in Table 1)

Field Name	Field Alias	Data Type	Description
LUCID_2016	2016 Land Use Classification Code	Short integer	The best known land use class as at 31 st December 2016 including improvements made after the original mapping.
LUCNA_2016	2016 Land Use Classification Name	String	
SUBID_2016	2016 Sub Class Code	Short integer	The sub-classification of the 2016 land use.
SUBNA_2016	2016 Sub Class Name	String	
LUCID_2012	2012 Land Use Classification Code	Short integer	The best known land use class as at 31 st December 2012 including improvements made after the original mapping.
LUCNA_2012	2012 Land Use Classification Name	String	
SUBID_2012	2012 Sub Class Code	Short integer	The sub-classification of the 2012 land use.
SUBNA_2012	2012 Sub Class Name	String	
LUCID_2008	2008 Land Use Classification Code	Short integer	The best known land use class as at 31 st December 2007 including improvements made after the original mapping.
LUCNA_2008	2008 Land Use Classification Name	String	
SUBID_2008	2008 Sub Class Code	Short integer	The sub-classification of the 2008 land use.

Field Name	Field Alias	Data Type	Description
SUBNA_2008	2008 Sub Class Name	String	
LUCID_1990	1990 Land Use Classification Code	Short integer	The best known land use as at 31st December 1989 including improvements made after the original mapping.
LUCNA_1990	1990 Land Use Classification Name	String	The value 73 – <i>Post-1989 forest</i> is not applicable by definition in this field.
LUM_REG_ID	Region Code	Short integer	The New Zealand region (circa 2006) to which the polygon belongs. Each region is self-contained (polygons do not span region boundaries).
LUM_REG_NAME	Region Name	String	
LUM_ISL_ID	Island Code	Short integer	The main New Zealand island to which the polygon relates.
LUM_ISL_NAME	Island Name	String	
LUM_YEAR	Mapping Year	Short integer	The latest nominal year mapped.
AREA_HA	Area in ha	Double	The polygon area in hectares.