Oregon Landslide Data Standard

A component of the Oregon Hazards Framework Theme

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1.0 Introduction

The Oregon Geographic Information Council (OGIC) oversees preparation of geospatial data standards for the state. The development of these standards ease the sharing of data and assist cooperative data development efforts. OGIC assigned a framework implementation team (FIT) to guide the development of standards for the various data themes, and separate framework work groups are developing standards for each theme. Hazards are one Oregon framework theme and the landslide element is one of these hazards. The Oregon Hazards Framework Team – Landslide Element Workgroup, was formed in December of 2010. During the drafting stage, DOGAMI provided the workgroup with updates on progress and at each step, invited comments. Elements of the draft model have also been available for wider review/comment on the Oregon Geospatial Enterprise Office (GEO) website: http://www.oregon.gov/DAS/EISPD/GEO/
The landslide element workgroup (LEW) is guiding development of the Oregon Landslide Data Standard (OLDS).

This document describes a content standard for the compilation of statewide landslide hazard data in map form for Oregon. The standard is based on the Oregon Geologic Data Standard (OGDS), developed by the Department of Geology & Mineral Industries (DOGAMI) and reviewed and approved by the LEW. The OLDS is intended to be flexible structure for organizing, storing, and using a range of landslide data compiled by individuals, working throughout Oregon, over the past 100 years and into the future. The standard addresses the graphic data elements held in a geographic information system (GIS) and the non-graphic descriptive information, or attributes that are typically linked to the graphic elements but organized in a relational database.

1.1 Purpose and Goals of Standard

The purpose of this standard is to provide a consistent and maintainable structure for the Statewide Landslide Information Database of Oregon (currently in release-2, SLIDO r-2). The overall aim is to assist both producers and users of landslide data in Oregon. The following goals influenced development of this standard:

- The intent of this standard is to foster the orderly development, sharing, and maintenance of the SLIDO r-2. This standard proposes a consistent format, structure, and documentation for the SLIDO r-2. It is a minimum standard intended to be usable by all levels of government, as well as academia, private sector, and the general public.
- Assemble the best available landslide data, statewide, for Oregon.
- Provide periodic updates to the database as new local and regional landslide mapping is completed and provide a process and data structure to integrate this new mapping into SLIDO.
- Create a widely usable dataset and data structure to promote landslide hazard awareness in Oregon.
- Provide source data and references for all of the landslide data.

1.2 Relationship to Existing Standards

DOGAMI established the OGDS to coordinate work on a statewide standard for digital geologic map information, which sometimes includes landslide mapping. This standard is published as version 1.0. The OLDS shares one fundamental attribute with OGDS, which is the Reference Identification Code which links each feature to the original data source from which it was derived. A number of other state geological surveys have developed their own data standards for landslide data; however, there is no federal standard for landslide data. Several states and the U.S. Geological Survey (USGS) have discussed establishing a federal standard at some point in the future.

1.3 Description of the Standard

The standard includes the content and data structure necessary to describe, produce, and use the SLIDO r-2. These elements are typically included on landslide maps.
The standard addresses three components:

1. Geospatial elements (points, lines, and polygons)
2. Attributes (specific data for each geospatial element)
3. Metadata describing the geospatial elements and attributes

The standard was written recognizing that: 1) landslide maps are complex and can be subjective, 2) landslide data will likely improve over time as more detailed mapping occurs throughout the state. Thus, the standard is adaptive and adheres to the data and interpretations the author used to developed the original map. However, one purpose of SLIDO r-2 is to provide a consistent method to merge redundant data fields and delete data fields that are extraneous in the statewide database.

1.2 Maintenance of the Standard

The Landslide Element Workgroup acknowledges that this standard will need periodic maintenance during updates of the SLIDO. Updates to this standard will be presented, when appropriate, to the Landslide Element Workgroup for comment, revision, and final endorsement. DOGAMI is implementing the standard to accompany the SLIDO r-2, and will be the data steward for the SLIDO r-2.

2.0 Body of the Standard

2.1 Scope and content of the Standard

The scope of this standard encompasses the public domain geospatial elements (vector and tabular data), attributes of the geospatial data, and metadata compiled for the SLIDO r-2. Since 1950, DOGAMI has compiled data about landslides in Oregon. Using existing published maps, DOGAMI compiled a database of landslides in Oregon and published it as SLIDO release-1 in 2008 (Burns, Madin, Ma, 2008). During the update from release-1 to release-2, data elements were added and parts of existing data elements was appended and replaced. The standard will accommodate new, high-resolution landslide mapping by DOGAMI and others as it becomes available. The unique identification of each landslide

point and polygon feature is within the scope of this standard and allows users to go to the original reference, if needed. This standard does not include a standardized vocabulary for describing, classifying and interpreting landslides. The concept of a standard geologic vocabulary is being addressed at the national level and may become a part of this standard in the future. This standard addresses three primary components:

1. Geospatial elements (points, lines, and polygons)
2. Attributes (information about the geospatial elements)
3. Metadata for documentation

The list of geospatial and attribute elements included in this standard will likely be modified and added to in the future. When appropriate, these modifications/additions will be submitted to the Landslide Element Workgroup for acceptance and the revised data content publicized to all users of the standard.

2.2 Need for the Standard

Landslide maps are diverse in the type(s) of information that they contain and the issues that they address. State or federal agencies, private industry consultants, and academic researchers produce landslide maps according to loosely agreed-upon professional guidelines for content and form. The features displayed on landslide maps are often subjective and interpretive. Furthermore, acceptance of overall mapping concepts and interpretations changes over time. Landslide hazard maps are used for identifying landslide risks to people and property. All of these aspects of landslide mapping point to the need for a consistent and maintainable data content standard to guide development and use of the SLIDO r-2 and future releases. Data exchange will be simplified among users of geologic information by the establishment of this standard.

2.3 Participation in Standards Development

The Landslide Element Workgroup is comprised of federal, state, county, and city representatives. Participation in the workgroup is open to all entities that are concerned with the production, use and exchange of statewide digital landslide information. Present member affiliations include:

Oregon Department of Geology and Mineral Industries (DOGAMI)
Oregon Department of Transportation (ODOT)
Washington County, Oregon
City of Astoria, Oregon
U.S. Geological Survey Landslide Program (USGS)

2.4 Integration with other Standards

The layout of this standard conforms to the OGIC layout template developed for the Oregon Framework Themes. The documentation component of this standard is specified in various tables listed in Appendices B. The metadata conforms to the OGIC-approved metadata standard.

2.5 Technical and Operational Context

2.5.1 Data Environment

The data environment for the SLIDO r-2 is a vector model of polygons, lines, and points linked to attributes. Digital landslide elements are assembled into a ESRI Geodatabase GIS format described in Appendix A (ESRI, 2010).

2.5.2 Reference Systems

The SLIDO r-2 will be stored and exchanged in the custom Oregon Lambert Projection. This is the adopted standard projection among Oregon state agencies. Specific parameters of this projection can be found at:
http://www.oregon.gov/DAS/EISPD/GEO/data/format.shtml

2.5.4 Integration of Themes

Landslides are related to the underlying soils and geology and therefore related to the Geoscience Theme. There are several other Themes including Climate, Preparedness, Land Use/Land Cover, Hydrography, Transportation, and Utilities, which are all related to the Landslide Element.

2.5.5 Encoding

Landslide data incorporated into the SLIDO r-2 will be encoded according to the OLDS, adopted by the Landslide Element Workgroup. Data dictionaries describing the specific format for the SLIDO r-2 are in Appendix A of this standard.

2.5.6 Resolution

The resolution of the SLIDO r-2 will vary according to the original reference map(s) or individual contributor's working map scale. The range of scales is 1:4,800 to 1:500,000. The OLDS has been designed to allow the best available landslide data to nest together in a single statewide dataset, regardless of original map scale.

2.5.7 Accuracy

This standard supports varying levels of positional accuracy, as implied by the range of original reference map scales. The accuracy of interpreted landslide information varies with the scale of its base map. Landslide interpretations from the original written explanatory reference materials are carried directly into the geodatabase without reinterpretation, thereby promoting attribute accuracy and maintaining any of the errors in the original source material.

2.5.8 Edge Matching and Overlap

Creating seamless and non-overlapping geometry is complicated when integrating data from widely varying original map scales and mapping objectives. The standard states that the best available data were used in the compilation of the SLIDO r-2. The database contains overlapping geometry within each geospatial element as a conservative approach. Individual polygon, line, and point features were not edge matched. However, a universal attribute (Description or "descript" field) will assist the user in interpreting overlapping

edges. Improvement in edge matching is anticipated as the SLIDO r-2 continually incorporates newer, higher resolution mapping.

2.5.9 Unique Feature Identification Code

Each of the geospatial elements (polygon, line, point) has several attributes in the geodatabase including a unique feature identification code or unique ID. The unique ID is a concatenation of two separate fields: 1) the reference identification code field (REF_ID_COD) and 2) the identification number field (OBJECT_ID). This concatenation results in a unique id for each geospatial element as shown in the table below.

Field	Description	Example
ID	Identification Number	1
REF_ID_COD	Reference Identification Code	MadiIP2006c
UNIQUE_ID	Unique Identification Code	MadiIP2006c_1

The IDs are simply a numeric string, which results in the number of polygons identified in each individual study or reference identification code.

The reference identification code is the shortened code of the full reference to the original study map. The reference identification code is a text field that identifies the reference author by the first four letters of the last name, followed by the first and middle initials, followed by the publication year of work or the unpublished status, followed by the plate information (if any). Where a particular first author has multiple publications in a year, those are designated by a, b,c following the year. This system was developed by DOGAMI for use in the OGDC database (Jenks et al, 2005). DOGAMI will maintain the list of REF_ID_CODs. An example of a REF_ID_COD is given below (in bold), with the correlating reference info:

MadiIP2006c = Madin, I.P., Burns, W.J., 2006, Map of Landslide Geomorphology of Oregon City, Oregon, and vicinity interpreted from Lidar imagery and Aerial photographs, Clackamas County OR, Open File Report O-06-27, Oregon Department of Geology and Mineral Industries, Portland, OR

2.5.10 Attributes

2.5.10.1 Polygons

Polygons are geospatial objects that represent the boundaries of landslide deposits, other landslide features (e.g. scarps and flanks), and extents of studies that have been mapped. Each polygon is uniquely identified according to the unique ID as previously described.

2.5.10.2 Lines

Lines are geospatial objects that represent landslide features (e.g. scarps) that have been mapped. Lines are uniquely identified according to the unique ID as previously described.

2.5.10.3 Points

Points are geospatial objects that identify the location of landslides, landslide specific studies, photos, and other landslide associated data. Points are uniquely identified according to the unique ID as previously described.

2.5.11 Updating

An exact process to handle transactional updating of landslide data is being explored. The data steward for the SLIDO r-2 is DOGAMI. The OLDS design strives to make possible the timely incorporation of new data as it becomes available.

2.5.12 Records Management

Versions of the OLDS and SLIDO r-2, as they are developed, will be tracked by DOGAMI. At a minimum, the SLIDO versions (releases) will satisfy the archiving mandates that apply to Oregon State agencies.

2.5.13 Metadata

This standard follows the Oregon Core Metadata Standard for geospatial data. Metadata detailing the characteristics, content, and quality of geologic map information must be provided. Metadata reports should make every effort to meet the more rigorous standards set forth in the federal Metadata Content Standard. The metadata will provide sufficient information to allow the potential user to determine if the dataset will meet their intended purpose, as well as to assist the user in accessing and interpreting the data.

3.0 Data Characteristics

The data characteristics detailed below are subject to revision, based on continuing refinement of the SLIDO r-2. The data characteristics described in this section represent the minimum set of graphical (polygons, lines, and points) and non-graphical attributes required to meet this standard.

3.1 Minimum Graphic Data Elements

See Appendix A

3.2 Minimum Attribute or Non-graphic Data Elements

See Appendix A

4.0 References

Burns, W.J., Madin, I.P., Ma, L., 2008. Statewide Landslide Information Database of Oregon Release-1, Oregon Department of Geology and Mineral Industries, SLIDO r-1

ESRI, 2010. Geodatabase File Format, ArcGIS Desktop 10.

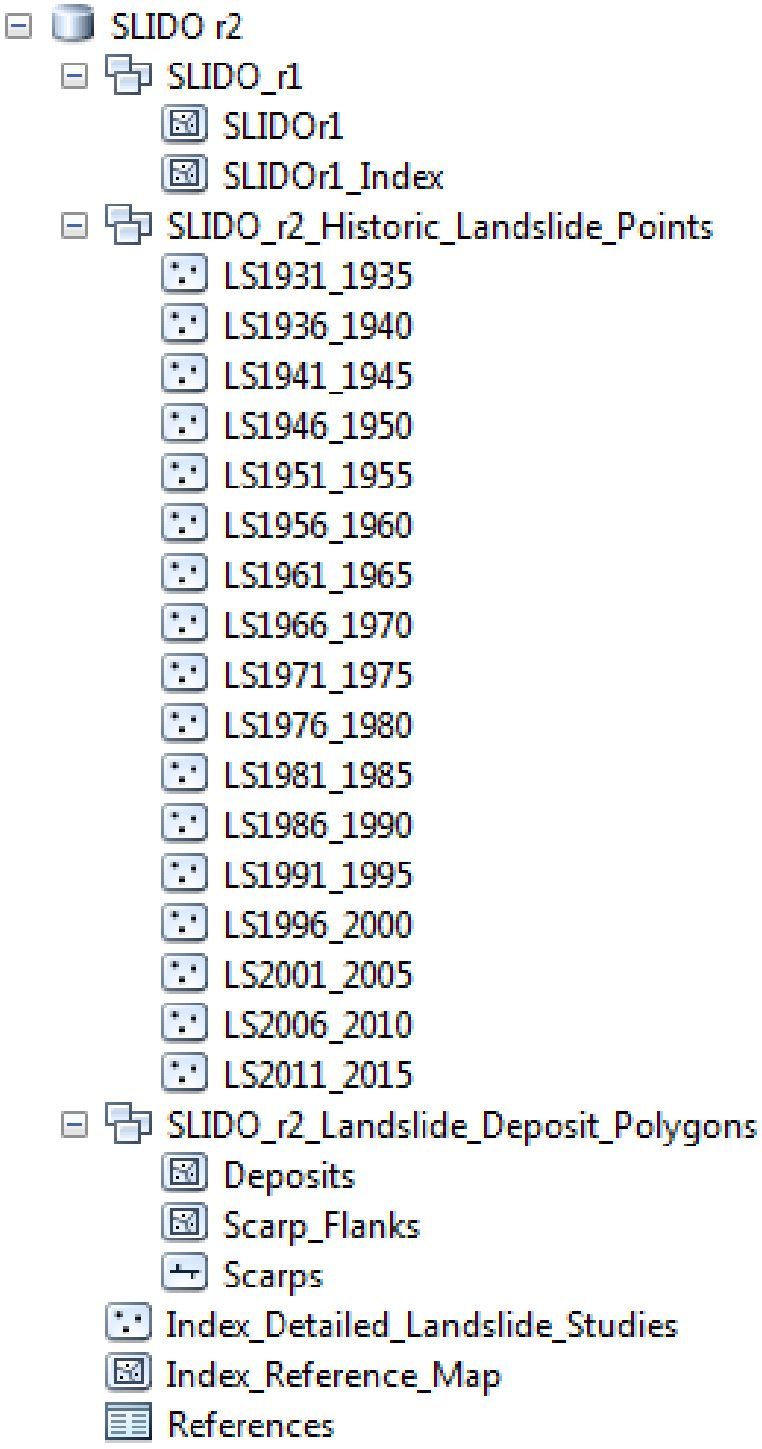
Federal Geographic Data Committee http://www.fgdc.gov/

Federal Geographic Data Committee, Geologic Data Subcommittee
http://www.fgdc.gov/participation/working-groups-subcommittees/gsc/index_html

Jenks, M., Staub, P., Ferns, M., Madin, I., Ma, L., Geitgey, R., 2005. Oregon Geologic Data Compilation (Northeast Oregon), Baker, Crook, Gilliam, Malheur, Morrow, Umatilla, Grant, Umatilla, Union, Wallowa, Wheeler Cos., Oregon, Oregon Department of Geology and Mineral Industries, OGDC-1

Content Standard for Digital Geospatial Metadata, FGDC, 1998
http://www.fgdc.gov/metadata/contstan.html

APPENDIX A: Geodatabase Structure


SLIDO r2
SLIDO_r1
SLIDOr1
SLIDOr1_Index
SLIDO_r2_Historic_Landslide_Points
LS1931_1935
LS1936_1940
LS1941_1945
LS1946_1950
LS1951_1955
LS1956_1960
LS1961_1965
LS1966_1970
LS1971_1975
LS1976_1980
LS1981_1985
LS1986_1990
LS1991_1995
LS1996_2000
LS2001_2005
LS2006_2010
LS2011_2015
SLIDO_r2_Landslide_Deposit_Polygons
Deposits
Scarp_Flanks
Scarps
Index_Detailed_Landslide_Studies
Index_Reference_Map
References

SLIDO_r2 – File Geodatabase. Created in ArcGIS 10.0. NAD1983HARN Oregon Statewide Lambert International Feet

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SLIDO_r1 – Feature Dataset. Contains the landslide polygon data from the SLIDO release-1 publication in 2008 and the extents of the original studies.

SLIDO_r1 – Feature Class. Polygons. Landslide, fan, and talus-colluvium polygons.

SLIDO_r1_Index – Feature Class. Polygons. Extents of the original studies included in SLIDO-r1.

SLIDO_r2_Historic_Landslide_Points – Feature Dataset. Contains historic landslide points.

LS2006-2010 – Feature Class. Points. Historic landslide locations that occurred between 2006-2010.

LS2001-2005 – Feature Class. Points. Historic landslide locations that occurred between 2001-2005.

LS1996-2000 – Feature Class. Points. Historic landslide locations that occurred between 1996-2000.

LS1991-1995 – Feature Class. Points. Historic landslide locations that occurred between 1991-1995.

LS1986-1990 – Feature Class. Points. Historic landslide locations that occurred between 1986-1990.

LS1981-1985 – Feature Class. Points. Historic landslide locations that occurred between 1981-1985.

LS1976-1980 – Feature Class. Points. Historic landslide locations that occurred between 1976-1980.

LS1971-1975 – Feature Class. Points. Historic landslide locations that occurred between 1971-1975.

LS1966-1970 – Feature Class. Points. Historic landslide locations that occurred between 1966-1970.

LS1961-1965 – Feature Class. Points. Historic landslide locations that occurred between 1961-1965.

LS1956-1960 – Feature Class. Points. Historic landslide locations that occurred between 1956-1960.

LS1951-1955 – Feature Class. Points. Historic landslide locations that occurred between 1951-1955.

LS1946-1950 – Feature Class. Points. Historic landslide locations that occurred between 1946-1950.

LS1941-1945 – Feature Class. Points. Historic landslide locations that occurred between 1941-1945.

LS1936-1940 – Feature Class. Points. Historic landslide locations that occurred between 1936-1940.

LS1931-1935 – Feature Class. Points. Historic landslide locations that occurred between 1931-1935.

Field Name	Field Type	Size	Description
REF_ID_COD	String	50	Unique code assigned by data steward to each original reference map
UNIQUE_ID	String	50	Unique code assigned by data steward to each data point in database
DATA_SOURC	String	100	The original source that provided the data
LOC_METHO D	String	100	Landslide mapping method
ORIG_ID	String	100	Unique ID from original study
SLIDE_NAME	String	50	Landslide name
DATE	String	25	Landslide failure date
LENGTH_FT	Single	4	Landslide length in feet
WIDTH_FT	Single	4	Landslide width in feet
DEPTH_FT	Single	4	Landslide failure depth in feet
SLOPE	Single	4	Adjacent slope angle in degrees
TYPE_MOVE	String	50	Type of landslide movement for example flow or slide
MOVE_CLASS	String	50	Movement classification which includes type of material and type of landslide movement
CONTR_FACT	String	100	Factors contributing to slide
LOSSES	SINGLE	4	Monetary value associated with damages from the landslide
TYPE_MTRL	String	25	Type of slide material
AREA_ft2	Single	4	Size of landslide deposit
VOLUME_ft3	Single	4	Volume of landslide deposit
DEEP_SHAL	String	25	Deep or shallow seated slide
Annual_Cost	Single	4	Estimated monetary value spent in maintaining the stability of each landslide yearly
Repair_Cost	Single	4	Initial monetary value spent repairing and stabilizing the landslide
COMMENTS	String	254	Additional comments or attributes
DAMAGES	String	254	Direct and Indirect damages caused by the slide

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SLIDO_r2_Landslide Deposit Polygons – Feature Dataset. Contains mapped landslide deposits and other landslide features.

Deposits – Feature Class. Polygons. Landslide deposits.
Scarp_Flanks – Feature Class. Polygons. Landslide scarp and flank polygons.
Scarps – Feature Class. Polylines. Landslide scarps polylines.

Field Name	Field Type	Size	Description
REF_ID_COD	String	25	Unique code assigned by data steward to each original reference map
UNIQUE_ID	String	50	Unique code assigned by data steward to each landslide polygon in database
MAP_UNIT_L	String	50	Map Unit Label—Reference map unit label symbol taken from the original source map
DESCRIP	String	25	Unit descriptor—Landslide, flow, talus-colluvium
QUADNAME	String	50	7.5 minute Quadrangle name
TYPE_MOVE	String	25	Type of landslide movement for example flow or slide
MOVE_CLASS	String	50	Movement classification which includes type of material and type of landslide movement
MOVE_CODE	String	50	Classification code based on type of material and type of landslide movement
CONFIDENCE	String	25	Confidence of identification—High, moderate, low
AGE	String	25	Estimated Age—Historic landslide age less than 150 years; prehistoric landslide age greater than 150 years
DATE_MOVE	String	50	Date of last known movement
NAME	String	50	Landslide Name
GEOL	String	50	Geologic Unit that the landslide occurred in
SLOPE	Single	4	Adjacent slope angle in degrees
HSHEIGHT	Single	4	Change in elevation from bottom to top of head scarp
FAIL_DEPTH	Single	4	Estimated and/or calculated slope normal thickness of failure depth
FAN_HEIGHT	Single	4	Change in elevation from top to toe of fan
DEEP_SHAL	String	25	Deep or shallow seated slide
HS_IS1	Single	4	Horizontal Distance from head scarp to internal scarp no.1
IS1_IS2	Single	4	Horizontal Distance from internal scarp no.1 to internal scarp no.2
IS2_IS3	Single	4	Horizontal Distance from internal scarp no.2 to internal scarp no.3
IS3_IS4	Single	4	Horizontal Distance from internal scarp no.3 to internal scarp no.4
HDAVE	Single	4	Calculated average horizontal distance between scarps
DIRECT	Single	4	Direction of movement
AREA	Single	4	Size of landslide deposit
VOL	Single	4	Volume of landslide deposit

Field Name	Field Type	Size	Description
REF_ID_COD	String	25	Unique code assigned by data steward to each original reference map
UNIQUE_ID	String	50	Same unique code assigned by data steward to each landslide polygon in database

Field Name	Field Type	Size	Description
REF_ID_COD	String	25	Unique code assigned by data steward to each original reference map

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Index of Reference Maps – Feature Class. Polygons. Extent of studies included in deposits.

Field Name	Field Type	Size	Description
REF_ID_COD	String	25	Unique code assigned by data steward to each original reference map
SCALE	String	25	Original Map Scale

Index of Detailed Landslide Studies – Feature Class. Points. Index deposit points for detailed landslide studies in Oregon.

Field Name	Field Type	Size	Description
REF_ID_COD	String	25	Unique code assigned by data steward to each original reference map
REFERENCE	String	400	Original reference for data