Oregon Floodplain Data Exchange Standard

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1. Introduction

The Hazards Framework is a collection of spatially referenced digital representations of potential natural hazards. Data elements in the Hazards Framework include: coastal erosion areas, debris flow hazards, drought areas, dust storm occurrences, faults, flood zones, tsunami zones, wildfire water sources, wildfire lookouts, wildfire occurrence, and wildfire burned areas. Under the direction of the Oregon Geographic Information Council (OGIC), the Oregon Framework Implementation Team delegated development of a Floodplain Data Exchange Standard to the Hazards Framework Implementation Team (Hazard-FIT), which, in turn, delegated the task to the Flood Map Modernization Working Group (Working Group).

This document, developed by the Working Group, sets forth standards and a data dictionary for the floodplain element of the Hazard Framework Theme.

1.1. Mission and Goals of Standard

The Oregon Floodplain Data Exchange Standard (Floodplain Standard) provides a consistent and maintainable structure for data producers and users to ensure the compatibility of datasets within the same framework feature set (horizontal integration) and between other framework feature sets and themes (vertical integration).

The goal of the Floodplain Standard is to ensure that floodplain data are easily exchanged and usable for flood hazard and mitigation planning at the state and local level. This standard is intended to increase confidence in the floodplain element by ensuring data and metadata integrity.

1.2. Need for a Floodplain Element

Local, state, federal agencies depend on floodplain maps to manage their Federal Emergency Management Agency (FEMA) flood insurance program obligations, for flood hazard management, and for emergency planning. Even though FEMA hosts official flood zone data, the need exists for a statewide, seamless set of floodplain elements to support multi-jurisdictional, non-regulatory hazard planning. The data contained in the floodplain elements supplement FEMA flood zone boundaries.

1.3. Relationship to Existing Standards

The Working Group developed the Floodplain Standard with FEMA standards in mind. This connection to FEMA standards should be maintained to ease information flow between agencies.

Much of the data used to populate Oregon's floodplain elements are extracted from databases maintained by FEMA. FEMA has developed detailed "Guidelines and Standards for Flood Hazard Mapping Partners" (Guidelines) to ensure consistent flood mapping products regardless of who produces them. The Guidelines present a comprehensive and integrated database schema for capturing and archiving the data elements needed to build FEMA's "Digital Flood Insurance Rate Map" (DFIRM) product.

FEMA flood zones may be modeled using key Oregon Framework elements, in particular elevation and hydrography. Base map data shown on FEMA DFIRMs also may be supplied from Oregon Framework elements and local data sources, including orthoimagery, transportation features, and administrative and cadastral boundaries. FEMA Guidelines specify minimum requirements for these base map elements. This standard does not address the Framework elements or local data used by FEMA for modeling and mapping.

1.4. Description of Standard

This Floodplain Standard describes essential characteristics and data structures for the floodplain elements in Oregon. The Floodplain Standard addresses point and polygon elements, and associated tabular data, that characterize natural floodplains. These elements include FEMA flood zones, amendments to FEMA flood zones, inundation areas, and other information necessary to characterize and regulate activities in a floodplain. Maintenance of floodplain elements is addressed in a separate stewardship plan.

1.5. Applicability and Intended Use of Standard

This standard is applicable to floodplain elements maintained in Oregon's Hazard Framework. This standard enables data users to understand how the floodplain elements were produced and which uses the producers deemed appropriate for the datasets.

The Floodplain Standard is not intended to replace FEMA guidelines, nor is the data subject to this standard meant as a replacement for official FEMA flood insurance rate maps (FIRMs).

1.6. Standard Development Procedures

The Map Modernization Working Group created the Floodplain Standard and published it on the Oregon Geospatial Data Clearinghouse website on November 7, 2006. (http://www.oregon.gov/DAS/IRMD/GEO/standards/standards.shtml).

A public review and comment period commenced with the publication of the first draft on November 7, 2006. After integrating comments, the Hazards-FIT presented the Floodplain Standard at the Eighth Oregon Standards Forum held December 8, 2006, where it was endorsed by the Oregon Geographic Information Council.

1.7. Participation in Standards Development

The Department of Land Conservation and Development (DLCD) prepared an initial draft of the Floodplain Standard and circulated it among members of the Hazards-FIT. Two meetings were held (09/25/2006 and 10/25/2006) to discuss and comment upon the draft standard. Comments also were submitted by email and communicated by telephone to DLCD. Participants included:

Steve Barnett, GIS Program Manager, Linn County
Susan Blohm, City of Salem
Bill Clingman, Lane Council of Governments
Randy Dana, Oregon Department of Land Conservation and Development, Coastal Program
Mark Darienzo, Oregon Department of Land Conservation and Development
Gail Ewart, Department of Administrative Services-Geospatial Enterprise Office
Chris Shirley, Oregon Department of Land Conservation and Development
Nancy Tubbs, USGS Geospatial Liaison for Oregon

1.8. Maintenance of Standard

The Floodplain Standard will be revised as needed, initiated by members of the Hazards-FIT or the Working Group, or as a result of changes to the FEMA Flood Map Modernization Guidelines.

2. File Standards

2.1. Scope and Content of the Floodplain Standard

This standard encompasses publicly available geographical and associated tabular data developed by FEMA and local communities, along with required metadata. Floodplain elements focus on the essential data and metadata required by local, state, and federal governments to manage and mitigate flood hazards. FEMA flood zones, inundation areas, and pending amendments to FEMA flood zones are examples of floodplain elements maintained in the Hazards Theme.

2.2. File Naming Convention

Element file names should be short and descriptive for maximum compatibility with GIS software packages. No spaces or special characters (other than underscore) are allowed. File names must begin with an alpha character. Remaining characters may be alphanumeric.

2.3. Technical

2.3.1. Data Environment

Floodplain elements may be comprised of point or polygon features, and associated tabular data. The exchange format for geographical data is the ESRI shapefile, a format supported by all GIS software suites used in Oregon. Information about the shapefile format may be found at the ESRI website.

2.3.2. Projection Parameters

The Department of Land Conservation and Development (DLCD), as the horizontal steward, will cast floodplain elements using the Oregon Lambert projection. For more details about this projection see http://egov.oregon.gov/DAS/IRMD/GEO/coordination/projections/projections.shtml. The Oregon Lambert projection was selected because it is the default standard for Oregon Framework elements. Projection parameters of source data contributed by custodial stewards must be clearly documented in the metadata accompanying the shapefiles.

Source projection is recorded for each feature since each floodplain element is compiled from many sources.

Horizontal Datum

Floodplain elements are projected using the North American 1983 Horizontal Datum (consistent with Oregon Lambert projection). The source datum is recorded for each feature since each floodplain element is compiled from many sources.

Vertical Datum

Floodplain elements are projected using the North American Vertical Datum of 1988 (consistent with Oregon Lambert projection). The source vertical datum is recorded for each feature since each floodplain element is compiled from many sources.

2.3.3. Integration of Themes

Floodplain elements must be registered to the base map elements provided to FEMA. These include the following elements from Oregon Framework:

- Digital Elevation Model
- Water Courses
- Orthoimagery
- Road Centerlines
- Political Boundaries

Floodplain elements also may relate spatially to the wetlands, vegetation (riparian), levee, and dams data standards, since floodplains interact with these elements.

2.3.4. Encoding and Record Format

Floodplain elements are encoded in an ESRI shapefile format. The ESRI shapefile format limits field name lengths to 10 characters. No spaces or special characters, besides the underscore, may be used in field names.

Feature record formats should, whenever possible, align with the database schema(s) developed by FEMA and described in their "Guidelines and Specifications for Flood Hazard Mapping Partners." Such alignment allows for efficient maintenance of floodplain elements. Section 3 of this standard presents a detailed data model.

2.3.5. Scale

Floodplain elements may contain data compiled at different map reference scales. Applicable scales range from 1:2,400 to 1:24,000. This wide range of scales reflects the variable resolution of floodplain mapping in the state. Larger scale data is most often available in urban areas where higher building densities potentially result in more costly flood damage. Larger scale data is also required in urban areas to visualize the smaller parcel size typically found there. Conversely, smaller scale data is sufficient for use in rural or industrially developed areas where parcel sizes tend to be large and structures are dispersed.

This range of scales, even within one element, makes it impossible to document source map scale in element metadata. Source map scale is, therefore, recorded for each feature. This also makes it possible to continually improve element resolution by providing for the incorporation of new, higher resolution features as they become available.

2.3.6. Uncertainty Tolerances

Referential

Referential uncertainty is error or omission in attribution. No more than 1% of features should contain attribute uncertainty.

Topological

Topological uncertainty refers to errors in the spatial data, such as broken or looped lines, dangling nodes, or unclosed polygons. Topological uncertainty tolerance is 0%. Polygons must close, with no dangling nodes or unconnected lines. Unnecessary nodes and vertices must be avoided.

Relative

Relative uncertainty refers to how features relate to each other. Polygons in a single element (such as flood zones) must not overlap. Polygons that cross state boundaries must end coincident with the state boundary line (no slivers). Polygons are sliced at county boundaries to maintain consistency with FEMA datasets.

Floodplain polygons must encompass mapped stream segments.

Temporal

Temporal uncertainty addresses how timely the data is in relation to changing conditions. FEMA flood zone elements must reflect FEMA's most current effective DFIRM. It may be beneficial to retain old flood zone boundaries upon delivery of a new effective DFIRM. In this case the retired records may be placed in an archival flood zone element. Likewise, any element that collects information from FEMA-approved letters of map change (LOMCs) must remain concurrent with FEMA databases.

2.3.7. Horizontal Uncertainty Tolerance and Reporting

Floodplain features support varying levels of positional accuracy. Accuracy should be recorded for each feature using the National Standards for Spatial Data Accuracy (NSSDA) radial accuracy procedures, which report the radius of a circle of uncertainty, such that the true location of test points falls within a circle 95 percent of the time. The minimum positional accuracy (error tolerance) for floodplain elements is that of the default base map used by FEMA -- the United States Geological Survey Digital Orthophoto Quadrangle or USGS DOQ -- which has an NSSDA radial accuracy of 38 feet. This is the FEMA minimum standard for community-supplied data. Spatial data derived from larger scale sources would have smaller radial accuracies.

2.3.8. Vertical Uncertainty Tolerance and Reporting

Vertical accuracy is reported according to the NSSDA, which defines vertical accuracy at the 95 percent confidence level. This means that the true location of test points falls within a linear uncertainty value 95 percent of the time. Vertical accuracy = $RMSE_Z * 1.96$, where $RMSE_Z$ is the square root of the mean of the squared errors in elevation check points used to evaluate the vertical accuracy of a digital dataset.

$RMSE_Z$ must be less than or equal to 1.2 feet in hilly terrain. In moderate or flat terrain, an $RMSE_Z$ of less than or equal to 0.6 feet is expected. These values are derived from FEMA minimum standards for community-supplied data.

Vertical accuracy shall be measured against professionally surveyed vertical benchmarks that reference a national datum.

2.3.9. Extent

Floodplain elements are intended to be seamless across Oregon. Features are sliced at county boundaries to maintain consistency with the FEMA data structure.

2.3.10. Completeness

Features in the floodplain element do not necessarily represent the full extent of a natural floodplain associated with a given watercourse. FEMA, for example, focuses on developing flood zone boundaries in populated areas where flood losses to structures are most likely to be sustained. Therefore, FEMA flood zone boundaries are likely to be incomplete in rural and undeveloped areas. Likewise, floodplain features developed from sources other than FEMA, will reflect the purposes for which the data were collected and the geographical extent of the effort.

2.3.11. Metadata

The Oregon Floodplain Standard follows the Oregon Core Metadata Standard for geospatial data. Metadata detailing the characteristics and quality of floodplain elements must be provided. Metadata should make every effort to meet the more rigorous standards set forth in the Federal Metadata Content Standard, where feasible. Metadata must provide sufficient information to allow the user to determine whether the element is appropriate for the intended purpose.

Metadata must address the following uncertainties: referential, topological, relative, temporal, horizontal, and vertical. Ideally a quantitative error statement will be prepared.

The following standard language shall be included in metadata:

> FLOODPLAIN ELEMENTS DO NOT DEPICT ALL FLOOD HAZARDS IN THE STATE OF OREGON. FLOODPLAIN STUDIES TEND TO FOCUS ON DEVELOPED AREAS, GENERALLY WITH DRAINAGE AREAS GREATER THAN ONE MILE. NOT ALL WATERCOURSES IN THE STATE OF OREGON HAVE MAPPED FLOODPLAINS. FURTHERMORE, LAND AREAS OUTSIDE OF MAPPED FLOODPLAINS ARE SUBJECT TO FLOODING. THE STATE OF OREGON MAKES NO WARRANTY WHATSOEVER AS TO THE ACCURACY OR COMPLETENESS OF ANY INFORMATION CONTAINED IN FLOODPLAIN ELEMENTS. THE STATE OF OREGON SHALL NOT BE RESPONSIBLE FOR ANY CLAIMS ATTRIBUTABLE TO ERRORS, OMISSIONS OR OTHER INACCURACIES IN THE INFORMATION CONTAINED IN FLOODPLAIN ELEMENTS. IN NO EVENT SHALL THE STATE OF OREGON BE LIABLE FOR DIRECT, INDIRECT, SPECIAL, INCIDENTAL OR CONSEQUENTIAL LOSS OR DAMAGE OF ANY NATURE CAUSED TO ANY PERSON, PARTY OR ENTITY AS A RESULT OF USE OF THE INFORMATION SET FORTH HEREIN. THE STATE OF OREGON HEREBY DISCLAIMS LIABILITY FOR ANY SUCH LOSS OR DAMAGE.

2.4. Data Maintenance

DLCD is the horizontal and vertical steward for floodplain elements. DLCD will ensure that floodplain elements remain in sync with FEMA's digital flood insurance rate maps and guidelines. A separate stewardship plan sets forth the details of data maintenance, including schedules and procedures.

3. Data Standards

This section describes the record format for geographical features in the floodplain elements.

3.1. Feature Description

Field names are limited to 10 characters for maximum compatibility with GIS software packages and versions. Field format and sizes are compatible with FEMA DFIRM table structure, wherever possible.

The "no data" code for numeric fields equals -9999. Blank in text fields are allowed where specified in the data dictionary.

Table 1. Floodplain Polygon Features

Field Name	Format	Field Size	Precision/ Scale
ID	string	11	
FLD_AR_ID	string	11	
SOURCE	string	50	
FLD_ZONE	string	55	
FLOODWAY	string	30	
SFHA_TF	string	1	
FIRM_PAN	string	11	
ELM_DATE	date	8	
H_ACC	double	8	8/4
V_ACC	double	8	8/4
SCALE	string	5	
H_DATUM	string	10	
V_DATUM	string	6	
PROJECTION	string	50	
PROJ_ZONE	string	4	
DOC_LINK	hyperlink	50	

Table 2: Floodplain Point Features

Field Name	Format	Field Size	Precision/ Scale
ID	string	11	
SOURCE	string	50	
PT_TYPE	string	50	
ELM_DATE	date	8	
H_ACC	double	8	8/4
V_ACC	double	8	8/4
SCALE	string	5	
H_DATUM	string	10	
V_DATUM	string	6	
PROJECTION	string	50	
PROJ_ZONE	string	4	
DOC_LINK	hyperlink	50	

3.2. Data Dictionary

Table 3: Data Dictionary

Field Name	Typical Values	Description	Source
ID		Record Number, automatically assigned	DLCD auto generated
FLD_AR_ID		Primary key extracted from FEMA. Allows linkage to FEMA tables when combined with FIRM_PAN value. Blank when data source is not equal to FEMA	FEMA: s_fld_haz_ar.shp
SOURCE	DFIRM Q3 LOMR INUND MODEL CLAIM OTHER	Record Source	DLCD
FLD_ZONE	A A1…A30 AE AH AO AR A99 B C	Flood zone designation Required if SOURCE = FEMA otherwise blank B, C, and D are deprecated, but included here to accommodate older datasets.	FEMA: s_fld_haz_ar.shp

	D X XFUT X500 V V1…V30 VE		
PT_TYPE		Description of point type such as, “HIGH WATER MARK” or “LOMA”	DLCD
FLOODWAY	FW blank	Floodway Blanks are allowed in this field.	FEMA: s_fld_haz_ar.shp
SFHA_TF	T F	Area of special flood hazard, T = FLD_ZONE is A, AE, A1…A30, AO, V, V1…V30, VE. Regulated floodzones.	FEMA: s_fld_haz_ar.shp
FIRM_PAN		FEMA flood map panel number; required if SOURCE = FEMA, otherwise blank	FEMA: s_firm_pan.shp
ELM_DATE		If FEMA then Effective Date Else event or collection date	FEMA: s_firm_pan.shp
H_ACC		Horizontal accuracy	DLCD from FEMA metadata
V_ACC		Vertical accuracy	DLCD from FEMA metadata
SCALE		Source map scale	FEMA: s_firm_pan.shp
H_DATUM		Source horizontal datum	FEMA: study_info.dbf
V_DATUM		Source vertical datum	FEMA: s_fld_haz_ar.shp
PROJECTION		Source projection	FEMA: study_info.dbf
PROJ_ZONE		Source projection zone	FEMA: study_info.dbf
DOC_LINK		Hyperlink to source documents, e.g. LOMA, LOMR-F, and LOMR	DLCD

Appendix A. Definition of Terms

Term	Definition
Accuracy	**Absolute** - A measure of the location of features on a map compared to their true position on the face of the earth. **Relative** - A measure of the accuracy of individual features on a map when compared to other features on the same map.
Attribute	Attributes are the characteristics of **features**.
Boundary	Set that represents the limit of a **feature**.
Custodial Steward	Agency or organization responsible for specific tasks relating to maintaining certain geospatial data.
Datum	A standard system of reference from which measurements are made.
DFIRM	Digital Flood Insurance Map: a product produced by FEMA used to rate flood insurance policies and manage development in flood prone areas.
Element	A logical unit within a Framework Theme. Each framework element contains one feature set and its associated tabular data.
ESRI	Environmental Systems Research Institute, Inc., a leading provider of geographic information software.
Feature	Abstraction (point, line or polygon) of a real world phenomenon stored within geospatial software.
Feature Delineation	Criteria or rules for defining the limits of a **feature** and how it will be represented geometrically in a dataset.
FEMA	Federal Emergency Management Agency
FGDC	Federal Geographic Data Committee
Floodplain	Land area adjacent to rivers and streams subject to recurring inundation.

Horizontal Steward	The agency or organization responsible for assembling and providing access to a statewide dataset of a particular **type**.
Line	A feature built of vectors connecting at least two points or vertices.
Metadata	Data about data.
NSDI	National Spatial Data Infrastructure. The effort of the FGDC to create and implement a shared data collection and maintenance resource for geospatial datasets.
NSSDA	National Standard for Spatial Data Accuracy, developed by Federal Geographic Data Committee.
Polygon	Bounded surface for which the interior configuration is not directly specified.
Resolution	The minimum difference between two independently measured or computed values which can be distinguished by measurement or analytical method being considered or used.
USGS DOQ	United States Geological Survey, Digital Ortho Quadrangle: an orthorectified photograph covering an area 3.75-minutes longitude by 3.75-minutes latitude, or in some cases an area of 7-minutes by 7-minutes.
Vertical Steward	The agency or organization responsible for assuring that a dataset of a particular **type** can be used with other Framework datasets.

Appendix B: Crosswalk to FEMA Databases

Crosswalk from FEMA Flood Hazard Spatial Databases to Oregon Framework, Hazards, Floodplain databases

Oregon Field Name	FEMA Field Name	(DFIRM file names)
FLD_AR_ID	FLD_AR_ID	s_fld_haz_ar.shp
FLD_ZONE	FLD_ZONE	s_fld_haz_ar.shp
FLOODWAY	FLOODWAY	s_fld_haz_ar.shp
SFHA_TF	SFHA_TF	s_fld_haz_ar.shp
FIRM_PAN	FIRM_PAN	s_firm_pan .shp
ELM_DATE	EFF_DATE	s_firm_pan .shp
SCALE	SCALE	s_firm_pan .shp
H_DATUM	H_DATUM	study_info.dbf
V_DATUM	V_DATUM	s_fld_haz_ar.shp
PROJECTION	PROJECTION	study_info.dbf
PROJ_ZONE	PROJ_ZONE	study_info.dbf

Appendix C. Referenced Documents and Web Links

Oregon Lambert Projection
http://egov.oregon.gov/DAS/IRMD/GEO/coordination/projections/projections.shtml

Federal Emergency Management Agency (2003) Guidelines and Standards for Flood Hazard Mapping Partners: Washington D.C.