

# An Analysis of Spatial Relation Predicates in U.S. Geological Survey Feature Definitions



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**Cover graphic:** Word cloud.

# **An Analysis of Spatial Relation Predicates in U.S. Geological Survey Feature Definitions**

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Holly K. Caro and Dalia E. Varanka

## Abstract

The Semantic Web uses a data model called a triple, which consists of a subject –predicate – object structure. When represented as triples, geospatial data require a spatial relation term to serve as the predicate linking two spatial features. This document summarizes the approaches and procedures used during the identification of spatial relationships common between topographic features using terms from topographic data standards. This project identified verb-predicate arguments that could be used in the creation of data triples and ontologies for *The National Map* of the U.S. Geological Survey and also investigated the possibility of deriving ontology from predefined textual definitions. The primary purpose of this report is to present the data used for subsequent analysis. A summary of terms organized by basic categories is provided.

Keywords: semantic technology, geospatial relations, topographic data

## Background and Objectives

One of the prominent issues facing the field of geospatial information science is the design and implications of the emergent Semantic Web, coordinated through the World Wide Web Consortium (W3C) (Berners-Lee and others, 2001; W3C, 2010). The Semantic Web is a vision and implementation of linked data in a network graph that assists knowledge formation. The data model to construct this graph is called Resource Description Framework (RDF) and is formed by triples consisting of two nodes and an edge. Triples are conceptually similar to the subject—predicate—object syntax of simple sentence structures (Beckett, 2004). Triples hold promise for geographic information science modeling for many reasons, including greater flexibility and efficient analysis (Egenhofer, 2002). Logical axioms programmed as properties of the triples enable reasoning algorithms called ontologies to regulate the association between feature class types and their data instances.

Spatial relation representation assumes variable forms, including cognitive, linguistic, topological, and geometric. Topological relations were researched broadly and formalized

in the 1990s, largely based on the 9-intersection model of binary relations applying to the interior, boundary, and exteriors of point, line, and area type objects (Egenhofer and Franzosa, 1991; Egenhofer and Herring, 1991). In the field of cognition and linguistics, some important publications on spatial information theory reference spatial relations. These publications focused on figure-ground alignment to analyze location and motion (Talmy, 1983), prepositions (Herskovits, 1986), and spatial reference systems (Levinson, 2003). Geographers cultivated these sources for ways to bridge formal models of spatial relations developed for geographic information systems (GIS) and natural language expressions to make these operations easier to understand and use in GIS (Shariff and others, 1998). Hirtle and Frank (1997) addressed spatial structure, boundaries, and change for similar reasons. A body of research emerged that established a basis for the semantics of geographic spatial relations. Although the work was developed for the user of the relational database model in GIS, this model is intuitively suited and being tested for representation in RDF triples.

Research results based on the 9-intersection model of topological spatial relations resulted in the establishment of eight standard spatial relations by the Open Geospatial Consortium (OGC); equals, disjoint, intersects, touches, crosses, within, contains, and overlaps (International Organization for Standardization, 2001). This standard was adapted to SPARQL Protocol and RDF Query Language (SPARQL) queries of geospatial ontology triples (Perry and Herring, 2010; W3C, 2008). Though this standard serves as an important foundation, the scope of the work is topologically specific, whereas topographic data and scientific modeling uses a broader range of spatial relation concepts. The subject of this report is the presentation of data used in the identification and on-going analysis of geospatial feature relations in topographic science as applied to semantic triples. Such terms are not quantitatively described, but operate based on cognitive and linguistic structures. For example, prepositions are terms that express a relation or location and typically govern another word or element in the clause. Prepositions are thus key terms for examining spatial relations between statement subjects and objects.

The approach used in this analysis also may prove useful to the development of text mining approaches for automated

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information extraction, or in comparing the ways that human interpretation of written definitions may differ from automated approaches. The discrepancies between the practical use of natural language and machine representation become evident when using this approach, and may present an outline as to how to resolve certain problems; for example, the further refinement of particular natural language phrasings to better ascertain the underlying semantics. This work should be viewed as a potential starting point for further investigation into the capabilities and intended functions of map ontologies and the ways that textual information may be used along with visual map displays, such as search functionality, or other semantic web technology applications.

### Approach and Procedures

The approach to analyze spatial relations for topographic data triple predicates draws verb-predicate spatial relationships from textual definitions created and used by the U.S. Geological Survey (USGS) and its partners. These are the Spatial Data Transfer Standard (SDTS), Digital Line Graph Standards (DLG), and Geonames (U.S. Geological Survey, 2010; U.S. Board on Geographic Names, 2010). Similar approaches have been previously used by Mizen and others (2005) and Kokla and Kavouras (2005). The analysis was interpreted by native English language speakers, with the help of a dictionary. The data for this work are presented in appendixes.

The electronic tools used to locate, organize, and study the spatial relations within the text of this study primarily involved concordance and spreadsheet software. The concordance software was used to facilitate the easy sorting and display of a corpus of text by word (Watt, 2009a). The results allowed for textual analysis of trends in single word usage throughout text.

Attempts at analyzing predicates uncovered major limitations in the concordance software and most of the work was subsequently completed manually. One such limitation was the mechanism used for sorting. The concordance sorts a text based on an exact word match, an instance of a word irrelevant of its variant forms, such as different tense or person. A lemmatizer was provided with the program, where lemmas function as the head word for a related set of words that vary grammatically, but the predefined list of words in the lemmatizer is limited. While customization is possible, each new word or set of words has to be manually entered into the system. Some additional limitations of the use of predefined sets in the lemmatizer are that its use requires manually checking outputs created with each sort. Most of the limitations are understandably caused because the lemmatizer works on character matching in the words, and does not tag for parts of speech. Ambiguous noun/adjective forms occur within the predefined sets (for example, “know, known”, “do, done”), and there are no present participle forms currently included in the lemmatizer. Adding or correcting these features would have created an additional time commitment in using the lemmatizer for studies

such as these. With limited datasets, such as those used in this analysis, entering the lemmas could take as long as manually identifying them, though for an analysis of larger datasets, customization and use of the lemmatizer would be beneficial. Additionally, some of the entries already programmed into the lemmatizer were related systematically, though not true lemmas (for example, “good, better, best”). Thus, the problem of exact word match would have still existed, even with its use. The set of “bear, bore, born, borne” is predefined, though most of the words carry multiple meanings and may not refer in any one use to the root verb “bear”—this would defeat the point of sorting them, because a human will still have to manually re-check and sort the results for accuracy. The online documentation discloses these aspects of the software in the section about the lemmatizer, concerning an example about the ambiguous word “lay.” “Since human language is not a wholly rational construct, there is no general remedy for this issue except vigilance” (Watt, 2009b). It is important to note that many systems devoted to processing natural language currently experience similar pitfalls, and these issues are more often than not the product of naturally occurring inconsistencies and idiosyncrasies in natural language.

Microsoft Excel was used to store and sort the resulting tables of information to view the use of recurrent predicate spatial relations for a final analysis. Information was stored in a four column format. The first column represents the defined term, and the second, third, and fourth columns resemble the subject-predicate-object of the triple, in which the third column stores the identified verb and preposition (predicate) pair under examination. The subjects/objects found in the second and fourth columns store the relative parts of the definition appearing before and after the predicate to lend context to the use of the spatial relation in the definition. While completing the spreadsheet, a fifth column was used to record notes concerning the data.

Because natural language is a social and communicative tool that has not been (or cannot be) reduced to a system fully understood and correctly processed by computer automation, the intuition and understanding of a linguist whose first and native language is English also were used, though the method would be valid in other languages as well. In the case of this piece of research, the linguist also was the primary analyst responsible for processing, recording, and reporting the data.

The DLG and National Hydrography Dataset (NHD) glossaries are based on the feature types compiled from years of repeated field survey validation by cartographers (E.L. Usery, oral commun., 2010; U.S. Geological Survey, 1984). The SDTS feature list was developed by committees of representatives from partnering organizations and so has a wider scope of included features than those of topographic data. The Geographic Names Information System (GNIS) list originally was compiled from feature types shown on USGS topographical maps, but has added partner and volunteer contributions since 1987 (Orth and Payne, 1997). For each set of definitions, the entries were retrieved online and copied to a



plain text document that would be compatible for use with the concordance.

The analysis involved reading each definition and interpreting any verb and preposition pairs within the definition. These pairs were then recorded on a spreadsheet. To find relevant spatial relations, both verbs and prepositions were examined independently and then analyzed for any relevant semantic relation with a counterpart. Then, the concordance was used to proceed through the definitions in the text document word by word to identify and analyze any verbs or prepositions that may have been missed in the initial reading. This step was critical in identifying secondary spatial relations that may have escaped initial analysis when overshadowed by a more prominent verb and preposition pair. Viewing verbs and prepositions with the concordance also allowed for analysis and understanding of word use trends throughout the text; for example, it became evident if a given verb seemed to favor usage with a particular preposition or set of prepositions, and thereby allowed for a supposition of an intended verb or preposition if a definition was written with either omitted.

## Findings

A total of 668 feature term definitions were examined. In several instances, it was discovered that definitions were not composed as complete grammatical sentences. Where this occurred, a verb or preposition was inferred for inclusion in the spreadsheet. All verb-preposition pairs presented in the spreadsheets maintain their original phrasing, except for noted exceptions, especially inferences. Wherever a word had to be inferred from the context of the definition, it has been indicated by parentheses in the spreadsheet. An effort was made to keep inferred verbs simple and unassuming in nature while still filling the function of the verb. For example, the verb “to go” implies a movement from one point to another without adding any further assumptions, such as speed or directionality—this can be seen in the SDTS definition for “Route”:

- Route: A designated path **through** a road network.
- Predicate: (goes)THROUGH
- Other common verbs used in these instances include “to be” and “to use.”

The inferring of prepositions proved to be problematic, as all prepositions have particular meanings, and many can have multiple meanings. The preposition “on” can have several different meanings dependent upon the context, as shown in these examples from SDTS:

- Airport: A facility, either **on** land or water, where aircraft can takeoff and land; usually consists of hard-surfaced landing strips, a control tower, hangars, and accommodations for passengers and cargo.
- Crater: Circular-shaped depression at the summit of a volcano or **on** the surface of the land.

- Fault: A fracture in the Earth’s crust with displacement **on** one side of the fracture relative to the other.

In the above examples, “on” can, respectively, have the different semantic meanings “built in contact with and perhaps supported by”, “within and made of”, or “located at or relative to a center line.”

Verbs and prepositions in the place of the predicate of the definition or implying relation to features can be of multiple types. A word can be used as an adverb, adjective, or preposition, or some other combination of types. For example, the word “beyond” can be a noun (the great beyond), preposition (beyond the lake), or an adverb (it’s beyond great). Words take various grammatical forms, such as tenses or participles. Verbs sometimes appeared in pairs, such as “\* \* \* disappears underground at \* \* \* and \* \* \* reappears at the surface \* \* \*.”

Several definitions contained multiple relations and associations. One difficulty with applying definitions in terms of spatial relations was that many of these were not defined spatially, but rather by material composition or an intended purpose. Some were even defined by temporal or qualitative constraints (examples from the Geonames and SDTS datasets):

- Canal: Manmade waterway **used by** watercraft or **for** drainage, irrigation, mining, or water power (ditch).
- Overfalls: Short breaking waves **occurring when** a current passes over a shoal or other submarine obstruction or meets a contrary current or wind.

Recording examples and instances of fuzzy logic also was problematic. For example, where a peninsula is defined as being “nearly surrounded by” water, the tendency would be to record the spatial relation predicate as “nearly\_surroundedBY” instead of “surroundedBY”, because the latter does not correctly convey the intended meaning. However, the effect that the fuzzy logic term “nearly” bears upon the semantic meaning can be interpreted to have an outside and separate meaning from “surroundedBY.” In the creation of a working ontology, the fuzzy logic aspect could be included from other aspects of the programming instead of coding the distinction in the Resource Description Framework (RDF) predicate—programming this in an alternate way would, in fact, be preferable to account for gradient levels.

This small-scale analysis provides an introduction to some of the challenges to be expected in the development of a formal ontology from text to RDF definitions. Ambiguous expressions for deeper semantic meanings can benefit a system designed for spatial relations data mining by reducing the number of rules of all semantic variants. Nevertheless, the further refinement of the embedded semantic meanings behind the representative forms of the words used to express them would benefit any ontology designed to approximate natural language semantics.

## Results

Words were examined in topographical context to determine a general categorization. Terms were divided between two main groups: spatial relations among topographical features, as would be used with two or more such features, and feature attributes that characterize features alone. Within these, relations were grouped as active verbs, verbs of being, and prepositions. Attributes were grouped into terms indicating location, description, or generative processes. These categories also can include inverses of terms. For example, a feature can be assigned an attribute to represent the result it generates and the morphological forces to which it is subject. Relations and attributes can combine to form complex properties.

The list of terms compiled from this study is neither conclusive nor final. No results regarding word syntax are offered. The list serves as a baseline vocabulary for development and refinement.

## Spatial Relations

Most predicates extracted from the standards were verb/preposition pairs (table 1). Active verbs (for example, words of motion) were most numerous. Prepositions often were determined to be used as spatial relations. Verb/preposition combinations can have multiple terms, such as “cast up upon.” Some verb/preposition combinations could be replaced by single verbs, such as “carry out” to mean “execute.” Synonyms were noted; a tension was noted between a simpler term,

**Table 1.** Verb/preposition pairs functioning as predicates in feature term glossaries.

	Active verbs			Spatial prepositions	
access	descend	function	above	near	
advance	direct	goes	across	of	
approach	disappear	interrupt	along	on	
attached	distribute	issue	alongside	out	
backed	divide	move	around	over	
borders	ejected	pass	at	through	
buried	enclose	passage	below	to	
change	entry	raise	between	toward	
connect	exit	reappears	beyond	under	
contact	fall	resist	by	where	
control	fill	run	from	with	
course	float	rush	into	within	
cover	flow	strung			
cross	follow	sunk			
departure	fronted	transport			

which may be more widely used, but may be more ambiguous than a specific term, as in “underground” or “subterranean.”

The verb/preposition pairs are context dependent and are nuanced in meaning within the syntax and semantics of sentences. The context of some verbs created criteria for inclusion or exclusion from the study.

Active verbs also could imply locative or generative properties, such as “located,” “stored,” or “positioned.” “Built,” “caused,” “constructed,” or “formed” all indicate topographical processes of feature formation. Such attributes were categorized as “locator” or “generator”, and are discussed in the next section.

Verbs of being include “is” and “are,” and passive verbs implying affordance, relevant properties of ontologies, such as, “affords” or “capable” were not considered spatial relations (Sen, 2008). Verb/preposition pairs that indicate purpose, such as “intended for” or “intended to be,” are nonspatial in nature, but could play a role as attributes. This possibility also applies to ownership, administration, or control. Passive verbs can imply part relations, such as “having,” “composed,” “consisting,” and others. Terms that are classified as “part” relations do not include independent features, as a structure is an independent feature though it may be part of a built-up area. Part relations are indicated by a verb, such as “consist,” or a term from a spatial reference system, such as “bottom.”

Several verbs were events involving features that would not be considered topographical, such as “ship.” In this example, verbs such as “anchored,” “berthed,” and “moored” were categorized as events or affordances relating to topographical features, to “port,” in this example, and not categorized as predicates or spatial relations between topographical features (Gibson, 1977).

The remaining topological terms can be either verbs, such as “crosses” or adjectives, such as “adjacent to.” Only two of the eight standard Open Geospatial Consortium (OGC) spatial relation terms were used in the glossaries, “within” and “contains.” Many glossary terms were synonyms or close approximations to standard terms, or “fuzzy” matches. Besides serving as triple predicates, topological relations may be leveraged for the logical consistency of data and spatial analysis. Once they are tied to the topology of geospatial data involving geometric feature types, such as “area” or “point,” predicates matching geometry types to feature types may support rules controlling the consistency of relations between features. For example, logical consistency rules involving topological predicates would prevent an error such as “crosses” when two polygons actually “overlap.”

## Feature Attributes

Attributes are nonspatial terms or spatial terms lacking relative relations to other features that characterize triple resources. Most adjectives present in feature type definitions indicated attributes, such as “known,” “away,” “out,” and “parallel.” Three general types of attributes were

identified from glossaries, called “Locator,” “Descriptor,” and “Generator.”

Feature attributes categorized as Locator are words with express location descriptions. In this group included are, “underground” and “positioned.” Many prepositions, such as “where” or “at,” indicate location.

Descriptors are attribute terms that are humanly-perceived. Descriptors usually take the form of adjectives, but are not abstract, such as “away” or “out.” Terms characterized as descriptors include: “curve,” “depression,” “slopes,” “broken,” or “visible.”

Terms of feature generation, called Generator attributes, include active verbs representing causes or processes that directly relate to the formation of the feature, not just having an affect on the feature. This set of terms applies to a wide range of human activities on the landscape, such as “cultivated” or “developed.” Other terms are more generic, such as “adapted,” “maintained,” “created,” or “determined.”

## Conclusions

Natural language spatial relations used in topographic science are complex phrases involving a range of properties. In addition to Geographic Information Systems approaches involving topology and geometric values of distance and direction, linguistic terms easily can communicate meaning to a diverse public, but they are complex and difficult to systematize in geospatial semantic web applications. Some relations embedded in the glossary are common terms with the Open Geospatial Consortium Simple Feature model operators, but can be expanded from binary topology between features to include resource systems and region fields. For example, the transitive property applies to terms such as “within” so that if A is within B, and B is within C, then A is within C.

Though the analysis focused primarily on verb/preposition pairs, other types of relations found in the complex phrases include properties indicating state of being (such as, “composed of”), location (such as, “subterranean”) and feature parts (such as, “entrance”). Topographic terms indicating a part of a feature were sometimes defined in terms of the motion or event it allows. For example, an entrance “\* \* \* affords entry to \* \* \*” Other types of properties that were semantically related to spatial relations, especially in the physical or material world, included terms of description (such as, “high” or “near”), generation of physical processes (such as, “naturally formed”), and motion (such as, “approaches”). The identification of these properties aids the representation of the complexity of phrases, which can be expressed as graphs or as a list of triples using common identifiers for resources, identifiers, or values.

The set of verb/preposition pairs found in this study function as predicates, together with topographic feature attributes, and compose a corpus of work that offers promise for user/technology interface facilitation. Such interfaces may involve

geographic information extraction, topographic feature identification, science process modeling, and visualization.

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# Appendixes

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## 8 An Analysis of Spatial Relation Predicates in U.S. Geological Survey Feature Definitions

### Appendix 1. Predicate terms in Digital Line Graph (DLG) standard feature definitions.

[The data analyzed in this table is based on the DLG standard. The text from the original documents was changed as little as possible and only for research purposes. As a result, the glossary definitions may appear to be breaking rules of grammar, but were arranged to help clarify semantic meanings. Feature type terms are listed in alphabetical order. Verbs appear in lowercase and prepositions appear in uppercase fonts. Inferred terms are presented within parentheses. --, no data]

Term	Subject	Predicate	Object
Aircraft_Facility	An area	WHERE	aircraft can take-off and land, usually equipped with associated buildings and facilities.
Aircraft_Facility	An area where aircraft can take-off and land, usually	equippedWITH	associated buildings and facilities.
Anchorage	An area	WHERE	a vessel anchors or may anchor, either because of suitability or designation.
Aquaculture_Site	A set of pools	(consisting)OF	water and related structures used for producing fin-fish, shellfish, or aquatic plants.
Aquaculture_Site	A	setOF	pools of water and related structures used for producing finfish, shellfish, or aquatic plants.
Aquaculture_Site	A set of pools of water and related structures	usedFOR	producing finfish, shellfish, or aquatic plants.
Arch	A naturally occurring, freestanding curved structure	spans(OVER)	an opening.
Archeological_Site/ Ruin	An area that	CONTAINS	the material remains of past human activities.
Archeological_Site/ Ruin	An area	OF	scientific interest that contains the material remains of past human activities.
Area_Of_Complex_Channels	An area	WHERE	a stream or river flows in an intricate network of interlacing channels.
Area_Of_Complex_Channels	An area where a stream or river	flowsIN	an intricate network of interlacing channels.
Area_Of_Complex_Channels	An area where a stream or river flows in an intricate	networkOF	interlacing channels.
Area_To_Be_Submerged	The known extent of the intended lake that will be	createdBEHIND	a dam under construction.
Area_To_Be_Submerged	The	known_extentOF	the intended lake that will be created behind a dam under construction.
Athletic_Field	A defined, but often unbounded, open area	constructedFOR, maintainedFOR	the purpose of holding sporting events and activities.
Bar	A natural	accumulationOF	sand, gravel, or other material forming an underwater or exposed embankment.
Bar	A natural accumulation of sand, gravel, or other	materialFORMING	an underwater or exposed embankment.
Barren_Land	Places	composedOF	bare rock, sand, silt, gravel, or other earthen material with little or no vegetation and having limited ability to support life.
Basin	A bowl-shaped	depressionIN	the surface of the land or ocean floor.
Basin	A bowl-shaped depression in the	surfaceOF	the land or ocean floor.
Bay/Inlet	A water area that is an	openingINTO	the land, or of an estuary, lake, or river into its shore.
Bay/Inlet	A water area that is an	openingINTO	its shore.
Bay/Inlet	A water area that is an	openingOF	the sea/ocean into the land, or of an estuary, lake, or river into its shore.
Beach	The gently sloping shore that is washed by waves, usually	composedOF	sand and pebbles.



**Appendix 1.** Predicate terms in Digital Line Graph (DLG) standard feature definitions.—Continued

[The data analyzed in this table is based on the DLG standard. The text from the original documents was changed as little as possible and only for research purposes. As a result, the glossary definitions may appear to be breaking rules of grammar, but were arranged to help clarify semantic meanings. Feature type terms are listed in alphabetical order. Verbs appear in lowercase and prepositions appear in uppercase fonts. Inferred terms are presented within parentheses. --, no data]

<b>Term</b>	<b>Subject</b>	<b>Predicate</b>	<b>Object</b>
Beach	The gently sloping shore that is washed by waves, usually	is_washedBY	waves, usually composed of sand and pebbles.
Bend	A curve in the	courseOF	a stream or the land within the curve.
Bend	A	curveIN	the course of a stream or the land within the curve.
Boardwalk	A promenade, usually	constructedOF	planks.
Boundary_Line	The	limiting_lineOF	jurisdictional authority for various levels of government.
Boundary_Line	The limiting line of jurisdictional authority	usedFOR	various levels of government.
Boundary_Point	An identified	locationON, locationNEAR	a current boundary or former boundary.
Bridge	A structure	spanningOVER, providing_passageOVER	a waterway, railroad, or other obstacle.
Building	A permanent construction that	isROOFED, isWALLED.	--
Built-Up_Area	An area	OF	intensive use, with much of the land covered by structures.
Built-Up_Area	An area of intensive use, with much of the land	coveredBY	structures.
Cable/Pipeline_Site	An area where cables or pipelines	are_locatedUNDER	water.
Cable/Pipeline_Site	An area	WHERE	cables or pipelines are located under water.
Cableway	A conveyor system in which carrier units	are_suspendedFROM	wire cables strung between supports.
Cableway	A conveyor system in which carrier units are suspended from wire cables	strungBETWEEN	supports.
Campground	A designated area	ON	which primitive structure(s) may be erected for temporary shelter and/or where recreational vehicles are temporarily parked.
Campground	A designated area on which primitive structure(s) may be	erectedFOR	temporary shelter and/or where recreational vehicles are temporarily parked.
Canal/Ditch	An artificial open waterway	constructedTO	transport water, to irrigate or drain land, to connect two or more bodies of water, or to serve as a waterway for watercraft.
Cape	A projection of land	extendingINTO	a body of water that prominently marks a change in or interrupts the coastal trend of that water body.
Cape	A projection of land extending into a body of water that prominently marks a change in or interrupts the coastal	trendOF	that water body.
Cave_Entrance	A passage that affords	entryTO	a naturally formed subterranean open area or chamber.
Cemetery	A burial ground.	--	--
Chimney	A structure containing a passage or flue for	discharging(OF)	combustion smoke and gases.

## 10 An Analysis of Spatial Relation Predicates in U.S. Geological Survey Feature Definitions

### Appendix 1. Predicate terms in Digital Line Graph (DLG) standard feature definitions.—Continued

[The data analyzed in this table is based on the DLG standard. The text from the original documents was changed as little as possible and only for research purposes. As a result, the glossary definitions may appear to be breaking rules of grammar, but were arranged to help clarify semantic meanings. Feature type terms are listed in alphabetical order. Verbs appear in lowercase and prepositions appear in uppercase fonts. Inferred terms are presented within parentheses. --, no data]

Term	Subject	Predicate	Object
City	An incorporated, populated place such as a village, city, town, or borough,	including	an independent city.
Cliff	A	high vertical, near-vertical, or over-hanging	face.
Connector	A known, but nonspecific,	connectionBETWEEN	two nonadjacent network segments.
Contour (Land)	A line	connectingWITH	a reference to a vertical datum.
Conveyor	Any permanent mechanism, such as continuous moving belt, that	transportsFROM	one place to another.
County	Second order	divisionOF	a nation such as parish, borough, municipio, judicial division, and independent cities in Maryland, Missouri, Nevada, and Virginia.
Crevasse Field	An area of deep fissures	IN	the surface of an ice mass caused by breaking or parting.
Crevasse Field	An area	OF	deep fissures in the surface of an ice mass caused by breaking or parting.
Crevasse Field	An area of deep fissures in the surface of an ice mass	causedBY	breaking or parting.
Crevasse Field	An area of deep fissures in the	surfaceOF	an ice mass caused by breaking or parting.
Cul-de-Sac	The round or circular	sectionOF	the end of a dead-end street.
Cultivated_Crop-land	Land that has been	plowedFOR, cultivatedFOR	crop production.
Dam/Weir	A barrier	constructedTO	control the flow or raise the level of water.
Dam/Weir	A barrier constructed to	controlFLOW_OF, raiseLEVEL_OF	water.
Depth_Curve	A line	connecting	points of equal depth below the hydrographic datum.
Desert	A region	rendered_barrenBY	environmental extremes, especially low rainfall.
Dish	A concave object	usedFOR	transmitting or receiving electromagnetic signals.
Disposal_Site	An area	WHERE	refuse is dumped.
Distributed_Surface	An area which is	brokenINTO	a chaotic pattern of elevations and depressions due to human intervention.
Distributed_Surface	An area which is broken into a chaotic pattern of elevations and depressions	dueTO	human intervention.
Divide	The line	separating	drainage basins.
Draw_Span	The	movablePORTION_OF	a bridge deck.
Drive-In_Theater_Screen	A picture is	projectedUPON	for viewing.
Drydock	An artificial basin fitted with a gate or caisson into which a vessel may be floated and from which water may be pumped out to expose the	bottomOF	the vessel.
Drydock	An artificial basin	fittedWITH	a gate or caisson into which a vessel may be floated and from which water may be pumped out to expose the bottom of the vessel.



**Appendix 1.** Predicate terms in Digital Line Graph (DLG) standard feature definitions.—Continued

[The data analyzed in this table is based on the DLG standard. The text from the original documents was changed as little as possible and only for research purposes. As a result, the glossary definitions may appear to be breaking rules of grammar, but were arranged to help clarify semantic meanings. Feature type terms are listed in alphabetical order. Verbs appear in lowercase and prepositions appear in uppercase fonts. Inferred terms are presented within parentheses. --, no data]

<b>Term</b>	<b>Subject</b>	<b>Predicate</b>	<b>Object</b>
Drydock	A vessel may be	floatedINTO.	--
Drydock	Water may be	pumped_outFROM	to expose the bottom of the vessel.
Dunes	Hills or ridges	(composed)OF	sand piled up by the wind.
Dunes	Hills or ridges of sand	piled_upBY	the wind.
Embankment	A	raisedLINEAR_ MOUND_OF	earth, gravel, or similar material.
Estuary	The lower end of a river, or a semienclosed coastal body of water with access to the open ocean, which is affected by the tides and	(is)WHERE	fresh and salt water mix.
Estuary	The lower end of a river, or a semienclosed coastal body of water with	accessTO	the open ocean, which is affected by the tides and where fresh and salt water mix.
Estuary	The lower end of a river, or a semienclosed coastal body	composedOF	water with access to the open ocean, which is affected by the tides and where fresh and salt water mix.
Estuary	The lower	endOF	a river, or a semienclosed coastal body of water with access to the open ocean, which is affected by the tides and where fresh and salt water mix.
Estuary	The lower end of a river, or a semienclosed coastal body of water with access to the open ocean, which	is_affectedBY	the tides and where fresh and salt water mix.
Exhibition_Ground	A public area where outdoor fairs, circuses, and other events are held, which also contains permanent structures	(used)FOR	the display of livestock, machinery, agricultural produce, etc.
Exhibition_Ground	A public area where outdoor fairs, circuses, and other events are held, which also	CONTAINS	permanent structures for the display of livestock, machinery, agricultural produce, etc.
Exhibition_Ground	A public area	WHERE	outdoor fairs, circuses, and other events are held, which also contains permanent structures for the display of livestock, machinery, agricultural produce, etc.
Fence_Line	An identifiable fence or field line	visibleON	an aerial photograph.
Filtration_Plant	A group	composedOF	structures functioning as a unit used for the purification and distribution of a water supply.
Filtration_Plant	A group of structures	functioningAS	a unit used for the purification and distribution of a water supply.
Filtration_Plant	A group of structures functioning as a unit used for the	purificationOF, distributionOF	a water supply.
Filtration_Plant	A group of structures functioning as a unit	usedFoR	the purification and distribution of a water supply.
Fish_Ladder	A facility consisting of a series of small pools, each one slightly higher than the preceding,	builtAROUND	an obstruction to enable fish to make their way upstream.

## 12 An Analysis of Spatial Relation Predicates in U.S. Geological Survey Feature Definitions

### Appendix 1. Predicate terms in Digital Line Graph (DLG) standard feature definitions.—Continued

[The data analyzed in this table is based on the DLG standard. The text from the original documents was changed as little as possible and only for research purposes. As a result, the glossary definitions may appear to be breaking rules of grammar, but were arranged to help clarify semantic meanings. Feature type terms are listed in alphabetical order. Verbs appear in lowercase and prepositions appear in uppercase fonts. Inferred terms are presented within parentheses. --, no data]

Term	Subject	Predicate	Object
Fish_Ladder	A facility	consistingOF	a series of small pools, each one slightly higher than the preceding, built around an obstruction to enable fish to make their way upstream.
Fish_Ladder	A facility consisting of a series of small pools, each one slightly higher than the preceding, built around an	obstructionTO	enable fish to make their way upstream.
Fish_Ladder	A facility consisting of a	seriesOF	small pools, each one slightly higher than the preceding, built around an obstruction to enable fish to make their way upstream.
Flume	An open, inclined, artificial channel	constructedOF	wood, metal, or concrete; generally elevated.
Ford	A location in a body	composedOF	water for a road or trail crossing where the physical characteristics of the bottom, water depth, and approaches permit passage without a bridge or ferry.
Ford	A location in a body of water for a road or trail	crossingWHERE	the physical characteristics of the bottom, water depth, and approaches permit passage without a bridge or ferry.
Ford	A	locationIN	a body of water for a road or trail crossing where the physical characteristics of the bottom, water depth, and approaches permit passage without a bridge or ferry.
Ford	A location in a body of water	usedFOR	a road or trail crossing where the physical characteristics of the bottom, water depth, and approaches permit passage without a bridge or ferry.
Foreshore	The part of a seashore	(is)BETWEEN	high-water and low-water marks.
Foreshore	The	part of	a seashore between high-water and low-water marks.
Fracture	A deformation in the Earth's crust	causedBY	a loss of cohesion.
Fracture	A	deformationIN	the Earth's crust caused by a loss of cohesion.
Fumarole	steam and gases are	emittedFROM	a hole in the earth's crust.
Gaging_Station	A structure	usedTO	measure the characteristics of a hydrographic feature.
Gap	A	low_pointBETWEEN, openingBETWEEN	mounts or in a ridge.
Gap	A	low_pointIN, openingIN	a ridge.
Gate	A structure that may be	swungTO, drawnTO, loweredTO	block an entrance or passageway.
Geyser	A natural fountain that intermittently	ejectsFROM	a hole in the Earth's crust.
Geyser	A natural fountain that intermittently	ejectsINTO	the air from a hole in the Earth's crust.
Hazard_Zone	An area	identifiedAS	a danger to maritime navigation.
Helipad	A structure	usedFOR	the landing and take-off of helicopters.
Historical_Monument			
Holding_Pen	Livestock are temporarily	keptIN	an enclosed area.
Ice_Mass	A field of ice,	formedIN	regions of perennial frost.

**Appendix 1.** Predicate terms in Digital Line Graph (DLG) standard feature definitions.—Continued

[The data analyzed in this table is based on the DLG standard. The text from the original documents was changed as little as possible and only for research purposes. As a result, the glossary definitions may appear to be breaking rules of grammar, but were arranged to help clarify semantic meanings. Feature type terms are listed in alphabetical order. Verbs appear in lowercase and prepositions appear in uppercase fonts. Inferred terms are presented within parentheses. --, no data]

<b>Term</b>	<b>Subject</b>	<b>Predicate</b>	<b>Object</b>
Iceberg	Large mass of floating or stranded ice of greatly varying shape, more than 5 meters above sea level, which has	brokenAWAY	from a glacier.
Iceberg_Tongue	A major accumulation of icebergs projecting from the coast,	held_in_placeBY	by grounding and joined together by fast ice.
Iceberg_Tongue	A major accumulation of icebergs projecting from the coast, held in place by grounding and	joined_togetherBY	fast ice.
Iceberg_Tongue	A major accumulation of icebergs	projectingFROM	the coast, held in place by grounding and joined together by fast ice.
Incline/Flow	A feature	characterizedBY	a sloping surface or a formation resulting from movement down a sloping surface.
Incline/Flow	A feature characterized by a sloping surface or a formation	resultingFROM	movement down a sloping surface.
Institutional_Site	A group of buildings or associated structures,	functioningAS	a unit, used predominantly for educational, correctional, governmental, medical, or religious purposes.
Interchange	An area	designatedTO	provide traffic access between roadways of differing levels.
Interchange	An area designated to	provide_accessBE-TWEEN	roadways of differing levels.
Inundation_Area	An area of land	subjectTO	flooding.
Island	An area of dry or relatively dry land	surroundedBY	water or low wetland.
Isthmus	A narrow strip of land,	borderedBY	water, connecting two larger land areas.
Isthmus	A narrow strip of land,	borderedON	both sides by water, connecting two larger land areas.
Isthmus	A narrow strip of land, bordered on both sides by water,	connecting	two larger land areas.
Junction	An intersection or confluence of two or more adjacent network segments, or a terminus of a single network segment. Network segments	areIN	a roadway network or drainage network that have direction of flow or carry traffic.
Junction	An intersection or confluence of two or more adjacent network segments, or a terminus of a single network segment. Network segments are those links in a roadway network or drainage network that	have_directionOF	flow or carry traffic.
Junction	An	intersectionOF, confluenceOF	two or more adjacent network segments, or a terminus of a single network segment. Network segments are those links in a roadway network or drainage network that have direction of flow or carry traffic.
Junction	An intersection or confluence of two or more adjacent network segments, or a	terminusOF	a single network segment. Network segments are those links in a roadway network or drainage network that have direction of flow or carry traffic.
Kiln	Any of various ovens	(used)FOR	hardening, burning, or drying substances.
Lake/Pond	A standing body of water with a predominantly natural shoreline	surroundedBY	land.

## 14 An Analysis of Spatial Relation Predicates in U.S. Geological Survey Feature Definitions

### Appendix 1. Predicate terms in Digital Line Graph (DLG) standard feature definitions.—Continued

[The data analyzed in this table is based on the DLG standard. The text from the original documents was changed as little as possible and only for research purposes. As a result, the glossary definitions may appear to be breaking rules of grammar, but were arranged to help clarify semantic meanings. Feature type terms are listed in alphabetical order. Verbs appear in lowercase and prepositions appear in uppercase fonts. Inferred terms are presented within parentheses. --, no data]

Term	Subject	Predicate	Object
Land_Grant	An area of land to which title was conferred by a predecessor government and confirmed by the U.S. Government after the territory in which it is situated was	acquiredBY	the United States.
Land_Grant	An area of land to which title was	conferredBY	a predecessor government and confirmed by the U.S. Government after the territory in which it is situated was acquired by the United States.
Land_Grant	An area of land to which title was conferred by a predecessor government and	confirmedBY	the U.S. Government after the territory in which it is situated was acquired by the United States.
Lane	A	prescribed_courseFOR	ships, boats, or seaplanes.
Launch_Facility	An area	(is)WHERE	rockets or missiles may be housed and from which they are launched, usually equipped with associated buildings and facilities.
Launch_Facility	An area where rockets or missiles may be housed and from which they are launched, usually	equippedWITH	associated buildings and facilities.
Launch_Facility	An area where rockets or missiles may be housed and	launchedFROM	usually equipped with associated buildings and facilities.
Launch_Pad	a rocket or missile is	launchedFROM	a structure.
Launching_Ramp	A partially submerged hard surface	(is)ON	on a shoreline for launching or retrieving vessels or aircraft.
Launching_Ramp	A partially submerged hard surface on a shoreline	(used)FOR	launching or retrieving vessels or aircraft.
Locale	A named place not otherwise categorized.	--	--
Lock_Chamber	An enclosure	(is)ON	a waterway used to raise and lower vessels as they pass from one level to another.
Lock_Chamber	An enclosure on a waterway used to raise and lower vessels as they	passFROM	one level to another.
Lock_Chamber	An enclosure on a waterway	usedTO	raise and lower vessels as they pass from one level to another.
Marina	A harbor facility for recreational craft	(is)WHERE	supplies, repairs, and various services are available.
Marina	A harbor facility	(used)FOR	recreational craft where supplies, repairs, and various services are available.
Mile_Marker	A point	(is)ON	a feature indicating the distance, in miles, measured along the course or path of the feature, from an established origin point on the feature.
Mile_Marker	A point on a feature indicating the distance, in miles, measured along the course or path of the feature, from an established origin point	(is)ON	the feature.
Mile_Marker	A point on a feature indicating the distance, in miles,	measuredALONG	the course or path of the feature, from an established origin point on the feature.

**Appendix 1.** Predicate terms in Digital Line Graph (DLG) standard feature definitions.—Continued

[The data analyzed in this table is based on the DLG standard. The text from the original documents was changed as little as possible and only for research purposes. As a result, the glossary definitions may appear to be breaking rules of grammar, but were arranged to help clarify semantic meanings. Feature type terms are listed in alphabetical order. Verbs appear in lowercase and prepositions appear in uppercase fonts. Inferred terms are presented within parentheses. --, no data]

Term	Subject	Predicate	Object
Mile_Marker	A point on a feature indicating the distance, in miles,	measuredFROM	an established origin point on the feature.
Mine	An excavation in the earth	(is)FOR_THE_PURPOSE_OF	extracting earth materials.
Mine	An excavation	(is)IN	the earth for the purpose of extracting earth materials.
Mine_Entrance	Passage that	affords_entryTO	an underground mine.
Minor_Civil_Division	Third order	divisionOF	a nation such as township, town, district, precinct, or barrio.
Mobile_Home_Park	An area	maintainedFOR	the parking of inhabited mobile homes.
Mobile_Home_Park	An area maintained for the	parkingOF	inhabited mobile homes.
Monorail	A vehicle or train of cars	travelsON	a single rail.
Moraine	An	accumulationOF	earth and stones carried and deposited by a glacier.
Moraine	An accumulation of earth and stones	carriedBY, depositedBY	a glacier.
Mount	A landmass that	projectsABOVE	its surroundings.
Mud_Pot	gas or vapors	issueFROM	a pool of mud.
Nation	An area	under_jurisdictionOF	a sovereign government.
Nonearthen_Shore	A structure built of stone, brick, concrete, or other building materials that	borders	a body of water.
Nonearthen_Shore	A structure	builtOF	stone, brick, concrete, or other building materials that borders a body of water.
Offshore_Platform	A raised structure located in a sea,	equippedFOR	the extraction, loading or unloading of petroleum products.
Offshore_Platform	A raised structure located in a sea, equipped for the	extractionOF, loadingOF, unloadingOF	petroleum products.
Offshore_Platform	A raised structure	locatedIN	a sea, equipped for the extraction, loading or unloading of petroleum products.
Outdoor_Theater	An outdoor area consisting of a stage or other focal point, and an area	(is)WHERE	the audience can be seated to view the performance or event.
Outdoor_Theater	An outdoor area	consistingOF	a stage or other focal point, and an area where the audience can be seated to view the performance or event.
Park	A place or area	developedFOR	public use or recreation.
Pier/Breakwater/Jetty	Structure	extendingFROM	the shore or positioned offshore for protection, berthing vessels, or recreation.
Pier/Breakwater/Jetty	Structure	extendingIN	the longest dimension from the shore or positioned offshore for protection, berthing vessels, or recreation.
Pier/Breakwater/Jetty	Structure extending in the longest dimension from the shore or	positionedFOR	protection, berthing vessels, or recreation.
Pinnacle	A	vertical often spire-shaped	natural rock formation.

**Appendix 1.** Predicate terms in Digital Line Graph (DLG) standard feature definitions.—Continued

[The data analyzed in this table is based on the DLG standard. The text from the original documents was changed as little as possible and only for research purposes. As a result, the glossary definitions may appear to be breaking rules of grammar, but were arranged to help clarify semantic meanings. Feature type terms are listed in alphabetical order. Verbs appear in lowercase and prepositions appear in uppercase fonts. Inferred terms are presented within parentheses. --, no data]

Term	Subject	Predicate	Object
Pipeline	A closed conduit, with pumps, valves and control devices,	(used)FOR	conveying fluids, gases, or finely divided solids.
Pipeline_Regulation_Station	An ancillary facility that	controls_the_flow-ALONG	a pipeline route.
Pipeline_Regulation_Station	An ancillary facility that	controls_the_flowOF	fluids or gasses along a pipeline route.
Plateau	An elevated and comparatively level expanse	(composed)OF	land.
Playa	The flat area	(is)AT	the lowest part of an undrained desert basin, generally devoid of vegetation.
Playa	The flat area at the lowest part of an undrained desert basin, generally	devoidOF	vegetation.
Point_Monument	A structure that marks the location of a point	determinedBY	surveying.
Point_Monument	A structure that marks the	locationOF	a point determined by surveying.
Populated_Place	A place or area	(is)WITH	clustered or scattered buildings and a permanent human population.
Post	An upright piece of timber or other material,	(is)IN, adjacentTO	a body of water, used for mooring ships or supporting other structures.
Post	An upright piece of timber or other material, in or adjacent to a body of water	usedFOR	mooring ships or supporting other structures.
Power_Site	A group of associated structures,	functioningAS	a unit, used for generating electricity.
Power_Site	A group of associated structures, functioning as a unit,	usedFOR	generating electricity.
Principal_Meridian	The line	extendingFROM	the initial point of a Rectangular Survey. Ranges are referenced east or west of the principal meridian.
Principal_Meridian	The line extending north and south, intended to	followALONG	a true meridian, from the initial point of a Rectangular Survey. Ranges are referenced east or west of the principal meridian.
Principal_Meridian	The line extending north and south,	intendedTO	follow along a true meridian, from the initial point of a Rectangular Survey. Ranges are referenced east or west of the principal meridian.
Principal_Meridian	The line extending north and south, intended to follow along a true meridian, from the initial point of a Rectangular Survey. Ranges are	referencedEAST_OF, referencedWEST_OF	the principal meridian.
Prospect	A marked location	(is)WHERE	mineral exploration has occurred, but no mine has been developed.
Proving_Ground	An area	set_asideFOR	performance testing.
Public_Land_Survey_System_Area	An area of land which is subdivided by the Public Land Survey System (PLSS), and was originally	createdON	public domain lands, and the rules for its use were defined by the authority of the U.S. Government. The PLSS has since been extended, following similar rules, into non-public domain areas.

**Appendix 1.** Predicate terms in Digital Line Graph (DLG) standard feature definitions.—Continued

[The data analyzed in this table is based on the DLG standard. The text from the original documents was changed as little as possible and only for research purposes. As a result, the glossary definitions may appear to be breaking rules of grammar, but were arranged to help clarify semantic meanings. Feature type terms are listed in alphabetical order. Verbs appear in lowercase and prepositions appear in uppercase fonts. Inferred terms are presented within parentheses. --, no data]

<b>Term</b>	<b>Subject</b>	<b>Predicate</b>	<b>Object</b>
Public_Land_Survey_System_Area	An area of land which is subdivided by the Public Land Survey System (PLSS), and was originally created on public domain lands, and the rules for its use were	definedBY	the authority of the U.S. Government. The PLSS has since been extended, following similar rules, into non-public domain areas.
Public_Land_Survey_System_Area	An area of land which is subdivided by the Public Land Survey System (PLSS), and was originally created on public domain lands, and the rules for its use were defined by the authority of the U.S. Government. The PLSS has since been	extendedINTO	non-public domain areas.
Public_Land_Survey_System_Area	An area of land which is	subdividedBY	the Public Land Survey System (PLSS), and was originally created on public domain lands, and the rules for its use were defined by the authority of the U.S. Government. The PLSS has since been extended, following similar rules, into non-public domain areas.
Racetrack	A course	laid_outFOR	racing.
Railway	A train or trolley	runsON	a set of parallel rails.
Railway_Yard	An area provided with a system of tracks and associated structures,	(is)WHERE	railway trains are assembled, and railway cars are switched, stored or serviced.
Railway_Yard	An area	providedWITH	a system of tracks and associated structures, where railway trains are assembled, and railway cars are switched, stored or serviced.
Range	A chain	(composed)OF	mounts and/or ridges.
Rapids	An area of swift current	(is)IN	a stream or river, characterized by standing waves or by boulders and rocks.
Rapids	An area of swift current in a stream or river,	characterizedBY	standing waves or by boulders and rocks.
Recreational_Slide	An amusement structure	consistingOF	a smooth, usually inclined, surface or track for sliding.
Recreational_Slide	An amusement structure consisting of a smooth, usually inclined, surface or track	usedFOR	sliding.
Reef	A chain of rocks or coral	(is)AT, (is)NEAR	the surface of the water.
Reservation	Bounded land	set_asideFOR	a particular purpose, generally having certain use restrictions.
Reservoir	A constructed basin	formedTO	contain water or other liquids.
Rest_Site	A roadside area usually having facilities	(intended)FOR	people and/or vehicles.
Ridge	A	long and narrow	upland with steep sides.
Road	An open way	usedFOR	the passage of vehicles.
Rock	A concreted mass	(composed)OF	stony material.
Route	A designated path	(goes)THROUGH	a road network.
Runway/Apron/Taxiway	An area	(is)ON	land used by aircraft for takeoff, landing, parking or access to runways.



**Appendix 1.** Predicate terms in Digital Line Graph (DLG) standard feature definitions.—Continued

[The data analyzed in this table is based on the DLG standard. The text from the original documents was changed as little as possible and only for research purposes. As a result, the glossary definitions may appear to be breaking rules of grammar, but were arranged to help clarify semantic meanings. Feature type terms are listed in alphabetical order. Verbs appear in lowercase and prepositions appear in uppercase fonts. Inferred terms are presented within parentheses. --, no data]

<b>Term</b>	<b>Subject</b>	<b>Predicate</b>	<b>Object</b>
Runway/Apron/ Taxiway	An area on land	usedBY	aircraft for takeoff, landing, parking or access to runways.
Runway/Apron/ Taxiway	An area on land	usedFOR	takeoff, landing, parking or access to runways.
Sea/Ocean	The great body of salt water that	covers	much of the earth.
Sewage_Disposal_ Plant	A group of structures	functioningAS	a unit used for the disposal of domestic water-born waste.
Sewage_Disposal_ Plant	A group of structures functioning as a unit	usedFOR	the disposal of domestic water-born waste.
Shopping_Center	A group of structures	usedFOR	the sale of products and services.
Shoreline	A naturally occurring line of contact	(is)between	a body of water and the land.
Shrubland	Area	coveredWITH	plants that have persistent woody stems and a relatively low growth habit, and that generally produce several basal shoots instead of a single shoot.
Sink/Rise	The place at which a stream disappears underground or reappears at the surface	(is)IN	a karst area.
Sink/Rise	A stream	disappears_undergroundAT, reappears_at_the_surfaceAT,	the place.
Ski_Jump	An inclined structure	consistingOF	a track from which snow skiers vault.
Ski_Jump	snow skiers	vaultFROM	an inclined structure consisting of a track.
Snag/Stump	A firmly attached stem or trunk of a tree	(is)NEAR	the surface of water.
Sounding	The	measured_depthOF, chartered_depthOF	water below the hydrographic datum.
Sounding_Datum_ Line	bathymetric contours are	referencedTO	a line representing the tidal datum.
Special_Survey_ Area	An area of land	(is)WITHIN	the original holdings secured by the Federal Government (within Public Land states), subdivided by surveys that involve unusual applications of, or departures from, the rectangular system. The subdivided surveys often carry out the provisions of a special legislative act.
Special_Survey_ Area	An area of land within the original holdings secured by the Federal Government	(is)WITHIN	Public Land states, subdivided by surveys that involve unusual applications of, or departures from, the rectangular system. The subdivided surveys often carry out the provisions of a special legislative act.
Special_Survey_ Area	An area of land within the original holdings secured by the Federal Government (within Public Land states), subdivided by surveys that involve unusual	applicationsOF, departuresFROM	the rectangular system. The subdivided surveys often carry out the provisions of a special legislative act.



**Appendix 1.** Predicate terms in Digital Line Graph (DLG) standard feature definitions.—Continued

[The data analyzed in this table is based on the DLG standard. The text from the original documents was changed as little as possible and only for research purposes. As a result, the glossary definitions may appear to be breaking rules of grammar, but were arranged to help clarify semantic meanings. Feature type terms are listed in alphabetical order. Verbs appear in lowercase and prepositions appear in uppercase fonts. Inferred terms are presented within parentheses. --, no data]

Term	Subject	Predicate	Object
Special_Survey_Area	An area of land within the original holdings secured by the Federal Government (within Public Land states), subdivided by surveys that involve unusual applications of, or departures from, the rectangular system. The subdivided surveys often	carry_out_provision- sOF	a special legislative act.
Special_Survey_Area	An area of land within the original holdings	securedBY	the Federal Government (within Public Land states), subdivided by surveys that involve unusual applications of, or departures from, the rectangular system. The subdivided surveys often carry out the provisions of a special legislative act.
Special_Survey_Area	An area of land within the original holdings secured by the Federal Government (within Public Land states),	subdividedBY	surveys that involve unusual applications of, or departures from, the rectangular system. The subdivided surveys often carry out the provisions of a special legislative act.
Special_Use_Zone	An area	WHERE	distinctive types of maritime activities occur.
Special_Use_Zone	Distinctive types of maritime activities	occur(AT)	an area.
Special_Use_Zone_Limit	The limit of an area	usedFOR	distinctive types of maritime activities.
Spillway	A * * * passage	constructedFOR	surplus water to run over or around a dam.
Spillway	A constructed passage for surplus water to	runOVER, runAROUND	a dam.
Sports_Site	A collection of facilities (open areas, structures)	functioningAS	a unit for the purpose of holding sporting events and activities.
Sports_Site	Collection of facilities (open areas, structures) functioning as a unit	usedFOR	the purpose of holding sporting events and activities.
Spot_Elevation	A point with a measured vertical position of less than third order accuracy,	measured_relativeTO	a reference datum.
Spring/Seep	A place where water	issuesFROM	the ground naturally.
State/Territory	First order division	(is)OF	a nation.
Stream/River	A body	(composed)OF	flowing water.
Submerged_Stream	An old river course	inundatedBY	an impounded water body.
Substation	An ancillary facility	(is)ALONG	a powerline route for transforming electrical current.
Substation	An ancillary facility along a powerline route	(used)FOR	transforming electrical current.
Survey_Corner	A survey location that was originally	establishedFOR	the purpose of referencing and/or defining the limits of a survey.
Survey_Corner	A survey location that was originally established for the purpose of	referencing_limitsOF, defining_limitsOF	a survey.
Survey_Line	The limiting line	(is)BETWEEN	public-land and/or private subdivisions.
Swamp/Marsh	A noncultivated, vegetated area that is inundated or saturated for a significant part of the year. The vegetation is	adaptedFOR	life in saturated soil conditions.

**Appendix 1.** Predicate terms in Digital Line Graph (DLG) standard feature definitions.—Continued

[The data analyzed in this table is based on the DLG standard. The text from the original documents was changed as little as possible and only for research purposes. As a result, the glossary definitions may appear to be breaking rules of grammar, but were arranged to help clarify semantic meanings. Feature type terms are listed in alphabetical order. Verbs appear in lowercase and prepositions appear in uppercase fonts. Inferred terms are presented within parentheses. --, no data]

<b>Term</b>	<b>Subject</b>	<b>Predicate</b>	<b>Object</b>
Swamp/Marsh	A noncultivated, vegetated area that is	inundatedFOR, saturatedFOR	a significant part of the year. The vegetation is adapted for life in saturated soil conditions.
Tank	A large container	usedFOR	storage.
Terrace	A step-like surface	(is)BETWEEN	higher and lower ground.
Tower	A tall framework or structure, the height of which is	requiredBY	its function.
Traffic_Inspection_Facility	An area having facilities	(used)TO	examine pedestrian and vehicular traffic and/or cargo.
Traffic_Inspection_Facility	An area	HAVING	facilities to examine pedestrian and vehicular traffic and/or cargo.
Trail	A cleared path, beaten track, or improved surface, as	(going)THROUGH	woods or wilderness, not usually trafficked by vehicles because of width, seasonal conditions, or access restrictions.
Trail	A cleared path, beaten track, or improved surface, as through woods or wilderness, not usually	traffickedBY	vehicles because of width, seasonal conditions, or access restrictions.
Transmission_Line	A system of wires that	transmitsOVER	distance.
Trees	An extensive area	OF	land covered with woody perennial plants having a self-supporting main stem or trunk, a definite crown and usually reaching a mature height of more than 6 feet.
Trees	An extensive area of land	coveredWITH	woody perennial plants having a self-supporting main stem or trunk, a definite crown and usually reaching a mature height of more than 6 feet.
Tunnel	An	underground or underwater	passage.
Tunnel_Entrance	Opening that	affords_entryTO	an underground or underwater passage.
Turntable	A rotating platform with railway tracks	usedFOR	turning locomotives or cars.
Underpass	The grade separation where part or all of one feature instance	isABOVE	part or all of another feature instance.
Valley	An elongated depression	(is)IN	the earth's surface which generally slopes from one end to the other.
Valley	An elongated depression in the earth's surface which generally	slopesFROM	one end.
Valley	An elongated depression in the earth's surface which generally slopes from one end	slopesTO	the other.
Wall	An upright structure of masonry, wood, plaster, or other building material	servingTO	enclose, divide, or protect an area.
Wash	The usually dry portion of a stream bed that	contains	water only during or after a local rainstorm or heavy snowmelt.
Water_Intake/Outflow	Water	entersTHROUGH, exitsTHROUGH	a conduit structure.
Watercourse	A named path	(goes)THROUGH	a drainage network.

**Appendix 1.** Predicate terms in Digital Line Graph (DLG) standard feature definitions.—Continued

[The data analyzed in this table is based on the DLG standard. The text from the original documents was changed as little as possible and only for research purposes. As a result, the glossary definitions may appear to be breaking rules of grammar, but were arranged to help clarify semantic meanings. Feature type terms are listed in alphabetical order. Verbs appear in lowercase and prepositions appear in uppercase fonts. Inferred terms are presented within parentheses. --, no data]

<b>Term</b>	<b>Subject</b>	<b>Predicate</b>	<b>Object</b>
Waterfall	A vertical or near vertical descent of water	(descends)OVER	step or ledge in the bed of a river.
Waterfall	A vertical or near vertical descent of water over a step or ledge	(is)IN	the bed of a river.
Well	A pit or hole dug or bored into the earth	(used)FOR	the extraction of oil, water, other fluids, or gases.
Well	A pit or hole	dugINTO, boredINTO	the earth for the extraction of oil, water, other fluids, or gases.
Well_Field	An area	WHERE	petroleum and/or natural gas is or was removed from the earth.
Well_Field	An area where petroleum and/or natural gas is or was	removedFROM	the earth.
Wharf	Vessels may be	berthedON	the one side only.
Wharf	Vessels may be	berthedTO	the shoreline.
Wharf	A structure with its longest axis	builtPARALLEL_TO	the shoreline to which vessels may be berthed on one side only.
Windmill	A mill or other machine that runs on the energy	generatedBY	a wheel of adjustable blades or flats rotated by the wind.
Windmill	A mill or other machine that runs on the energy generated by a wheel of adjustable blades or flats	rotatedBY	the wind.
Windmill	A mill or other machine that	runsON	the energy generated by a wheel of adjustable blades or flats rotated by the wind.
Wreck	The hulk or the ruins of a disabled vessel which is	attachedTO, foulOF	the bottom or cast up on the shore.
Wreck	hulk or the ruins of a disabled vessel which is attached to or foul of the bottom or	castUP, castON	the shore.

## 22 An Analysis of Spatial Relation Predicates in U.S. Geological Survey Feature Definitions

### Appendix 2. Predicate terms in USGS Geonames standard feature definitions.

[The data analyzed in this table is based on the Geonames standard. The text from the original documents was changed as little as possible and only for research purposes. As a result, the glossary definitions may appear to be breaking rules of grammar, but were arranged to help clarify semantic meanings. Feature type terms are listed in alphabetical order. Verbs appear in lowercase and prepositions appear in uppercase fonts. Inferred terms are presented within parentheses. --, no data]

Term	Subject	Predicate	Object
Airport	Manmade facility	maintainedFOR	the use of aircraft (airfield, airstrip, landing field, landing strip).
Arch	Natural arch-like	openingIN	a rock mass (bridge, natural bridge, sea arch).
Area	Any one of several areally extensive natural features	not_includedIN	other categories (badlands, barren, delta, fan, garden).
Arroyo	Water may occasionally	flowTHROUGH	watercourse or channel.
Bar	Natural accumulation of sand, gravel, or alluvium	formingEMBANKMENT	(ledge, reef, sandbar, shoal, spit).
Basin	Natural depression or relatively low area	enclosedBY	higher land (amphitheater, cirque, pit, sink).
Bay	A part of a body of water; a body of water partly surrounded by land (arm, bight, cove, estuary, gulf, inlet, sound).	enclosedBY	indentation of a coastline or shoreline.
Beach	The sloping shore	(is)ALONG	a body of water that is washed by waves or tides and is usually covered by sand or gravel (coast, shore, strand).
Beach	The sloping shore	(is)ALONG	a body of water.
Beach	The sloping shore along a body of water that is washed by waves or tides and is usually	coveredBY	sand or gravel (coast, shore, strand).
Beach	The sloping shore along a body of water that is	washedBY	waves or tides and is usually covered by sand or gravel (coast, shore, strand).
Bench	Area of relatively level land	(is)ON	the flank of an elevation such as a hill, ridge, or mountain where the slope of the land rises on one side and descends on the opposite side (level).
Bench	Area of relatively level land on the flank of an elevation such as a hill, ridge, or mountain where the slope of the land rises on one side and	descendsON	the opposite side (level).
Bench	Area of relatively level land on the flank of an elevation such as a hill, ridge, or mountain where the slope of the land	risesON	one side and descends on the opposite side (level).
Bend	--	[curve]IN	the course of a stream and (or) the land within the curve; a curve in a linear body of water (bottom, loop, meander).
Bend	A	[curve]IN	a linear body of water (bottom, loop, meander).
Bridge	Manmade structure	carryingACROSS	a body of water or depression (causeway, overpass, trestle).
Building	A manmade structure with walls and a roof	(is)FOR	protection of people and (or) materials, but not including church, hospital, or school.
Canal	Manmade waterway	usedBY	watercraft.
Canal	Manmade waterway	usedFOR	drainage, irrigation, mining, or water power (ditch, lateral).
Cape	Projection of land	extendingINTO	a body of water (lea, neck, peninsula, point).
Cave	Natural underground passageway or chamber, or a hollowed out	[cavity]IN	the side of a cliff (cavern, grotto).
Cemetery	A place or area	(used)FOR	burying the dead (burial, burying ground, grave, memorial garden).

**Appendix 2.** Predicate terms in USGS Geonames standard feature definitions.—Continued

[The data analyzed in this table is based on the Geonames standard. The text from the original documents was changed as little as possible and only for research purposes. As a result, the glossary definitions may appear to be breaking rules of grammar, but were arranged to help clarify semantic meanings. Feature type terms are listed in alphabetical order. Verbs appear in lowercase and prepositions appear in uppercase fonts. Inferred terms are presented within parentheses. --, no data]

<b>Term</b>	<b>Subject</b>	<b>Predicate</b>	<b>Object</b>
Census	A statistical area delineated locally specifically for the tabulation of Census Bureau data (census designated place, census county division, unorganized territory, various types of American Indian/Alaska Native statistical areas).	[distinct]FROM	civil and populated place.
Census	A statistical area	delineatedFOR	the tabulation of Census Bureau data (census designated place, census county division, unorganized territory, various types of American Indian/Alaska Native statistical areas).
Channel	Water	flowsTHROUGH	linear deep part of a body of water.
Channel	Linear deep part of a body of water through which the main volume of water flows and is frequently	usedAS	a route for watercraft (passage, reach, strait, thoroughfare, throughfare).
Church	Building	usedFOR	religious worship (chapel, mosque, synagogue, tabernacle, temple).
Civil	A political division formed for administrative purposes (borough, county, incorporated place, municipio, parish, town, township).	[distinct]FROM	census and populated place.
Civil	A political division	formedFOR	administrative purposes (borough, county, incorporated place, municipio, parish, town, township).
Cliff	--	(is)[STEEP]	slope (bluff, crag, head, headland, nose, palisades, precipice, promontory, rim, rimrock).
Crater	Circular-shaped depression	(is)AT	the summit of a volcanic cone or one on the surface of the land caused by the impact of a meteorite; a manmade depression caused by an explosion (caldera, lua).
Crater	Circular-shaped depression at the summit of a volcanic cone or one	(is)ON	the surface of the land caused by the impact of a meteorite; a manmade depression caused by an explosion (caldera, lua).
Crater	Circular-shaped depression at the summit of a volcanic cone or one on the surface of the land	causedBY	the impact of a meteorite; a manmade depression caused by an explosion (caldera, lua).
Crater	A manmade depression	causedBY	an explosion (caldera, lua).
Crossing	A place where two or more routes of transportation	formINTERSECTION	(overpass, underpass).
Dam	Water barrier or embankment	builtACROSS	the course of a stream or into a body of water to control and (or) impound the flow of water (breakwater, dike, jetty).
Dam	Water barrier or embankment built across the course of a stream or into a body of water to	controlFLOW	of water (breakwater, dike, jetty).
Falls	Perpendicular or very steep	fallIN	the course of a stream (cascade, cataract, waterfall).
Flat	Relative level area	(is)WITHIN	a region of greater relief (clearing, glade, playa).
Forest	Bounded area of woods, forest, or grassland	(is)[UNDER_ADMINISTRATION_OF]	a political agency (see “woods”) (national forest, national grasslands, State forest).

**Appendix 2.** Predicate terms in USGS Geonames standard feature definitions.—Continued

[The data analyzed in this table is based on the Geonames standard. The text from the original documents was changed as little as possible and only for research purposes. As a result, the glossary definitions may appear to be breaking rules of grammar, but were arranged to help clarify semantic meanings. Feature type terms are listed in alphabetical order. Verbs appear in lowercase and prepositions appear in uppercase fonts. Inferred terms are presented within parentheses. --, no data]

<b>Term</b>	<b>Subject</b>	<b>Predicate</b>	<b>Object</b>
Gap	Low point or	openingBEWTEEN	hills or mountains or in a ridge or mountain range (col, notch, pass, saddle, water gap, wind gap).
Gap	Low point or	openingIN	a ridge or mountain range (col, notch, pass, saddle, water gap, wind gap).
Glacier	An area of relatively permanent snow or ice	(is)ON	the top or side of a mountain or mountainous area (icefield, ice patch, snow patch).
Glacier	Body or stream of ice	movingFROM	an area of accumulation.
Gut	Relatively small coastal waterway	connecting(BETWEEN)	larger bodies of water or other waterways (creek, inlet, slough).
Harbor	Sheltered area of water	(is)WHERE	ships or other watercraft can anchor or dock (hono, port, roads, roadstead).
Hospital	Building	(is)WHERE	the sick or injured may receive medical or surgical attention (infirmary).
Island	Area of dry or relatively dry land	surroundedBY	water or low wetland (archipelago, atoll, cay, hammock, hummock, isla, isle, key, moku, rock).
Isthmus	Narrow section of land	(is)IN	a body of water connecting two larger land areas.
Isthmus	Narrow section of land in a body of water	connecting(BETWEEN)	two larger land areas.
Lake	Natural body of inland water	(enclosedBY)	land.
Lava	Formations resulting from the consolidation of molten rock	(is)ON	the surface of the Earth (kepula, lava flow).
Lava	Formations	resultingFROM	the consolidation of molten rock on the surface of the Earth (kepula, lava flow).
Levee	Natural or manmade embankment	flanking(ALONGSIDE)	a stream (bank, berm).
Locale	Place at which there	(used)(FOR)	human activity; it does not include populated places, mines, and dams (battlefield, crossroad, camp, farm, ghost town, landing, railroad siding, ranch, ruins, site, station, windmill).
Military	Place or facility	usedFOR	various aspects of or relating to military activity.
Mine	Commercial minerals are or were	removedFROM	place or area—the Earth; not including oilfield (pit, quarry, shaft).
Oilfield	Petroleum is or was	removedFROM	area—the Earth.
Park	Place or area	setAsideFOR	recreation or preservation of a cultural or natural resource and under some form of government administration; not including National or State forests or Reserves (national historical landmark, national park, State park, wilderness area).
Pillar	A	(is)[VERTICAL]	natural rock formation (chimney, monument, pinnacle, pohaku, rock tower).
Populated Place	Usually	isNOT_INCORPORATED	and has no legal boundaries. Distinct from census and civil classes.
Post Office	An official facility of the U.S. Postal Service	usedFOR	processing and distributing mail and other postal material.
Rapids	Fast-flowing	sectionOF	a stream , often shallow and with exposed rock or boulders (riffle, ripple).

**Appendix 2.** Predicate terms in USGS Geonames standard feature definitions.—Continued

[The data analyzed in this table is based on the Geonames standard. The text from the original documents was changed as little as possible and only for research purposes. As a result, the glossary definitions may appear to be breaking rules of grammar, but were arranged to help clarify semantic meanings. Feature type terms are listed in alphabetical order. Verbs appear in lowercase and prepositions appear in uppercase fonts. Inferred terms are presented within parentheses. --, no data]

<b>Term</b>	<b>Subject</b>	<b>Predicate</b>	<b>Object</b>
Reserve	A tract of land	set_asideFOR	a specific use (does not include forests, civil divisions, parks).
Ridge	Elevation with a narrow, elongated crest which can be	partOF	a hill or mountain (crest, cuesta, escarpment, hogback, lae, rim, spur).
School	Building or group of buildings	usedAS	an institution for study, teaching, and learning (academy, college, high school, university).
Sea	Large body	(composed)OF	salt water (gulf, ocean).
Slope	A gently inclined	partOF	the Earth's surface (grade, pitch).
Spring	Place	(is)WHERE	underground water flows naturally to the surface of the Earth (seep).
Spring	Place where underground water	flowsTO	the surface of the Earth (seep).
Stream	Linear body of water	flowingON	the Earth's surface (anabranched, awawa, bayou, branch, brook, creek, distributary, fork, kill, pup, rio, river, run, slough).
Summit	Prominent elevation	risingABOVE	the surrounding level of the Earth's surface; does not include pillars, ridges, or ranges (ahu, berg, bald, butte, cerro, colina, cone, cumbre, dome, head, hill, horn, knob, knoll, mauna, mesa, mesita, mound, mount, mountain, peak, puu, rock, sugarloaf, table, volcano).
Summit	Prominent elevation	risingABOVE	the surrounding level of the Earth's surface; does not include pillars, ridges, or ranges (ahu, berg, bald, butte, cerro, colina, cone, cumbre, dome, head, hill, horn, knob, knoll, mauna, mesa, mesita, mound, mount, mountain, peak, puu, rock, sugarloaf, table, volcano).
Swamp	Poorly drained wetland, fresh or saltwater, wooded or grassy, possibly	coveredWITH	open water (bog, cienega, marais, marsh, pocosin).
Tower	A manmade structure	higherTHAN	its diameter, generally used for observation, storage, or electronic transmission.
Tower	A manmade structure, higher than its diameter, generally	usedFOR	observation, storage, or electronic transmission.
Trail	Route for passage	(going)FROM	one point to another; does not include roads or highways (jeep trail, path, ski trail).
Tunnel	Linear underground passageway	openAT	both ends.
Valley	Linear depression	(is)IN	the Earth's surface that generally slopes from one end to the other (barranca, canyon, chasm, cove, draw, glen, gorge, gulch, gulf, hollow, ravine).
Valley	Linear depression in the Earth's surface that generally	slopesFROM	one end to the other (barranca, canyon, chasm, cove, draw, glen, gorge, gulch, gulf, hollow, ravine).
Well	Manmade shaft or hole	(is)IN	the Earth's surface used to obtain fluid or gaseous materials.
Well	Manmade shaft or hole in the Earth's surface	usedTO	obtain fluid or gaseous materials.
Woods	Small area	coveredWITH	a dense growth of trees; does not include an area of trees under the administration of a political agency (see "forest").



**Appendix 3.** Predicate terms in Spatial Data Transfer Standard (SDTS) feature definitions.

[The data analyzed in this table is based on the SDTS standard. The text from the original documents was changed as little as possible and only for research purposes. As a result, the glossary definitions may appear to be breaking rules of grammar, but were arranged to help clarify semantic meanings. Feature type terms are listed in alphabetical order. Verbs appear in lowercase and prepositions appear in uppercase fonts. Inferred terms are presented within parentheses. --, no data]

Term	Subject	Predicate	Object
Airport	A facility, either	(is)ON	land or water, where aircraft can take off and land; usually consists of hard-surfaced landing strips, a control tower, hangars, and accommodations for passengers and cargo.
Airport	A facility, either on land or water,	(is)WHERE	aircraft can take off and land; usually consists of hard-surfaced landing strips, a control tower, hangars, and accommodations for passengers and cargo.
Airport	A facility, either on land or water, where aircraft can take off and land; usually	consistsOF	hard-surfaced landing strips, a control tower, hangars, and accommodations for passengers and cargo.
Alluvium	All unconsolidated fragmental material	laid_downBY	a stream.
Ammunition Dump	A military installation	usedFOR	the storage of explosives and other warlike stores.
Antenna	A metallic apparatus	forSENDING, forRECEIVING	electro-magnetic waves.
Antenna_Array	A	groupOF	directional antennas.
Approachway	The airspace that aircraft	approachTHROUGH, leaveTHROUGH	a landing area.
Arch	A curved structure	supportsOVER	an open space.
Backwater	an area of calm water	unaffectedBY	the current of a stream.
Bar	A submerged or emerged mound, ridge, or succession of ridges of sand or other material	extendingACROSS	the bottom, and which may obstruct navigation.
Basin	Any bowl-shaped depression	(is)IN	the surface of the land or ocean floor.
Beach	The gently sloping shore which is washed by waves or tides, especially the parts	coveredBY	sand or pebbles.
Beach	The gently sloping shore which	isWASHED	by waves or tides, especially the parts covered by sand or pebbles.
Beacon	A fixed signal, mark, or light and associated facilities	erectedFOR	the guidance of mariners or airplane pilots.
Berth	The	placeWHERE	a ship lies when at anchor secured to a pier or wharf.
Bottom	The portion of the ground surface which	liesBELOW	water.
Boundary	A nonphysical line	indicatingLIMIT, indicatingEXTENT	of an area or territory.
Breakers	A zone or region of waves breaking into foam as they	advanceTOWARD	the shore.
Breakers	A zone or region of waves	breakingINTO	foam as they advance toward the shore.
Breakwater	A structure	builtTO	break the force of waves so as to protect a beach, harbor, or other waterfront facility.
Bridge	A structure erected to	carryOVER	a depression or obstacle to carry traffic or some facility such as a pipeline.
Bridge	A structure	erectedOVER	a depression or obstacle to carry traffic or some facility such as a pipeline.



**Appendix 3.** Predicate terms in Spatial Data Transfer Standard (SDTS) feature definitions.—Continued

[The data analyzed in this table is based on the SDTS standard. The text from the original documents was changed as little as possible and only for research purposes. As a result, the glossary definitions may appear to be breaking rules of grammar, but were arranged to help clarify semantic meanings. Feature type terms are listed in alphabetical order. Verbs appear in lowercase and prepositions appear in uppercase fonts. Inferred terms are presented within parentheses. --, no data]

<b>Term</b>	<b>Subject</b>	<b>Predicate</b>	<b>Object</b>
Bridge_Superstructure	Those elements of the bridge structure which	areABOVE	the uppermost deck.
Building	A permanent	(is)WALLED, (is)ROOFED	construction.
Building_Complex	A group of buldings and associated facilities	functioningTOGETHER	as a unit.
Buoy	A float	mooredIN, anchoredIN	water.
Cableway	A conveyor system in which carries units run on wire cables	[strung]BETWEEN	supports.
Cableway	A conveyor system in which carrier units	runON	wire cables [strung] between supports.
Campground	The ground or area on which tents, huts, etc. are	erectedFOR	temporary shelter.
Cape	A relatively extensive land area jutting into a water body, which prominently marks a	changeIN, interruptionIN	the coastal trend of that water body.
Cape	A relatively extensive land area	juttingINTO	a water body, which prominently marks a change in or interrupts notably the coastal trend of that water body.
Catchment	A natural drainage area which may coincide with a river basin, in which the divides	directinto	a river.
Catchment	An area	drainedBY	an single watercourse.
Cave	A	(is)NATURALLY_FORMED, (is)SUBTERRANEAN, (is)OPEN	area or chamber.
Cemetary	A	placeFOR	burying the dead.
Chimney	A structure	containingPASSAGE, containingFLUE	for discharging smoke and gases from combustion.
Chimney	A structure containing a passage or flue	forDISCHARGING	smoke and gases from combustion.
Cirque	A deep natural hollow	(is)NEAR	the crest of a mountain.
Clearing	An open area	(is)IN	a forest.
Cliff	A	(is)HIGH, (is)STEEP, (is)OVERHANGING	face of rock.
Coast	The general region of indefinite width that	extendsFROM	the sea inland to the first major change in terrain features.
Coast	The general region of indefinite width that	extendsTO	the first major change in terrain features.
Continent	Earth's surface is	dividedINTO	one of the large, unbroken masses of land.
Control_Point	A point of	(is)KNOWN	location.
Crater	Circular-shaped depression	atSUMMIT	of a volcanic cone or on the surface of the land.
Crater	Circular-shaped depression at the summit of a volcanic cone or	onSURFACE	of the land.

**Appendix 3.** Predicate terms in Spatial Data Transfer Standard (SDTS) feature definitions.—Continued

[The data analyzed in this table is based on the SDTS standard. The text from the original documents was changed as little as possible and only for research purposes. As a result, the glossary definitions may appear to be breaking rules of grammar, but were arranged to help clarify semantic meanings. Feature type terms are listed in alphabetical order. Verbs appear in lowercase and prepositions appear in uppercase fonts. Inferred terms are presented within parentheses. --, no data]

Term	Subject	Predicate	Object
Crevasse	A deep fissure	(is)IN	snow or ice.
Crib	A crate-like construction of logs or beams, usually	filledWITH	stones, placed in water as a free standing mooring device or as the foundation of a pier or wharf.
Crib	A crate-like construction of logs or beams, usually filled with stones,	placedIN	water as a free standing mooring device or as the foundation of a pier or wharf.
Cropland	Land that	(is)PLOWED, (is) CULTIVATED.	--
Cut	An excavation of the Earth's surface to provide	passageFOR	a road, railway, canal, etc.
Dam	A barrier	constructedACROSS	a watercourse to control the flow or raise the level of water.
Dam	A barrier constructed across a watercourse to	controlFLOW, raiseLEVEL	of water.
Delta	A tract of alluvium formed at the mouth of a river where the deposition of some of its load exceeds its rate of removal,	crossedBY	the divergent channels (distributaries) of the river.
Delta	A tract of alluvium	formedAT	the mouth of a river where the deposition of some of its load exceeds its rate of removal.
Demilitarized_Zone	An area	(is)WHERE)	military activity is prohibited.
Desert	A region	rendered_barrenBY	environmental extremes, especially by low rainfall.
Dry_Dock	An artificial basin	fittedWITH	gate or caisson into which a vessel may be floated and from which the water may be pumped out to expose the bottom of the vessel.
Dry_Dock	A vessel may be	floatedINTO	and from which the water may be pumped out to expose the bottom of the vessel.
Dry_Dock	Water may be	pumpedFROM	to expose the bottom of the vessel.
Dumping_Ground	Area	designatedFOR	dumping various types of materials.
Earth_Surface	The outermost	surfaceOF	the land and waters of the planet.
Embankment	A raised structure	(composed)OF	earth, ground, etc.
Exhibition_Ground	A public area containing buildings, paddocks, etc.,	(is)FOR	the display of livestock, agricultural produce, machinery, etc.
Farm	A tract of crop or grazing land, as well as the group of buildings with and often	(is)SURROUNDING	a farmhouse, including barns, sheds, and other outbuildings, used for agricultural production.
Farm	A tract of crop or grazing land, as well as the group of buildings with and often surrounding a farmhouse, including barns, sheds, and other outbuildings,	usedFOR	agricultural production.
Fault	A fracture	(is)IN	the Earth's crust with displacement on one side of the fracture relative to the other.
Fence	An enclosure or barrier	madeOF	wire, rails, slats or other relatively light material, as opposed to a wall which is of stone or other heavy material.

**Appendix 3.** Predicate terms in Spatial Data Transfer Standard (SDTS) feature definitions.—Continued

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<b>Term</b>	<b>Subject</b>	<b>Predicate</b>	<b>Object</b>
Filtration_Beds	An area	(is)CONTAINING	layers of material used to filter or aerate water.
Filtration_Beds	An area containing layers of material	usedTO	filter or aerate water.
Fish_Hatchery	A facility	usedFOR	the spawning of fish which are subsequently used to stock lakes and streams.
Fish_Ladder	A facility consisting of a series of small pools each one slightly higher than the preceding,	builtAROUND	a dam to enable fish to make their way upstream.
Fish_Ladder	A facility	consistingOF	a series of small pools each one slightly higher than the preceding, built around a dam to enable fish to make their way upstream.
Fish_Trap	A device	usedTO	catch fish.
Fishing_Ground	A water area	(usedFOR)	fishing.
Flat	A level tract	lyingBELOW	the surface of water, or alternately covered and left bare by the tide.
Flood_Plain	An area which is	subjectTO	periodic flooding.
Ford	The shallow	partOF	a river which can be easily crossed.
Fort	Place or position	(is)FORTIFIED	--
Fumarole	A hole	(is)IN	the Earth's crust from which steam and gases are emitted.
Fumarole	Steam and gases	emittedFROM	a hole in the Earth's crust.
Gantry	A frame structure	raisedON	side supports so as to span over or around something.
Gantry	A frame structure raised on side supports so as to	spanOVER, spanAROUND	something.
Gap	Low point or opening	(is)BETWEEN	hills or mountains or in a ridge or mountain range.
Gap	Low point or opening between hills or mountains or	(is)IN	a ridge or mountain range.
Gate	A structure that	mayBLOCK	an entrance or passageway.
Geyser	An intermittent fountain of hot water ejected with force from a hole	(is)IN	the Earth's crust.
Geyser	An intermittent fountain of hot water	ejectedFROM	a hole in the Earth's crust.
Golf_Course	An area	(is)FOR	the playing of golf.
Grandstand	A usually roofed structure	(is)FOR	viewing events and having tiers of seats for spectators.
Grassland	An uncultivated	areaOF	grass or grass-like vegetation.
Grave	A place	(is)WITHIN	a graveyard used for burial.
Grave	A place within a graveyard	usedFOR	burial.
Ground	The solid	portionOF	the Earth up to and including the ground surface.
Ground_Surface	The land	surfaceOF	the Earth, both exposed and underwater.
Guard_Rail	A strong fence or barrier to prevent vehicles from leaving the roadway, or	(used)FOR	people's safety.

**Appendix 3.** Predicate terms in Spatial Data Transfer Standard (SDTS) feature definitions.—Continued

[The data analyzed in this table is based on the SDTS standard. The text from the original documents was changed as little as possible and only for research purposes. As a result, the glossary definitions may appear to be breaking rules of grammar, but were arranged to help clarify semantic meanings. Feature type terms are listed in alphabetical order. Verbs appear in lowercase and prepositions appear in uppercase fonts. Inferred terms are presented within parentheses. --, no data]

Term	Subject	Predicate	Object
Guard_Rail	A strong fence or barrier	(used)TO	prevent vehicles from leaving the roadway, or for people's safety.
Harbor	An area of water	(is)WHERE	ships, planes or other watercraft can anchor or dock.
Headwaters	The	upper_partOF	a river system, denoting the upper basin and source streams of a river.
Hedge	A dense growth of shrubbery	plantedAS	a fence or boundary.
Helipad	A transportation structure	usedFOR	the landing of helicopters.
Hopper	A top loading funnel-shaped structure	(used)FOR	temporary storage of loose materials which will be dispensed from its bottom.
Hopper	A top loading funnel-shaped structure for temporary storage of loose materials which will be	dispensedFROM	its bottom.
Ice_Field	Large area	(composed)OF	permanent sea or land ice.
Ice_Rink	A surface	(composed)OF	ice.
Ice_Rink	A surface of ice	(used)FOR	ice skating.
Iceberg	A large mass of detached land ice	(is)IN	the sea or stranded in shallow water.
Indian_Reservation	An area	set_asideFOR	the use of an indian tribe or tribes.
Inlet	The sea	opensINTO	the land.
Inlet	A lake	opensINTO	its shore.
Inshore_Traffic_Zone	A designated area	(is)BETWEEN	the landward boundary of a traffic separation scheme and the adjacent coast, intended for local traffic.
Inshore_Traffic_Zone	A designated area between the landward boundary of a traffic separation scheme and the adjacent coast,	intendedFOR	local traffic.
Intersection	The	junctionOF	roads or tracks.
Irrigation_System	A system	designedTO	supply land with water.
Island	Area	(composed)OF	dry or relatively dry land surrounded by water or low wetland.
Island	Area of dry or relatively dry land	surroundedBY	water or low wetland.
Island_Cluster	A group	(composed)OF	islands.
Isthmus	Narrow section of land in a body of water	(is)CONNECTING	two larger land areas.
Isthmus	Narrow section of land	(is)IN	a body of water connecting two larger land areas.
Lagoon	The sheet of water	(is)BETWEEN	an offshore reef, especially of coral and mainland.
Lagoon	The sheet of water	(is)WITHIN	a ring or horseshoe shaped atoll.
Lagoon	Sand or shingle banks	(is)BETWEEN	a sheet of salt water separated from the open sea.
Lagoon	A sheet of salt water	separatedFROM	the open sea by sand or shingle banks. The sheet of water between an offshore reef, esp. of coral and mainland. The sheet of water within a ring or horseshoe shaped atoll.
Lake	Any standard body	(composed)OF	inland water.
Landing_Place	A place	(used)FOR	loading and unloading passengers or cargo to and from water vessels.

**Appendix 3.** Predicate terms in Spatial Data Transfer Standard (SDTS) feature definitions.—Continued

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<b>Term</b>	<b>Subject</b>	<b>Predicate</b>	<b>Object</b>
Lane	A prescribed course	(used)FOR	ships or aircraft, or a strip delineated on a road to accommodate a single line of automobiles; not to be confused with the road itself.
Lane	A prescribed course for ships or aircraft, or a strip delineated on a road	(used)TO	accommodate a single line of automobiles; not to be confused with the road itself.
Lane	A prescribed course for ships or aircraft, or a strip	delineatedON	a road to accommodate a single line of automobiles; not to be confused with the road itself.
Launching_Ramp	A transportation structure	usedFOR	launching boats.
Lock	An enclosure	(is)IN	a water body with gates at each end to raise or lower vessels as they pass from one level to another.
Lock	An enclosure in a water body with gates at each end	(used)TO	raise or lower vessels as they pass from one level to another.
Lock	An enclosure in a water body with gates at each end to raise or lower vessels as they	passFROM	one level to another.
Marina	A harbor facility for recreational craft	(is)WHERE	supplies, repairs, and various services are available.
Marina	A harbor facility	(used)FOR	recreational craft where supplies, repairs, and various services are available.
Military_Base	An area owned and operated by the government	inWHICH (is)WHERE)	various military activities take place.
Military_Base	An area	ownedBY, operatedBY	the government in which various military activities take place.
Military_Bunker	A military strong point, usually	partOF	an extensive fortification.
Mine	An excavation	(is)IN	the Earth for the purpose of extracting earth materials.
Mine	An excavation in the Earth	forEXTRACTING	earth materials.
Mine_Field	An area where explosive mines have been	anchoredIN, sunkIN	water or buried on land.
Mine_Field	An	areaWHERE	explosive mines have been anchored or sunk in water or buried on land.
Mine_Field	An area where explosive mines have been anchored or sunk in water or	buriedON	land.
Missile_Site	An	areaFOR	housing and launching guided missiles.
Mobile_Home	A trailer that	isDWELLING, isDESIGNED	without a permanent foundation.
Mobile_Home_Park	An	areaFOR	the parking of inhabited mobile homes.
Monument	A structure	erectedAS	a memorial.
Mooring	The	placeWHERE	a craft may be secured to the ground, wharf, pier, post, or buoy.
Mooring	The place where a craft may be	securedTO	the ground, wharf, pier, post, or buoy.
Moraine	An	accumulationOF	boulders, stones, or other debris carried and deposited by a glacier.

**Appendix 3.** Predicate terms in Spatial Data Transfer Standard (SDTS) feature definitions.—Continued

[The data analyzed in this table is based on the SDTS standard. The text from the original documents was changed as little as possible and only for research purposes. As a result, the glossary definitions may appear to be breaking rules of grammar, but were arranged to help clarify semantic meanings. Feature type terms are listed in alphabetical order. Verbs appear in lowercase and prepositions appear in uppercase fonts. Inferred terms are presented within parentheses. --, no data]

<b>Term</b>	<b>Subject</b>	<b>Predicate</b>	<b>Object</b>
Morained	An accumulation of boulders, stones, or other debris	carriedBY, depositedBY	a glacier.
Mount		(is)	a mountain or hill.
Mount_Range	A series of	(is)CONNECTED, (is) ALIGNED	mountains or mountain ridges.
Mount_Range	A	seriesOF	connected and aligned mountains or mountain ridges.
Mouth	stream	exitINTO, dischargeINTO	another stream, lake, or sea.
Mouth	The	exitOF, point_of_dischargeOF	a stream into another stream, lake, or sea.
Oasis	A small, isolated, fertile or green	areaIN	a desert region, usually having a spring well.
Off_Road_Vehicular_Area	An	areaFOR	the testing of, or use by, vehicles that are designed to travel across the terrain.
Off_Road_Vehicular_Area	An area for the	testingOF, useBY	vehicles that are designed to travel across the terrain.
Offshore_Platform	A raised surface	locatedIN	a sea.
Oil_Field	An	areaWHERE	petroleum is or was removed from the Earth.
Oil_Field	An area where petroleum is or was	removedFROM	the Earth.
Outdoor_Theater	An outdoor area consisting of a stage or other focal point, and an	areaWHERE	the audience can be seated.
Outdoor_Theater	An outdoor area	consistingOF	a stage or other focal point, and an area where the audience can be seated.
Overfalls	Short breaking waves occurring when a current passes over a shoal or other submarine obstruction or	MEETS	a contrary wind or current.
Overfalls	Short breaking waves	occurringWHEN	a current passes over a shoal or other submarine obstruction or meets a contrary current or wind.
Overfalls	Short breaking waves occurring when a current	passesOVER	a shoal or other submarine obstruction or meets a contrary current or wind.
Overrun/Stopway	An area beyond the take-off runway	able_toSUPPORT	an airplane during an aborted take-off.
Overrun/Stopway	An	areaBEYOND	the take-off runway able to support an airplane during an aborted take-off.
Park	A place or area	set_asideFOR	recreation or preservation of a cultural or natural resource.
Parking_Area	An area	set_asideFOR	the parking of motor vehicles.
Peak	The	summitOF	a mountain.
Peninsula	A	bodyOF	land jutting out into and nearly surrounded by water.
Peninsula	A body of land	jutting_outINTO, nearly_surroundedBY	water.
Pier	A structure built out into the water, usually with its greatest dimension	at_right_anglesTO	the shore, forming a landing place or a place alongside which vessels can lie.

**Appendix 3.** Predicate terms in Spatial Data Transfer Standard (SDTS) feature definitions.—Continued

[The data analyzed in this table is based on the SDTS standard. The text from the original documents was changed as little as possible and only for research purposes. As a result, the glossary definitions may appear to be breaking rules of grammar, but were arranged to help clarify semantic meanings. Feature type terms are listed in alphabetical order. Verbs appear in lowercase and prepositions appear in uppercase fonts. Inferred terms are presented within parentheses. --, no data]

<b>Term</b>	<b>Subject</b>	<b>Predicate</b>	<b>Object</b>
Pier	A structure	built_outINTO	the water, usually with its greatest dimension at right angles to the shore, forming a landing place or a place alongside which vessels can lie.
Pier	A structure built out into the water, usually with its greatest dimension at right angles to the shore,	placeALONGSIDE	which vessels can lie.
Piling	A set of posts	forcedINTO	the earth to serve as a support, as for a pier, or to resist lateral pressure.
Piling	A	setOF	posts forced into the earth to serve as a support, as for a pier, or to resist lateral pressure.
Piling	A set of posts forced into the earth to serve as a support, as for a pier, or	to_resist	lateral pressure.
Piling	A set of posts forced into the earth	to_serveAS	a support, as for a pier, or to resist lateral pressure.
Pilot_Waters	Areas	IN_WHICH	the services of a marine pilot are essential.
Pinnacle	A tall, slender, spire-shaped rock	projectingFROM	a level or more gently sloping surface.
Place	An	areaWITH	definite or indefinite boundaries.
Plain	A	regionOF	general uniform slope, comparatively level, and of considerable extent.
Plateau	An elevated and comparatively level	expanseOF	land.
Plunge_Pool	A hollow eroded by the force of the falling water	atBASE_OF	a waterfall, particularly by the eddying effect.
Plunge_Pool	A hollow	erodedBY	the force of the falling water at the base of a waterfall, particularly by the eddying effect.
Polyna	Any water area	enclosedIN	pack ice, other than a lead, not large enough to be called open water. When frozen over, a polyna becomes an ice skylight from the point of view of the submariner. Also called BIG CLEARING, CLEARING, GLADE, ICE CLEARING, POOL, REGIONAL CLEARING.
Port	A landing place provided with terminal and transfer facilities	(used)FOR	loading and discharging cargo or passengers, usually located in a harbor.
Port	A landing place provided with terminal and transfer facilities for loading and discharging cargo or passengers, usually	locatedIN	a harbor.
Port	A landing place	providedWITH	terminal and transfer facilities for loading and discharging cargo or passengers, usually located in a harbor.
Post	A long relatively slender, and generally round	pieceOF	wood or other material.
Pump_Out_Facility	A	holding_placeWHERE	ship's bilges and cargo are pumped.
Pyramid	An ancient structure having a broad base with sides	narrowingTOWARDS	the top.
Pyramid	An ancient	structureHAVING	a broad base with sides narrowing towards the top.



**Appendix 3.** Predicate terms in Spatial Data Transfer Standard (SDTS) feature definitions.—Continued

[The data analyzed in this table is based on the SDTS standard. The text from the original documents was changed as little as possible and only for research purposes. As a result, the glossary definitions may appear to be breaking rules of grammar, but were arranged to help clarify semantic meanings. Feature type terms are listed in alphabetical order. Verbs appear in lowercase and prepositions appear in uppercase fonts. Inferred terms are presented within parentheses. --, no data]

Term	Subject	Predicate	Object
Quicksand	A bed of loose sand mixed with water	formingMASS	that yields easily to pressure.
Quicksand	A bed of loose sand	mixedWITH	water forming a soft, shifting mass that yields easily to pressure.
Racetrack	A course	laid_outFOR	racing.
Radar_Dome	A dome shaped structure	usedTO	protect the antenna of a radar installation.
Radar_Reflector	A device	capableOF, intendedFOR	reflecting radar signals.
Railway	A permanent way having one or more rails which provides a track	(used)FOR	cars.
Railway_Yard	An area provided with a system of tracks	(is)WHERE	railroad trains are made up and cars are switched, stored, or serviced.
Railway_Yard	An area provided with a system of tracks where railroad trains	areMADE_UP	--
Railway_Yard	An area provided with a system of tracks where railroad trains are made up and cars	areSWITCHED, areSTORED, areSERVICED	--
Railway_Yard	An area	providedWITH	a system of tracks where railroad trains are made up and cars are switched, stored, or serviced.
Rapids	An area of broken, fast flowing water in a stream,	(is)WHERE	the slope of the bed increases (but without a prominent break of slope which might result in a waterfall), or where a gently dipping bar of harder rock outcrops.
Rapids	An	areaOF	broken, fast flowing water in a stream, where the slope of the bed increases (but without a prominent break of slope which might result in a waterfall), or where a gently dipping bar of harder rock outcrops.
Reef	A ridge of rocks, lying near the surface of the sea, which may be visible at low tide, but is usually	coveredBY	water.
Reef	A ridge of rocks,	lyingNEAR	the surface of the sea, which may be visible at low tide, but is usually covered by water.
Reef	A ridge of rocks, lying near the surface of the sea, which may be	visibleAT	low tide, but is usually covered by water.
Refueling_Track	Airspace	designatedFOR	conducting aerial refueling.
Reserve	A tract of land	set_asideFOR	a specific use.
Restricted_Area	An area of air, land, or water	inWHICH (is)WHERE)	travel or other activities are subject to specified conditions or constraints.
Revetment	A facing, other than a wall, of stone, concrete, wood, etc.,	builtTO	sustain an embankment.
Ridge	A long and narrow upland	WITH	steep sides.
Ridge_Line	The line	SEPARATING	drainage basins.
Rig	Vertical structure	fittedFOR	drilling or lifting operations.
Road	An open way	(used)FOR	the passage of vehicles, persons, or animals on land.



**Appendix 3.** Predicate terms in Spatial Data Transfer Standard (SDTS) feature definitions.—Continued

[The data analyzed in this table is based on the SDTS standard. The text from the original documents was changed as little as possible and only for research purposes. As a result, the glossary definitions may appear to be breaking rules of grammar, but were arranged to help clarify semantic meanings. Feature type terms are listed in alphabetical order. Verbs appear in lowercase and prepositions appear in uppercase fonts. Inferred terms are presented within parentheses. --, no data]

Term	Subject	Predicate	Object
Rock	An isolated rocky formation or a single large stone, usually one constituting a	dangerTO	navigation. It may be always submerged, always uncovered, or alternately covered and uncovered by the tide.
Rock	An isolated rocky formation or a single large stone, usually one constituting a danger to navigation. It may be always	submergedBY, uncoveredBY, coveredBY	the tide.
Roundabout	--	areaOF	water subject to a routing measure restricting ship movement to a counter-clockwise direction.
Roundabout	Area of water subject to a routing measure	restrictingSHIP_MOVE-MENT	to a counter-clockwise direction.
Runway	A straight path	usedFOR	landing, taxiing, and take-off of aircraft.
Salt_Pan	An	areaOF	salt deposits.
Sea	The great	bodyOF	salt water of the oceans.
Shaft	A long narrow passage	sunkIN	the earth.
Shingle	A	collectionOF	loose pebbles on the shore of the sea or a lake.
Shingle	A collection of loose pebbles	onSHORE	of the sea or a lake.
Shipyards	A yard or	areaWHERE	ships are built or repaired.
Shore	That part of the land in immediate contact with a body of water including the	areaBETWEEN	high and low water lines.
Shore	That part of the land on immediate	contactWITH	a body of water including the area between high and low water lines.
Shore	That	partOF	the land in immediate contact with a body of water including the area between high and low water lines.
Shoreline	The	line_of_contactBE-TWEEN	a body of water and the land.
Sign	A roadway associated feature which	providesINFORMA-TION	to people passing.
Ski_Area	An area	usedFOR	skiing.
Ski_Jump	A ramp	usedFOR	ski jumping.
Snag	A stem or trunk of a tree	aboveSURFACE, belowSURFACE	of the water.
Snag	A	stemOF, trunkOF	a tree above or below the surface of the water.
Snowfield	A region of permanent snow	IN	mountainous areas or high latitudes.
Snowfield	A	regionOF	permanent snow in mountainous areas or high latitudes.
Solar_Panel	A unit of solar cells	forCONVERTING	sunlight into electrical energy or heat.
Sports_Field	A field	onWHICH	sporting activities are carried out.
Spring	The place	(is)WHERE	water issues from the ground naturally.
Spring	The place where water	issuesFROM	the ground naturally.
Stadium	Large often unroofed structure	inWHICH (is)WHERE	athletic events are held.
Stockyard	An enclosed area	inWHICH (is)WHERE	livestock are temporarily kept.

**Appendix 3.** Predicate terms in Spatial Data Transfer Standard (SDTS) feature definitions.—Continued

[The data analyzed in this table is based on the SDTS standard. The text from the original documents was changed as little as possible and only for research purposes. As a result, the glossary definitions may appear to be breaking rules of grammar, but were arranged to help clarify semantic meanings. Feature type terms are listed in alphabetical order. Verbs appear in lowercase and prepositions appear in uppercase fonts. Inferred terms are presented within parentheses. --, no data]

<b>Term</b>	<b>Subject</b>	<b>Predicate</b>	<b>Object</b>
Swash	The	massOF	broken foaming water which rushes bodily up a beach as a wave breaks. Synonymous with SEND.
Swash	The mass of broken foaming water which	rushesUP	a beach as a wave breaks. Synonymous with SEND.
Talus	Slopes of broken rock debris	(is)ON	a mountainside.
Tank	A structure	usedFOR	the storage of fluids.
Tennis_Court	A recreational area	usedFOR	playing tennis.
Terrace	A step-like feature	(is)BETWEEN	higher and lower ground: a relatively flat or gently inclined shelf of earth, backed and fronted by steep slopes or man-made retaining walls.
Terrace	A step-like feature between higher and lower ground: a relatively flat or gently inclined shelf of earth,	backedBY, frontedBY	steep slopes or man-made retaining walls.
Tidal_Gauge	An instrument	(used)FOR	measuring the height of the tide.
Time_Zone	A geographic region	withinWHICH	the same standard time is used.
Tower	A tall framework or structure, the elevation	ofWHICH	is functional.
Traffic_Separation_Scheme_Area	Area	(composed)OF	water with lanes designated to separate opposing streams of vessel traffic.
Traffic_Separation_Scheme_Area	Area of water with lanes	designatedTOseparate	separate opposing streams of vessel traffic.
Tree	A woody perennial plant, having a self-supporting main stem or trunk.	--	--
Trough	A long	depressionOF	the sea floor.
Tundra	A treeless area	poleward or upward	of the tree line of arctic or alpine regions, having a permanently frozen subsoil and supporting low-growing vegetation such as lichens, mosses, and stunted shrubs.
Tunnel	An	(is)UNDERGROUND, (is)UNDERWATER	passage.
Turning_Basin	A water area	usedFOR	turning vessels.
Turntable	A circular horizontal rotating platform	equippedWITH	a railway track, used for turning locomotives, as in a roundhouse.
Turntable	A circular horizontal rotating platform equipped with a railway track,	usedFOR	turning locomotives, as in a roundhouse.
Utility	A linear distribution system	consistingOF	pipelines, high tension wires, cables, etc., providing a public service and usually subject to government regulations.
Utility	A linear distribution system consisting of pipelines, high tension wires, cables, etc., providing a public service and usually	subjectTO	government regulations.
Valley	A long, narrow	depressionIN	the Earth's surface, usually with a fairly regular downslope.

**Appendix 3.** Predicate terms in Spatial Data Transfer Standard (SDTS) feature definitions.—Continued

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<b>Term</b>	<b>Subject</b>	<b>Predicate</b>	<b>Object</b>
Wall	An upright structure of masonry, wood, plaster, or other building material	servingTO	enclose, divide, or protect an area.
Water_Surface	The water portion of the Earth's surface,	includingSURFACE	of sea and inland waters.
Watercourse	A way or course	throughWHICH	water may or does flow.
Waterfall	A sudden	descentOVER	a step or ledge in the bed of a river.
Watering_Place	A	placeWHERE	vessels and vehicles replenish their water supply.
Well	A pit or hole dug or bored into the earth,	(used)FOR	the extraction of oil, water, other fluids or gases.
Well	A pit or hole	dugINTO, boredINTO	the earth, for the extraction of oil, water, other fluids or gases.
Wetland	A vegetated area that	is inundated or saturated by	surface or groundwater.
Wharf	A structure	extendingPARALLEL_TO	the shoreline so that vessels may lie close alongside to receive and discharge cargo.
Wharf	A structure extending parallel to the shoreline so that vessels may	lieALONGSIDE	to receive and discharge cargo.
Wind_Indicator	A visual device	usedTO	provide wind information.
Windbreak	A shelter, either natural (e.g., a line of trees or a thick hedge) or artificial (a screen), which	breaksFORCE_OF, interruptsFORCE_OF	the wind.
Windmill	A mill or other machine that runs on the energy	generatedBY	a wheel of adjustable blades or flats rotated by the wind.
Windmill	A mill or other machine that runs on the energy generated by a wheel of adjustable blades or flats	rotatedBY	the wind.
Windmill	A mill or other machine that	runsON	the energy generated by a wheel of adjustable blades or flats rotated by the wind.
Woodland	Land	havingCOVER_OF	trees, shrubs, or both.
Wreck	A wrecked vessel, either submerged or visible, which is	attachedTO, foulOF	the bottom or cast up on the shore.
Wreck	A wrecked vessel, either submerged or visible, which is attached to or foul of the bottom or	cast_upON	the shore.
Zone_Of_Occupation	An area, usually temporary,	heldBY, controlledBY	a foreign military force.

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