Bicycle Best Practices: Mapping

SALT LAKE COUNTY
PLANNING & TRANSPORTATION

The measure of an effective map is how well it conveys information to users. The best-designed maps will begin with a motive or goal as well as an understanding of the audience and where the map will be used. Design of the map will consider data availability and resources (time and equipment) available for development as well as maintenance and accessibility of the map to the intended user group.

In Salt Lake County, the intent of developing an integrated user map is to provide cyclists with information about current roadway and bikeway conditions, connections to other transportation modes, and locations of potential destinations. The County map should be easy to maintain and accessible through a variety of portals (the Internet and mobile user devices) to ensure the widest distribution.

Map Contents

An online user map can contain information about a variety of geographic features that impact the cycling experience. Though the features that are represented can vary based on the map's purpose, most existing online maps include information about the following primary features:

- Major/Minor
- Roadway classification (highway, arterial, and local)
- Administrative boundaries (city/county)
- Transit route/transit stop
- Bike facility types
- Parks
- Rivers/ponds/lakes
- Bicycle/pedestrian bridge
- School
- Trailhead

Mountain biking trails are intentionally not included in the bikeway types described in this document. It is recommended that the County first focus on urban bikeways and later include mountain biking trails when staff resources allow.

Color Palette and Symbology

A good user map will be easy to read and intuitive to navigate. Basic symbology for the primary features recommended on previous page are shown in the figure on the next page. Colors are chosen for contrast, visibility, and inherent associations (e.g. red means stop, green means go). Features that are attractions or barriers (parks, water) are complementary colors for familial grouping. Natural features are in the same saturation value range - easily visible but not obtrusive or dominant. Administrative boundaries are thick lines for ease of identification, but a subtle coloration complementary to roadways so they are not overly dominant.

Background color for jurisdictions can be white for best contrast, or an optional uniform tan color for a softer appearance that reduces glare. Highways and interstates are wide lines, but use of white on top of black makes them visible without overwhelming the map, as would happen with a wide, dark line. Arterials, which are widely-recognized for wayfinding, are moderately dark and moderate width. Local streets are thinner and lighter grey to keep the map from being overly busy. Transit, which can include rail, is a wide dashed line in a brown hue that is visible, dark, but not overly dominant.

The most dominant and visible features are the bicycle facilities. The colors are vivid and bright, and follow a spectrum of caution (yellow) to suitable (green and blue) to unusual (purple for off-street). Labels, whether for streets, parks, schools, or other facilities, should always be black for best legibility.

Portland, Oregon's citywide "Portland by Bicycle" map is a very popular map, often cited as an example of best practices in map design. It is found at: http://www.portlandonline.com/transportation/index.cfm?c=39402&a=322407

The Des Moines Bicycle Collective's Regional Trails Map also follows these principles for both the print and online versions, which are found at: http://www.dsmbikecollective.org/mapcentral

The following subsections describe the recommended specifications for bikeway mapping GIS symbology.

General

- Parks: Solid green fill, no border; RGB value 195/220/165
- River/Ponds/Lakes: Solid blue fill, no border; RGB value 160/220/235
- Administrative Boundaries: 3 pt. grey/green border; RGB value 206/220/211. Optional fill of tan color; RGB value 248/243/223
- Bike/Ped Bridge: beveled shape with white or background color fill to mask underlying linework; 1 pt. black line
- School: ESRI character, "Default Marker" font
- Trailhead: ESRI character, "US Forestry 1" font
- Major contours: 1 pt. line, round dots with a gap of 1 pt. between dots; RGB value 200/200/200
- Minor contours: 0.5 pt. line, round dots with a gap of 1 pt. between dots; RGB value 180/180/180

Roadways

- Interstate or Highway: 2 pt. white line on top of 3.5 pt black line
- Arterial: 2.5 pt. solid grey line; RGB value 150/150/150
- Local: 2 pt. solid grey line; RGB value 200/200/200

Transit

- Route: 4 pt. line, 1 pt. dash and 2 pt. gap; RGB value 130/100/30
- Stop: ESRI character, "Default Marker" font

Bicycle Facility Types

- Bike Boulevard: 3 pt. solid green line, RGB value 193/216/47
- Signed Shared Roadway: 3 pt. solid yellow line, RGB value 255/210/75
- Marked Shared Roadway: 2.5 pt. yellow/4 pt. white/5 pt. black line (yellow is same RGB value as above; under it is a white line, and under that is a black line to give a “halo” effect to the yellow line; see diagram)
- Bike Lane: 3 pt. solid green line, RGB value 66/133/76
- Buffered Bike Lanes: 2.5 pt. green/4 pt. white / 5 pt. black line (green is same RGB value as above; under it is a white line, and under that is a black line to give a “halo” effect to the green line; see diagram)
- Uphill Bike Lane/Downhill Shared Lane: 2 pt. dark green line adjacent to 2 pt. yellow line (same RGB values as above); black chevron indicates uphill direction
- Protected bike lane: 3 pt. solid blue line, RGB value 0/159/218
- Shared Use Path: 3 pt. solid purple line, RGB value 102/45/145

Relationship to Traditional Bikeway Classification

Bikeways have traditionally been categorized by the following terminology:

- Class I – off-street shared use paths
- Class II – on-street striped bike lanes
- Class III – streets designated as bike routes by signage only
- Class IV - a newer classification for separated on-street bike lanes (i.e., cycle track, protected bike lane)

Significant changes in bikeway best practices from 2000 to 2012 have greatly blurred the lines between the three traditional classes, making that classification system obsolete. For example, protected bike lanes combine the separation of a Class I facility with the on-street nature of Class II facilities. Likewise, bicycle boulevards and marked shared roadways do not fit cleanly into any of the classifications, and buffered bike lanes may be viewed as an enhanced Class II bikeway.

As advancements in the field of bikeway planning and design continue to develop, it is likely that the traditional system will lose even more of its original value. For this reason, Salt Lake County should depart from usage of this terminology and instead utilize the terminology and symbology presented herein.

Desirable User Features

A good user interface will provide more than just a map of bicycle routes across Salt Lake County. The summary of existing bicycle route finders displayed in the table below shows that some applications allow users to find transit stations, customize a route to avoid hills and busy roads, as well as log, share, and comment on recent rides.

Software Solutions and Handheld Applications

Numerous software solutions exist which can be used to successfully manage GIS data and deploy that data to the Internet. Currently, Salt Lake County utilizes ESRI’s ArcServer to provide data sharing services. Proprietary services, such as ESRI, provide consistent comprehensive functionality and software support and may be simpler to

SUMMARY OF EXISTING BICYCLE ROUTE PLANNER FUNCTIONALITY	BICYCLE ROUTES	TRANSIT INTEGRATION	HILLS	BUSY ROADS	LOG/SHARE RIDES	OTHER
Google Maps	■					
UBC Cycling Route Finder (Vancouver, BC)	■	Location of SkyTrain Stations	■	■		Vegetation, traffic pollution, truck routes, drinking foundtains
TriMet Regional Trip Planner (Portland, OR)	■	■	■	■		
Bikely			■		■	
NYC Bike Maps	■	Location of Metro Stops			■	Upload Photos
San Francisco Bike Route Planner	■		■	■		
iMap MyRIDE Riding Cycling GPS	■				■	

implement, but are more costly to maintain than open source solutions. The use of proprietary versus open source software is a decision that has to be constantly evaluated in any software project.

Proprietary Software Solutions

Proprietary solutions, in this case ESRI, have the benefit of a single company backing the product, providing support (for fees) and continuing upgrades. They also usually guarantee their product to work based on what it can offer. These products always cost much more money than open source solutions through licensing, upgrades, and support fees.

ESRI software is widely used across the US despite its high cost. It provides good tools for editing GIS data in the form of their desktop applications and solid web support. Recent ESRI advancements include the ability to create streaming map services that can be accessed by desktop and mobile devices utilizing ArcGIS online[1].

In summary, proprietary solutions can be a great decision if the budget can allow for it, the product functionality satisfies the requirements, and the solution is appropriately scoped. Also, the client purchasing the software needs to be comfortable with the End User License Agreement (EULA) that the company provides for their software. They have to acknowledge that they are paying for a product that another company owns and has the exclusive rights to modify, which is usually not the case with open source.

Open Source

Open source software has come a long way for many technology sectors in recent years, especially in the GIS and web mapping worlds. Open source projects provide a synergistic benefit – everyone gets to use code that others have improved for their own projects. The biggest benefit of open source software is zero licensing cost. However, costs are still involved in building and maintaining the system. In addition to licensing savings, open source software products can be easier to maintain with the right hired personnel that know the technology well. Also, knowledgeable staff can easily make incremental upgrades to the system as it changes over time.

One company of note, called Development Seed, is based in Washington, D.C.[2] They do web mapping projects for international development uses and have a very impressive set of GIS and web mapping tools with open source code for all to use. They have a toolset known as MapBox that provides functionality similar to ESRI. However, features would need to be evaluated to see if they would provide the functionality the County needs.

1 http://help.arcgis.com/en/arcgisdesktop/10.0/help/index.html#/What_is_ArcGIS_online/00v200000014000000/

2 http://developmentseed.org/

In summary, open source software deserves serious consideration for cost reasons, the ability to decide how the software should work, and the benefit of a community of users around the world that are using and improving the software, resulting in a quality product. Open source solutions are usually a bit more technically complex because of the types of integration required to make the system function as a whole. Proprietary systems are usually (but not always) easier to implement due to the fact that these companies commit resources into installer programs and sometimes even offer their own staff to assist in implementing their product for you, although such services may cost additional money. Most modern-day web development firms utilize open source technology for the work they do, so the County will not have a hard time finding appropriate talent to maintain an open source product, especially if the products are widely used around the world (and thus more mature and stable).

Integrated vs. Piecemeal Systems

Another noteworthy question is whether web mapping will be served from a single integration application or through smaller piecemeal web mapping services. An open source example of integrated services is Virtual Charlotte, which provides planning data for a multi-county area with support from multiple developers[3]. A proprietary example of integrated services is UDOT's uPLAN system, running on ESRI's ArcServer, which was originally built to support the long-range transportation planning process and now acts as a decision support and cost-benefit analysis tool for several government agencies[4].

A number of free open source applications can easily be embedded into an existing website on a piecemeal basis. These systems can be used to create ad hoc or single purpose maps (e.g. to display bicycle crash locations). They are easily embedded within a website and do not require a high level of technical proficiency, but provide limited functionality. Commonly used sites include:

- Geocommons: http://geocommons.com/
  - Provides a wide range of functionality and has public datasets available for use. Menus and map legends are easy to read.
- Batch Geo: http://www.batchgeo.com/
  - Good service for online geocoding of GIS information, but has limited functionality.
- ZEEmaps: http://www.zeemaps.com/
  - Wiki maps for crowd-sourcing. Free service has ads, but is easy to use.

Handheld Applications

Handheld applications for mobile devices can enhance the depth and breadth of the user experience. Well designed applications can augment more traditional data sources such as printed system maps, update quickly and at low cost to provide the newest information, and collect data from users to enhance the bicycle planning process. The county or other users may develop applications if the data are made available to the public.

Functionally good applications are stable and reliable, consistent with the platform (Android or iPhone), load quickly, and provide ad-free service.

Examples of useful applications include:

- Route recording and workout:
  - MapMyRide: http://www.mapmyride.com/
  - Move! Bike Computer
- Route Finding:
  - City of Calgary Bikeways and Pathways: http://www.calgary.ca/CS/ CSC/Pages/Mobile-Apps.aspx
- Bicycle Rental (Bike Share):
  - Telofun: http://www.amazon.com/Nur-ne-Telofun/dp/B0058P3W3Y/ref=sr_1_7?ie=UTF8&s=mobile-apps&qid=1325122729&sr=1-7

Resources

Objective

The objective is to provide standards for GIS data being submitted to the Bicycle Best Practices Plan. Specifically, this standard is for agencies responding to directives where it is required that data is to be delivered to the custodian of BBP geodatabase.

Datum, Projection and Domain Extent

- All data must be submitted in NAD_1983_StatePlane_Utah_Central_FIPS_4302_Feet
- Geographic Coordinate System: GCS North American 1983
- Map Projection: Lambert Conformal Conic (Spheroid GRS_1980)
- The domain extent of the data frame in Feature Class Properties should be as follows:

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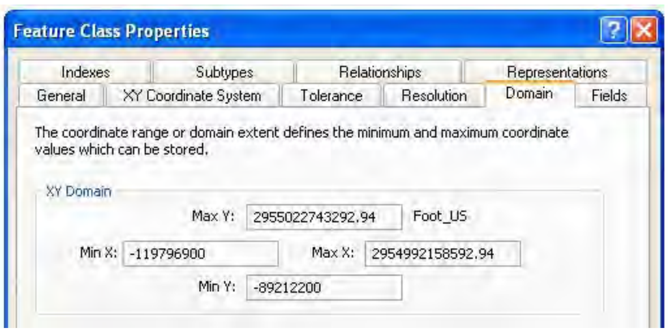
3 http://vc.charmeck.org/.
Additional information describing the system development is found here: http://www.directionsmag.com/webinars/view/webinar-virtual- charlotte-boosting-city-services-with-google-maps/206025.

4 http:// uplan.utah.gov/
Additional information about the system's development is found here: http://www.westernite.org/Sections/intermountain/slides/19.pdf and here: http://blog.udot.utah.gov/2010/06/planning-made-simpler/.

Data Format

Two acceptable formats are available for data submissions:

1) ESRI feature classes within a file geodatabase
   - Two or more feature classes must be formatted within a feature dataset.
   - Shapefiles are not allowed.
2) Autodesk AutoCAD DWG format that meets MMCD standards
   - This option is for engineering data only.



Data Standards

Feature Classes

- All feature class names must be mixed case and have a maximum length of 32 characters (emergencyPlanning).
- All feature datasets must have unique names.
- File geodatabases and other GIS related files should include a date of creation/revision. See date guidelines listed below.

Attribute Fields

- Attribute fields may not be named using a reserved word. See Appendix A, SQL Reserved Words.
- Names must be less than 20 characters.
- Names cannot contain spaces or symbols.
- Names should be in mixed "camel" case (e.g. pathType).

Relationships

Database and linked annotation should use an "rl" prefix so that they indicate they contain a relationship as well; they will be grouped together. The full syntax should be "rl" , [the source feature class], "Has" , [the destination feature class]. For example, an annotation class named wiPathAnno2010 which has a linked relationship to wiPathMain should read "rlwiPathMainHaswiPathAnno2010".

Standard Attribute Fields

When applicable, these fields should be included in each bike route feature class:

- **OID (Object ID)**[5]
- **shape**[5]
- **shape_length**[5]
- **city** (string) 20 character field identifying the city in which the feature lies.
- **comm** (string) 20 character field identifying the SLCo community council with decision-making authority over the feature.
- **township** (string) 20 character field identifying the unincorporated SLCo township in which the feature lies.
- **source** (string) 20 character field identifying the original source of the data.
- **editor** (string) 20 character field identifying the most recent editor of the data.
- **editDate** (date) Date field identifying the day of the most recent edit. (mm-dd-yyyy)
- **permUse** (string) 30 character field identifying the permitted uses of the trail. As this will be a searchable field, it is critical that similar uses are always entered identically for ease in selection. Only enter these standard singular field values in camel case. (Example: offHighwayVehicle)
  - *pedestrian*
  - *equestrian*
  - *bicycle*
  - *offHighwayVehicle*
  - *winterUse*
  - *snowmobile*
- **type** (string) 50 character field identifying the bikeway type as defined in the SLCo Bicycle Best Practices, pp. 19-20.
  - *sharedRoadways (marked & signed)*
  - *bikeLanes (standard & buffered)*
  - *cycleTracks (street-level & raised)*
  - *sharedUsePaths (marked & signed)*
- **jurisdict** (string) 20 character field identifying the entity responsible for the upkeep of the segment. (City, County, Municipal, State, University, Unknown)
- **existing** (1 short integer)
  - *0 = FALSE: proposed / planned trail*
  - *1 = TRUE: existing trail*
- **notes** (string) 250 character field displaying any questions, comments or concerns about the segment.
- **name** (string) 50 character field identifying the trail name

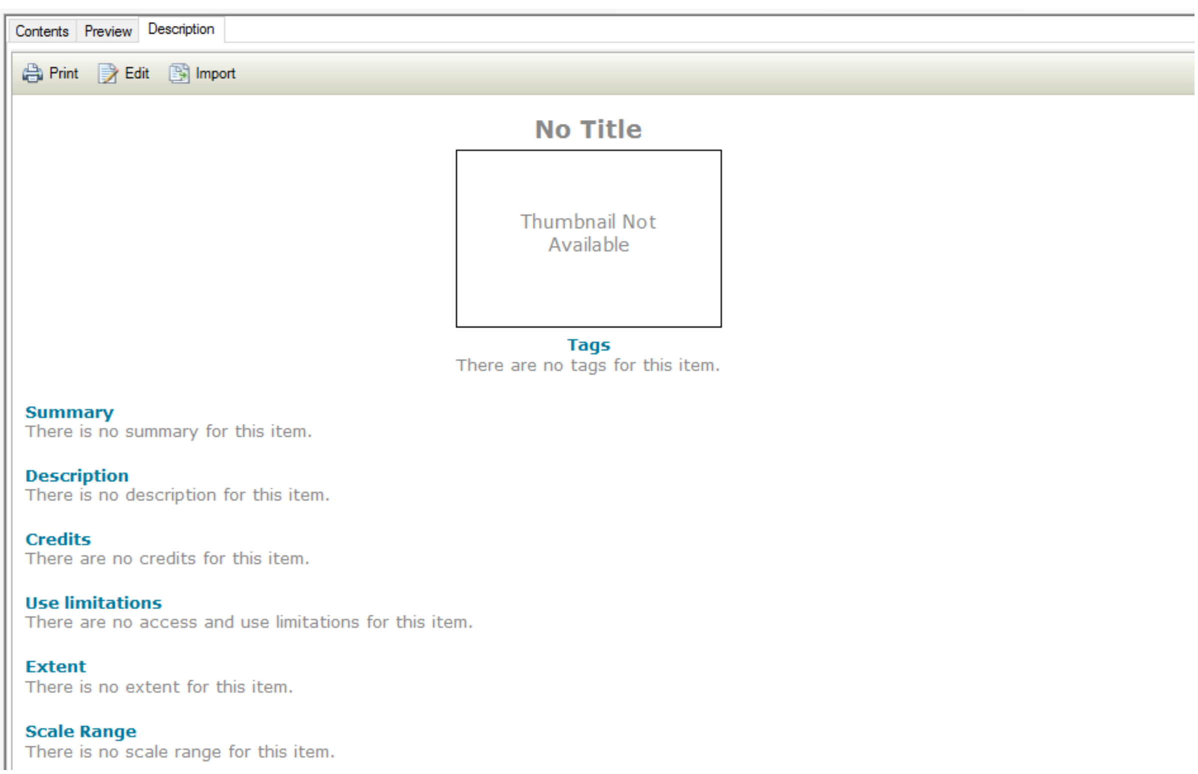
5 Default attributes automatically assign to features by ArcGIS

of the segment.

- **bikLanWdth** (integer) 2 character field identifying the bike lane width in feet.
- **connGap** (string) 1 character field identifying a binary relationship (Y/N). A record with a "Y" designation is a non-bikeway segment added to complete / connect a bicycle route.
- **class** (integer) 1 character field identifying the Traditional Bikeway Classification types as defined on page 2
- **roadName** (string) 35 character field identifying the name of the street the segment is on.
- **roadSpeed** (integer) 2 character field identifying the road speed limit in miles per hour.
- **roadComm** (string) 1 character field identifying a binary relationship (Y/N). A record with a "Y" designation indicates a road with heavy commercial traffic.
- **vehLnNum** (integer) 1 character field identifying the number of lanes on the road.
- **vehLnWdth** (integer) 2 character field identifying the lane width in feet.
- **vehLnDir** (string) 10 character field identifying lane direction. (One way, Two way)
- **vehLnType** (string) 25 character field identifying the type of vehicular road. (Highway, Residential, Arterial.)
- **maintainer** (string) 35 character field identifying the agency responsible for maintaining the bike route segment.
- **installYr** (integer) 4 character field identifying the year of bike route installation.
- **installOrg** (string) 35 character field identifying the organization that installed the bike route segment.
- **roadAADT** (integer) 4 character field identifying the measured annual average daily traffic of the road.
- **surfType** (string) 25 character field identifying the material that makes up the surface of the bikeway. (concrete, asphalt, gravel, wood)

Metadata

Please use the standard metadata format for GIS data as provided by ArcGIS. This information can be supplied in ArcCatalog. Ensure that each field is completely filled for easy reference.



Appendix A - SQL 2005 Reserved Words

Microsoft SQL Server uses reserved keywords for defining, manipulating and accessing databases. Reserved keywords are part of the grammar of the Transcript-SQL language that is used to parse and understand statements and batches. The following table lists SQL Server and ODBC reserved keywords that may not be used in any GIS data created for the Bicycle Best Practices.

Absolute	Count	Foreign	Merge	Read	Top
Action	Create	Fortran	Min	Readtext	Trailing
Ada	Cross	Found	Minute	Real	Tran
Add	Cross	Freetext	Module	Reconfigure	Transaction
All	Current	Freetexttable	Month	References	Translate
Allocate	Current_Date	From	Names	Relative	Translation
Alter	Current_Time	Full	National	Replication	Trigger
And	Current_Timestamp	Function	Natural	Restore	Trim
Any	Current_User	Got	Nchar	Restrict	True
Are	Cursor	Global	Next	Return	Truncate
As	Database	Go	No	Revert	TSequal
Asc	Date	Goto	Nocheck	Revoke	Union
Assertion	Day	Grant	Nonclustered	Right	Unique
At	Dbcc	Group	None	Rollback	Unknown
Authorization	Deallocate	Group	Not	Rowcount	Unpivot
Avg	Dec	Having	Null	Rowguidcol	Update
Backup	Decimal	Holdlock	Nullif	Rows	UpdateText
Begin	Declare	Hour	Numeric	Rule	Upper
Between	Default	Identity	Octet_Length	Save	Usage
Bit	Deferrable	Identity_+Insert	Of	Schema	Use
Bit_Length	Deferred	Identitycol	Off	Scroll	User
Both	Delete	If	Offsets	Second	Using
Break	Deny	Immediate	On	Section	Value
Browse	Desc	In	Only	Securityaudit	Values
Bulk	Describe	Include	Open	Selet	Varchar
By	Descriptor	Index	Opendatasource	Session	Varying
Cascade	Diagnostics	Indicator	Openquery	Session_User	View
Cascaded	Disconnect	Initially	Openrowset	Set	WaitFor
Case	Disk	Inner	Openxml	Setuser	When
Cast	Distinct	Input	Option	Shutdown	Whenever
Catalog	Distributed	Insensitive	Or	Size	Where
Char	Domain	Insert	Order	Smallint	While
Char_Length	Double	Int	Outer	Some	With
Character	Drop	Integer	Output	Space	Work
Character_length	Dump	Intersect	Over	Sql	Write