Bicycle Facility Data Elements for a Statewide Inventory

By:
Michael Lowry,
Bruce Godfrey,
Heather Green, and
Taylor Rogers

University of Idaho

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16. Abstract

ITD and community partners need to know where bicycle facilities currently exist throughout Idaho to help identify safety concerns, plan new facilities, prioritize projects, and manage non-motorized transportation. This report describes more than 100 data elements about bicycle travel that ITD could potentially collect and archive. The research team reviewed manuals and guidebooks and contacted neighboring state DOTs to gather information about the state-of-the-practice. Key data elements to calculate level of service are described including high priority data elements that ITD could immediately begin collecting for the State Highway System. This report also introduces three example database products that were created for ITD to help define, collect, and share important bicycle data. The first product is a video and classification chart that ITD can use to define bicycle facilities. The second product is an online database and data sharing platform called the *Bicycle Information Map*. The third product is an online story map for US Bicycle Route 10 that recreational cyclists can use to get information about towns they will pass through and riding conditions along the route.

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List of Acronyms

AASHTO	American Association of State Highway and Transportation Officials
ADA	Americans with Disabilities Act
BCI	Bicycle Compatibility Index
BEQI	Bicycle Environmental Quality Index
BLOS	Bicycle Level-of-Service
BSIR	Bicycle Safety Index Rating
BSL	Bicycle Stress Level
BSA	Bicycle Suitability Assessment
BSR	Bicycle Suitability Rating
BSS	Bicycle Suitability Score
BQI	Bicycle Quality Index
COMPASS	Community Planning Association of Southwest Idaho
CRC	Compatibility of Roads for Cyclists
DOTs	Departments of Transportation
FHWA	Federal Highway Administration
GIS	Geographic Information Systems
HCM	Highway Capacity Manual
HPMS	Highway Performance Monitoring System
ITA	Idaho Technology Authority
ITD	Idaho Transportation Department
HIS	Hazard Interaction Score
INSIDE Idaho	Interactive Numeric and Spatial Information Data Engine
MUTCD	Manual on Uniform Traffic Control Devices
MPO	Metropolitan Planning Organization
MIRE	Model Inventory of Roadway Elements
NACTO	National Association of City Transportation Officials
RCI	Road Condition Index
RBCI	Rural Bicycle Compatibility Index
UNC	University of North Carolina

Executive Summary

Project Overview

The Idaho Transportation Department's (ITD) Strategic Highway Safety Plan aims to have the safest transportation system possible for all users of Idaho´s roadways, including bicyclists. To achieve ITD's safety goal, it is essential to have information about bicycle travel, such as what and where facilities exist throughout the state. An inventory of facilities can help ITD and community partners identify safety concerns, plan new facilities, prioritize projects, and manage the existing system.

The objectives of this project were to:

Objective 1. Identify the datasets related to bicycle facilities that would provide value to the State for making informed planning and programming decisions.

Objective 2. Collect bicycle facility inventory data on the Idaho State Highway System.

This Executive Summary summarizes what was done ("Work Completed") and what was discovered ("Findings, Results, and Recommendations") for each objective.

Objective 1: Datasets related to bicycle facilities

Work Completed

The research team reviewed various manuals and guidebooks related to bicycle facilities to identify datasets that would provide value to the State for making informed planning and programming decisions.

One noteworthy publication from the Federal Highway Administration (FHWA) is the *Model Inventory of Roadway Elements* (MIRE). MIRE provides recommendations to state departments of transportation (DOTs) about which data elements should be collected and how they should be defined and organized. The MIRE recommendations include a handful of data elements that are relevant to bicycle travel. For example, Figure ES-1 shows data elements 40 and 41 which are not currently collected by ITD.

The MIRE data elements are merely *recommendations* from FHWA and few, if any, state DOTs collect all 202 data elements. However, FHWA requires all state DOTs to collect a smaller list of data elements for certain roadway types as part of the *Highway Performance Monitoring System* (HPMS). The HPMS data items are a subset of MIRE with equivalent or nearly equivalent definitions and attributes.

40. Presence/Type of Bicycle Facility

Definition: The presence and type of bicycle facility on the segment.

Attributes:

- None
- Wide curb lane with no bicycle markings
- Wide curb lane with bicycle markings (e.g., sharrows)
- Marked bicyle lane
- Separate parallel bicycle path
- Signed bicycle route only (no designated bicycle facility)
- Other

41. Width of Bicycle Facility

Definition: The width of the bicycle facility; either the width of the marked bicycle lane or bicycle path.

Attributes:

- Feet

Figure ES-1. MIRE Data Elements for Bicycle Facilities

We identified 67 MIRE elements that are relevant to bicycle travel and cross-referenced the definitions with HPMS items. Then, working with ITD staff, we verified which items are currently collected by ITD and to what extent.

Next, we identified the data elements required to calculate level-of-service (LOS) for bicycle facilities. LOS is a rating system used by transportation professionals to help plan, evaluate, and operate transportation facilities. ITD commonly uses Automobile Level-of-Service to evaluate highway segments and signalized intersections. The *Highway Capacity Manual* (HCM) provides a set of equations for calculating Bicycle Level-of-Service (BLOS) based on roadway characteristics, such as vehicle volumes, speed limit, and bike lane width. The HCM equations produce letter grades A through F, where F represents a facility with undesirable conditions. Twenty-four data elements are required to use all of the HCM equations for BLOS. Five of these data elements are not part of MIRE so we added them to our list of potential data elements.

We also gleaned additional data elements from design manuals, such as the recent *Urban Bikeway Design Guide* by the National Association of City Transportation Officials (NACTO). We identified which data elements are commonly used for safety analysis in the *Highway Safety Manual* (HSM).

Furthermore, we searched the internet for examples of bicycle inventories and contacted data specialists at neighboring state DOTs, Metropolitan Planning Organizations (MPOs), and cities. Finally, we added data elements to our list that were suggested by members of the Technical Advisory Committee (TAC) for this project. The list was sent via email to each member and also presented at a meeting held at ITD headquarters in Boise.

Findings, Results, and Recommendations

Information relevant to bicycle travel can be organized into seven categories:

1. Roadway characteristics (e.g. vehicle volumes, speed limit, shoulder width)
2. Facilities (infrastructure and paint markings, e.g. paths, special traffic signals, bike lanes)
3. Route designations (e.g. US Bicycle Routes, local snow removal routes, scenic byways)
4. Amenities (e.g. bike racks, retail stores, information kiosks)
5. Demand (e.g. volume counts)
6. Safety (e.g. crashes and near misses)
7. Geographic and environmental conditions (e.g. prevailing wind, weather, topography)

We created a list of more than 100 data elements from all seven categories (see Appendix B). ITD is already collecting and archiving some of these data elements and could potentially begin to collect more. ITD collects crash data (safety category) and a significant amount of roadway characteristics, although mostly for roads that have a high functional classification and are part of the State Highway System.

We calculated the percent of roadway miles for which ITD collects the roadway characteristic data elements that are required to calculate BLOS. The findings are shown in Table ES-1. Many road segments are missing one or two required data elements. Only about 17% of the roadway miles in Idaho have sufficient GIS-archived ITD data to calculate BLOS.

Table ES-1. Percent of roadway miles with GIS-archived ITD data

Roadway Characteristic	Interstate (%)	Freeways and Expressways (%)	Principal Arterial (%)	Minor Arterial (%)	Major Collector (%)	Minor Collector (%)	Local Street[a] (%)
Vehicle volumes	100	92	98	96	92	75	3
Speed limit	100	69	84	57	16	<1	<1
Number of lanes	100	82	86	58	16	<1	<1
Width of lane	100	82	86	58	16	<1	<1
Width of shoulder	100	82	86	58	16	<1	<1
Pavement rating	100	82	86	58	16	<1	<1
Parking regulation	100	59	31	49	15	<1	<1

[a] Roads in urban areas that have not been given a functional classification by ITD.

Yet, while all of the data elements in Appendix B are important, it may not be sensible for ITD to collect all of them everywhere. For example, some roadway characteristics can be reasonably estimated rather than collected. For some data elements estimated values can be used to calculate an approximate BLOS value that can still be meaningful and useful for some engineering and planning purposes. Vehicle volume, speed limit, and bicycle facility width are the most critical data elements in the BLOS equation. However, for some planning purposes, all that is needed is an “order of magnitude” estimate. For vehicle volume this means determining if the daily traffic volume is very high (more than 15,000 vehicles per day), high (7,000 to 15,000 vehicles per day), moderate (2,000 to 7,000 vehicles per day), or low (less than 2,000 vehicles per day). For speed limit, a rough estimate is high (more than 40 mph), moderate (30 mph to 40 mph), or low (less than 30 mph).

With rough estimates for vehicle volume and speed limit and data about bike facility width, other roadway characteristics like lane width and pavement condition have very little impact on BLOS. In fact, for most street segments with low speed and low vehicle volumes (25 or 30 mph and less than 2,000 AADT) the equation will produce a BLOS score equal to “A” or “B” regardless of the other roadway characteristics. Vehicle volume and speed limit can often be estimated based on functional classification. Thus, the truly critical data element that ITD does not collect, and which cannot be estimated, is knowing if a bicycle facility is present, the type of facility, and its width.

Likewise, it might not be sensible for ITD to collect and archive data concerning bicycle amenities. This data category includes knowing if there is a nearby bike rack, bike fix-it station, picnic table, drinking fountain, public art, informational kiosk, and bike retail stores. Most of these are local assets and catalogued by local agencies. In the case of retail stores, internet search engines such as Google can provide efficient and updated data.

Geographic and environmental conditions also might not be sensible for ITD to collect and archive. Information about topography (hills and summits) and geographic features (rivers and lakes) can be very helpful for bicyclists when conducting trip planning, but ITD can merely provide this information as a GIS “base layer” that sits underneath other, more specific bicycle data. Likewise, there are many well-established online database for weather and prevailing wind.

We recommend ITD focus on collecting and archiving:

- Roadway characteristics – only the data elements that are needed for safety analysis and capacity analysis as defined in the HSM and HCM, respectively (specifics listed in next section)
- Facility data – presence, type, and width of bicycle facilities (including off-street shared-use paths)
- Route designations – only those of statewide significance such as US Bicycle Route (USBR) and Scenic Byways
- Demand –Location of permanent continuous count machines and short-duration manual counts, Annual Average Daily Bicyclists (AADB)
- Safety – Crash data involving bicyclists

The next section describes example databases that were created to demonstrate how key data elements for bicycling can be made available online for use by ITD staff, community partners and the public.

Objective 2: Data on the Idaho State Highway System

Work Completed

We created three products to demonstrate collection and archiving of bicycle data on the State Highway System. The first product is a video and chart that ITD can use to define bicycle facilities for design, implementation, and inventory. The next two products are example databases that ITD can use to share data internally and with community partners and the public. The three products are:

- Instructional Video and Chart for Bicycle Facility Classification
- Bicycle Information Map Webpage
- Online Story Map for USBR 10

Findings, Results, and Recommendations

Instructional Video and Chart for Bicycle Facility Classification

We recommend ITD begin collecting information about bicycle facilities by integrating MIRE elements 40 and 41 into ITD´s HPMS data collection process (see Figure ES-1). Next we recommend ITD adopt a bicycle facility classification system as has been done in other states. Examples are shown in Figure ES-2.

- Class I: Off-street Pathway
- Class II: Protected Bike Lane
- Class III: Bike Lane
- Class IV: Bicycle Street

Class I: Pathway

Class II: Protected Bike Lane

Class III: Bike Lane

Class IV: Bicycle Street

Figure ES-2. Bicycle Facility Classification

We created an instructional video to help explain the history, benefits, and rational for establishing a bicycle facility classification system. Figure ES-3 shows a screenshot of the video which can be found online at: https://youtu.be/28V5BrA0PI8 Furthermore, we created the chart shown in Figure ES-4 to help ITD and community partners determine the most appropriate bicycle facility for a given level of traffic volume and speed limit.

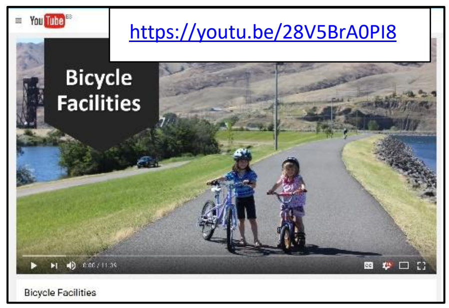


Figure ES-3. Instructional video about bicycle facility classification

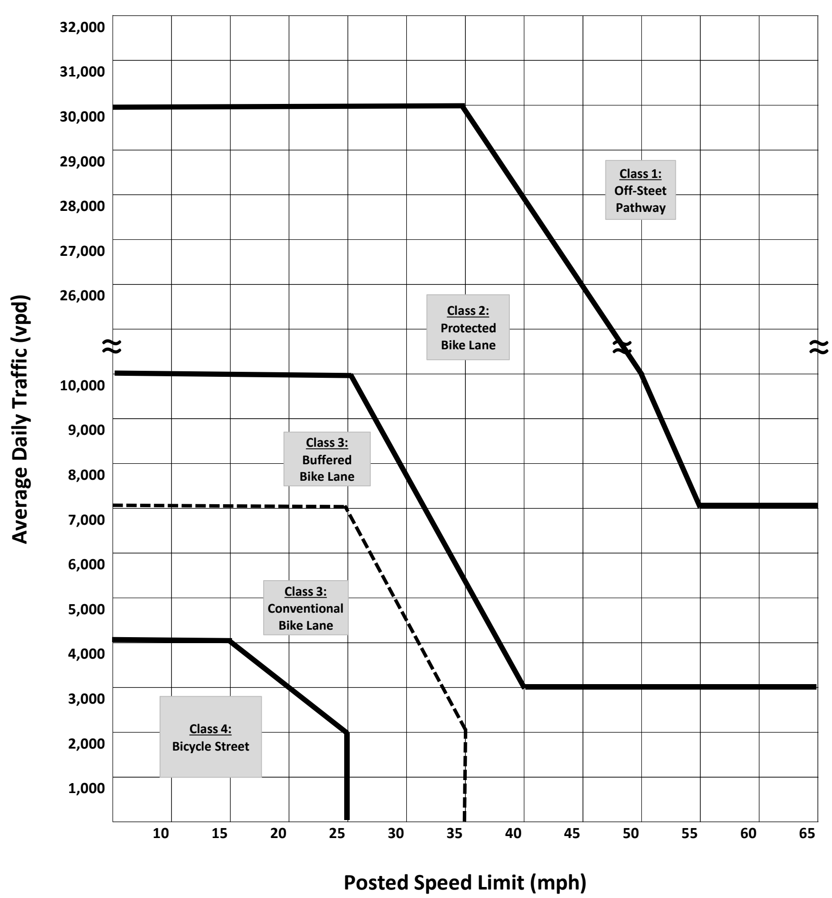


Figure ES-4. Chart for determining the most appropriate bicycle facility

Bicycle Information Map Webpage

We created the *Bicycle Information Map* to be ITD´s online database (inventory) for bicycle data. The map provides various GIS layers that can be turned on and off. A screenshot is shown in Figure ES-5.

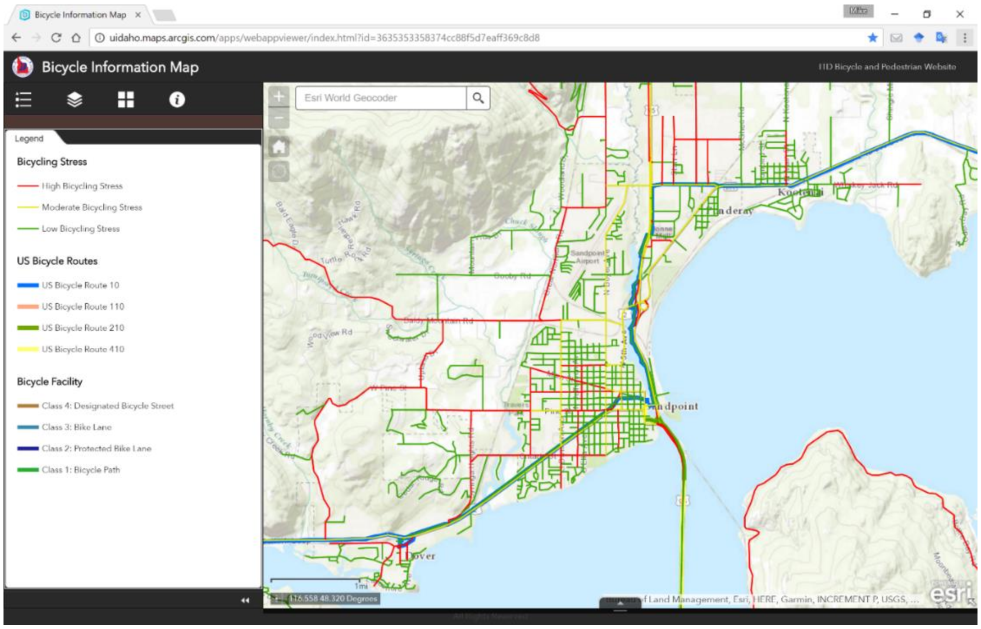


Figure ES-5. Bicycle Information Map

The geodatabase that underlies the *Bicycle Information Map* has three feature classes (See Appendix A for definitions of GIS terms such as feature class and field). Figure ES-6 shows the structure of the geodatabase. The data elements (fields) in the two DATA feature classes are exactly the same and are listed in Table X. The EXISTING_DATA comes from an ITD GIS repository located here: http://gis.itd.idaho.gov/arcgisprod/rest/services/ArcGISOnline/IdahoTransportationLayers/MapServer

For EXISTING_DATA, if ITD does not have data for a street segment, then the field value is "Null". In ESTIMATED_DATA the "Null" values are replaced with estimated values. Appendix C describes the process for estimating values.

The geodatabase can be downloaded from the website or accessed via a REST API.

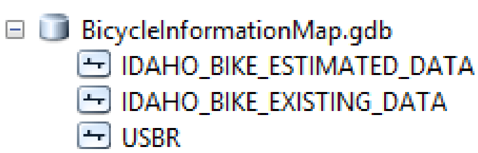


Figure ES-6. Geodatabase for the Bicycle Information Map

Table ES-2. Data elements in Bicycle Information Map

Id	Field	Description
1	SegCode	ITD's segment code[a]
2	USBR	US Bicycle Route[b]
3	Scenic	Idaho Scenic Byway[a,b]
	ScenicName	Idaho Scenic Byway Name[a]
4	Context	Urban or Rural[a]
5	Func_ID	FHWA's functional class ID[a]
6	Func	FHWA's functional class name[a]
7	Highway	Indicator as highway[a]
8	Terrain	Flat, Rolling, or Mountainous[a]
9	AADT	Annual Average Daily Traffic[a]
10	CAADT	Commercial AADT[a]
11	HV	Percent heavy vehicle CAADT/AADT[a]
12	K	Design hour K-factor
13	D	Design hour directional split
14	v	Design hour volume[a]
15	PHF	Peak Hour Factor
16	S	Speed limit[a]
17	Nth	Number of through lanes in one direction[a]
18	Wol	Width of the outside lane[a]
19	Wos	Width of the paved shoulder, including parking[a]
20	c	Presence of curb
21	Pc_text	Pavement condition text rating[a]
22	Pc	Pavement condition numeric rating[a]
23	pk	Parking regulation[a]
24	ppk	Proportion of on-street parking blockage
25	Bike_Class	Bicycle class
26	Wbl	Width of the bike lane
27	AADT_Cat	AADT category[a,b]
28	HV_Cat	Heavy vehicle category[a,b]
29	Speed_Cat	Speed limit category[a,b]
30	Wos_Cat	Highway paved shoulder category[a,b]
31	BLOS_Score	Bicycle level of service[a,b]
32	BLOS_Cat	Bicycle level of service category[a,b]
33	Stress_Cat	Stress level category[a,b]
34	Comment	"All values are based on ITD data." or "Some values were estimated."

[a] Data obtained or derived from:
http://gis.itd.idaho.gov/arcgisprod/rest/services/ArcGISOnline/IdahoTransportationLayers/MapServer
[b] Used for map layer.

ITD already archives most of the data elements in Table ES-2 for the State Highway System, and even provides a web map for much of this data as part of IPLAN. Thus, the intent of the *Bicycle Information Map* is to

1. consolidate all relevant bicycle information into a single database,
2. establish a repository for bicycle data elements that ITD does not currently archive, but might begin collecting in the future, and
3. provide map layers and layer categories that are specific to bicycling.

As part of this project we created an innovative process to extract bicycle facility data throughout Idaho from *Open Street Map* (OSM). OSM is a free online world map comprised of “crowdsourced” data, i.e. people create and edit the map similar to Wikipedia. We wrote Python computer code that (1) connects to the OSM database and (2) downloads bicycle facility data for any Idaho community for which ITD does not have local data (for example, since Ada County Highway District has given ITD local data, then ACHD´s data negates the need for OSM data).

The Python computer code for extracting OSM data and all the other computer code needed to create the *Bicycle Information Map* is found in Appendix D with annotation. We recommend ITD add the *Bicycle Information Map* to IPLAN and run this Python script on the same schedule of ITD´s other scripts that update the maps and layers of IPLAN.

Bicycling Stress
- High Bicycling Stress
- Moderate Bicycling Stress
- Low Bicycling Stress

US Bicycle Routes
- US Bicycle Route 10
- US Bicycle Route 110
- US Bicycle Route 210
- US Bicycle Route 410
- Us Bicycle Route 210 and 410

Scenic Byway
- Idaho Scenic Byway

Bicycle Facility
- Class IV: Bicycle Street
- Class III: Bike Lane
- Class II: Protected Bike Lane
- Class I: Off-street Pathway

Daily Vehicle Traffic
- Very high vehicle traffic (More than 15,000 per day)
- High vehicle traffic (7,000 to 15,000 per day)
- Moderate vehicle traffic (2,000 to 7,000 per day)
- Low vehicle traffic (Less than 2,000 per day)

Large Truck Traffic
- High truck traffic (More than 10%)
- Moderate truck traffic (5% to 10%)
- Low truck traffic (Less than 5%)

Vehicle Speed Limit
- High vehicle speeds (More than 40 mph)
- Moderate vehicle speeds (30 mph to 40 mph)
- Low vehicle speeds (Less than 30 mph)

Highway Shoulder Width
- No paved shoulder
- Narrow paved shoulder (Less than 4 feet)
- Moderate paved shoulder (4 to 6 feet)
- Wide paved shoulder (More than 6 feet)

Bicycle Level of Service
- F
- E
- D
- C
- B
- A

Figure ES-7. Layers for the Bicycle Information Map

Online Story Map for USBR 10

We created the *U.S. Bicycle Route 10 – Idaho* Story Map for ITD. It is primarily intended to serve as a resource for those considering riding the route. Users of the story map are provided information about towns they will pass through along the route, services available in those towns, riding conditions along the route (e.g. shoulder width, speed limit), and directions to navigate the route. The application can be accessed using a web browser on a desktop computer or mobile device.

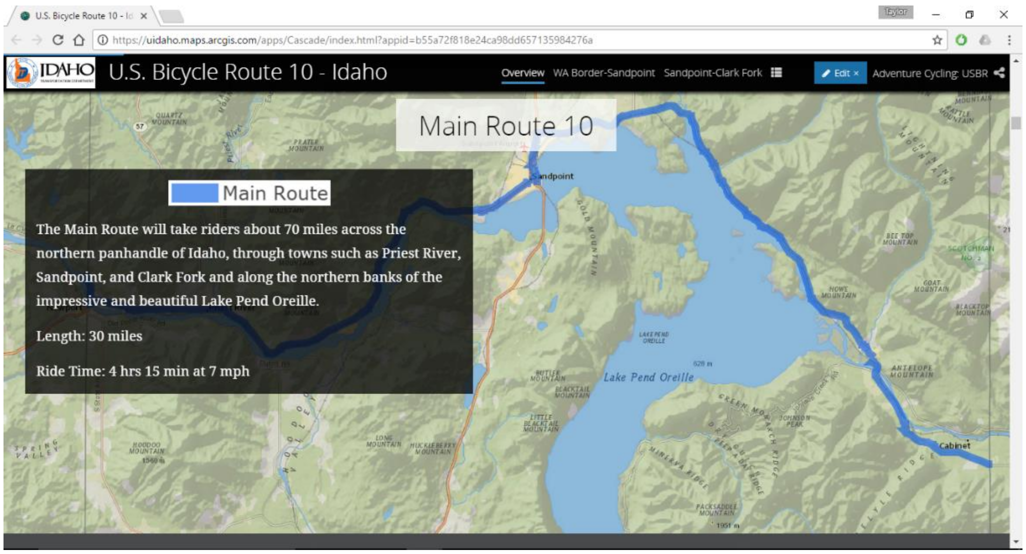


Figure ES-8. U.S. Bicycle Route 10 – Idaho Story Map

U.S. Bicycle Route 10 – Idaho is divided into different “chapters” that are webpage sections with themed information. The first chapter, *Overview*, gives a brief description of USBR 10 through Idaho, enticing the user to continue through the application. Then the user begins the chapters for each route. The first three chapters describe individual sections of the Main Route (the Washington border to Sandpoint, Sandpoint to Clark Fork, and Clark Fork to the Montana Border). These are followed by chapters for Alternate Route 210, Alternate Route 410, and Spur Route 110 respectively.

Each chapter begins with a map of the route section, navigation instructions to guide the rider, and an elevation profile to help riders determine the change in elevation. For each section, the route is described in terms of length in miles, ride time, and what the riders can expect to see. Each town is highlighted with a paragraph describing it and enticing the rider to spend some time there. A link is provided with to a PDF containing pertinent services to riders that they will find in each town. These “Services” PDFs contain live links to the Google Maps location of each service so that riders can easily locate them.

After the towns have been highlighted, metrics for the section are laid out for riders to know more about the route before riding it. These metrics are Traffic Volume, Speed Limits present, and Shoulder Width. Finally, each section ends with a YouTube video of a Google Earth fly-over to give the riders a bird’s eye view of their ride before leaving.

Conclusions

The findings of this project and all electronical files (charts, videos, computer code, geodatabases, and web-map applications) have been provided to ITD. These tools can help ITD to define, collect, and share important bicycle data.

This report lists and describes more than 100 potential data elements about bicycle travel that ITD could potentially collect and archive. The research team reviewed manuals and guidebooks related to bicycle facilities and contacted neighboring state DOTs to gather information about the state-of-the-practice. The Federal Highway Administration (FHWA) has recommended that state DOTs begin collecting some of these data elements as part of the MIRE initiative (See Chapter 2 for more information about MIRE). The attributes recommend in this report could be used by ITD and partners to conduct Level of Service Analysis using the HCM, safety analysis using the HSM, and provide useful information for tourism and commuter bicycling.

This project created three example database products. The first product is a video and classification chart that ITD can use to define bicycle facilities. Before adopting the classification system, ITD might want to conduct stake holder meetings with engineers, planners, bicycle advocates, community leaders, and the general public. Such meetings might improve and refine the class names, definitions, and speed-volume thresholds. The second product is an online database and data sharing platform called the *Bicycle Information Map*. This database can be used by ITD for data storage, visualization, and inventory. The process of updating and creating the map is completely automated through computer code that connects to existing ITD GIS databases. An important innovation of the computer code is the ability to extract Open Street Map data for bicycle facilities everywhere in the state for which ITD does not have local data. The third product is an online story map for US Bicycle Route 10. This resource can provide recreational cyclists information about towns they will pass through along the route, services available in those towns, and riding conditions along the route. ITD should seek input from Idaho Chambers of Commerce and the Idaho State Division of Tourism to enhance and improve the concept of a story map for USBR 10.

Chapter 1
Introduction

1.1 Project Objectives

The Idaho Transportation Department's (ITD) Strategic Highway Safety Plan aims to have the safest transportation system possible for all users of Idaho´s roadways. To achieve ITD's commitment to achieving a safe, effective and balanced multimodal transportation system including accommodations for bicyclists, pedestrians and pedestrians with disabilities, along with motorized transportation modes; it is essential to have access to crash and bicycle facility data both on and off the state highway system. Idaho is fortunate to already have a method to capture, store and expose statewide crash data. The state is lacking a similar means and method for bicycle facilities.

In addition, Title 23 U.S.C. § 217(d) indicates that each state receiving an apportionment under the Surface Transportation Program (STP) and the Highway Safety Improvement Program (HSIP) shall fund a position of Bicycle and Pedestrian Coordinator within the State DOT using such amounts of STP or HSIP monies as may be necessary for:

- Promoting and facilitating the increased use of non-motorized modes of transportation,
- Developing facilities for the use of bicyclists,
- Public education, promotional and safety programs for using such facilities.

In order to meet ITD's strategic safety goal along with the bulleted emphasis areas, ITD and community partners need to know what and where bicycle facilities currently exist throughout Idaho. A complete and detailed inventory of existing facilities can assist communities to identify safety concerns, plan new facilities, prioritize projects, and manage the system.

The objectives of this project were to:[1]

Objective 1. Identify the datasets related to bicycle facilities that would provide value to the State for making informed planning and programming decisions.

Objective 2. Collect bicycle facility inventory data on the Idaho State Highway System.

1.2 Method

The project objectives were accomplished in two phases. The first phase (objective 1) was a literature review and information gathering about the state-of-the-practice within Idaho and at neighboring state departments of transportation (DOT). The research team reviewed manuals and guidebooks related to

[1] Originally, the project included pedestrian facilities; however, cost, lack of readily available data and parallel efforts at ITD's Office of Civil Rights led ITD to narrow the focus to solely bicycle facilities.

bicycle facilities. The goal was to identify datasets that would provide value to the State for making informed planning and programming decisions.

We created a preliminary list of potential data elements based on the *Model Inventory of Roadway Elements* (MIRE) published by the Federal Highway Administration (FHWA). We identified 67 MIRE data elements that are relevant to bicycle travel. Then, working with ITD staff, we verified which items are currently collected by ITD and to what extent.

Next, we added to our list of potential data elements by reviewing various national engineering and planning manuals about designing and analyzing bicycle facilities. Furthermore, we contacted (via phone and/or email) data specialists at neighboring state DOTs, Metropolitan Planning Organizations (MPOs), and cities. Finally, we added data elements to our list that were suggested by members of the Technical Advisory Committee (TAC) for this project. The list was sent via email to each member and also presented at a meeting held at ITD headquarters in Boise.

The second phase of the project (objective 2) involved creating example databases and information sharing products. ITD´s project leader instructed the research team to focus these products on bicycle facilities, with hopes of producing similar products for pedestrian facilities in a future project. The first product is a video and chart that ITD can use to define bicycle facilities for design, implementation, and inventory. The next two products are example databases that ITD can use to share data internally and with community partners and the public. The three products are:

- Instructional Video and Chart for Bicycle Facility Classification
- Bicycle Information Map Webpage
- Online Story Map for USBR 10

1.2 Report Organization

Chapter 2 provides a brief summary of key design manuals and guidebooks that were used as reference for this report. This is followed by a description of bicycle data collected in Idaho and neighboring states.

Chapter 3 lists and describes the roadway characteristics (data elements) that are required to assess the quality of bicycle facilities. This is followed by a description of bicycle facilities.

Chapter 4 provides conclusions for the work accomplished and suggestions for next steps.

There are seven appendices. Appendix A defines various GIS terms. Appendix B lists more than 100 potential data elements. Appendix C provides guidance for using the *Bicycle Information Map*. Appendix D describes how missing data was estimated to calculate bicycling stress. Appendix E summarizes feedback that was received from the TAC and how issues were resolved. Appendix F describes the items needed to maintain the online Story Map for USBR 10. Appendix G (electronic copy only) reproduces the Python code for creating the *Bicycle Information Map*.

Chapter 2
Identifying Potential Data Elements

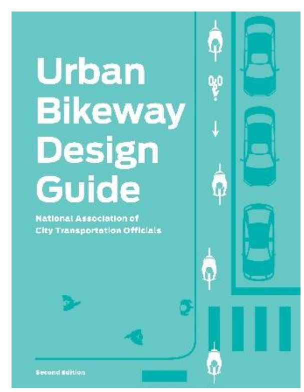
2.1 Design Manuals for Bicycle Facilities

There are various manuals and guidebooks available for the design, construction, and operation of bicycle facilities. This section summarizes key manuals and guidebooks that we reviewed to help identify datasets related to bicyclist facilities that would provide value to the State for making informed planning and programming decisions.

Separated Bike Lane Planning and Design Guide

The 2015 *Separated Bike Lane Planning and Design Guide* provides planning considerations for separated bike lanes (also known as protected bike lanes). It provides design options for one and two-way scenarios. The guide documents midblock designs for transit stops, loading zones, accessible parking, and driveways. It provides detailed intersection design information covering many topics such as signalization, signage, turning movement operations, and on-road markings. This document was developed by the UNC Highway Safety Research Center for the Federal Highway Administration.[1]

NACTO Urban Bikeway Design Guide

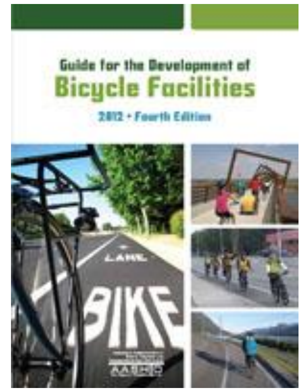


The 2014 *NACTO (National Association of City Transportation Officials) Urban Bikeway Design Guide* provides state-of-the-practice solutions that help create safe and enjoyable streets for bicyclists. All of the NACTO Guide treatments are used internationally and in many cities around the US. The authors of the Guide conducted an extensive worldwide literature search from design guidelines and real-life experience. They worked closely with traffic engineers, planners, and academics with deep experience in urban bikeway applications as well as a panel of urban bikeway planning professionals from NACTO member cities.[2]

Bicycle Safety Guide and Countermeasure Selection System (BIKESAFE)

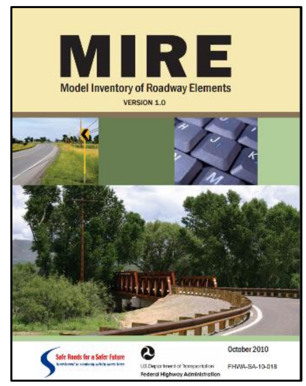
The 2014 *Bicycle Safety Guide and Countermeasure Selection System (BIKESAFE)* provides the latest information available for improving safety for bicycles. BIKESAFE was developed by the UNC Highway Safety Research Center for the Federal Highway Administration. The manual is comprised of the following sections: a guide of basic information, specific countermeasure details, case studies, and a tool for countermeasure selection.[3]

AASHTO Guide for the Development of Bicycle Facilities



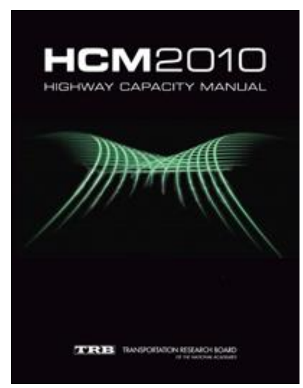
The 2012 *AASHTO (American Association of State Highway and Transportation Officials) Guide for the Development of Bicycle Facilities* provides information on how to accommodate bicycle travel and operations in most riding environments. The purpose of the Guide is to present sound guidelines for facilities that meet the needs of bicyclists and other highway users. The document provides guidance to designers and planners by referencing a recommended range of design values and describing alternative design approaches.[4]

Model Inventory of Roadway Elements (MIRE)



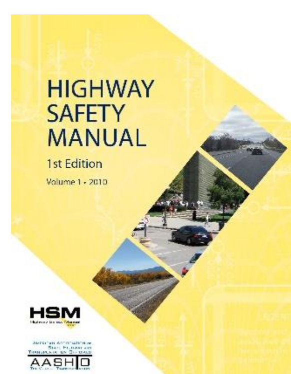
The 2010 *Model Inventory of Roadway Elements (MIRE)* provides common, consistent definitions and attributes for roadway inventory data elements. The roadway data elements used in MIRE were evaluated by various user groups to ensure they met the data needs for multiple disciplines. This inventory benefits safety, operations, asset management and maintenance.[5]

Highway Capacity Manual



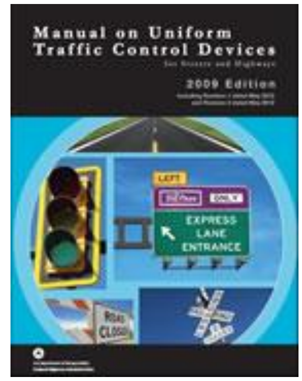
The 2010 *Highway Capacity Manual (HCM)* provides guidelines and computational procedures for computing the quality of service and capacity of various highway facilities, such as, highways, freeways, roundabouts, and signalized and unsignalized intersections. The HCM also measures the effects of mass transit, pedestrians, and bicycles on the performance of these systems. The HCM is a publication of the Transportation Research Board of the National Academies of Science in the United States.[6]

Highway Safety Manual



The 2010 *Highway Safety Manual (HSM)* provides guidelines and computational procedures for predicting the safety performance of various highway facilities. It provides a technical approach to safety analysis. The HSM provides tools allowing for safety to be quantitatively evaluated alongside other transportation performance measures such as construction costs, traffic operations, and environmental impacts. The HSM is a publication of the American Association of State Highway Transportation Officials.[7]

Manual on Uniform Traffic Control Devices (MUTCD)



The 2009 *Manual on Uniform Traffic Control Devices (MUTCD)* is the law governing all traffic control devices. The MUTCD has been administered by the Federal Highway Administration since 1971. It is a compilation of national standards for all traffic control devices, including road markings, traffic signals, and highway signs. The manual is updated periodically to accommodate changing transportation needs and address new safety technologies, traffic control tools and traffic management techniques.[8]

2.2 Bicycle Databases in Idaho and Neighboring States

There are number of existing GIS data services for Idaho. A few are sophisticated systems that facilitate automatic data collection, aggregation, and distribution. While others only provide visualization without the ability to download the data. This section summarizes our findings about bicycle data collected in Idaho and neighboring states. The information for this section was gathered by searching agency websites, phone calls, and email communication.

ITD Bike/Ped Website

http://itd.idaho.gov/bike_ped/

The Bicycle and Pedestrian Program hosts a website with a variety of resources and information (Figure 1). The website includes links to guidebooks, upcoming events, the websites of other organizations, and ITD initiatives and projects. The website also provides links to various maps, including a bike map that provides information about shoulder width, grades, and prevailing winds (Figure 2).

Figure 1. ITD's Bicycle and Pedestrian Program Website

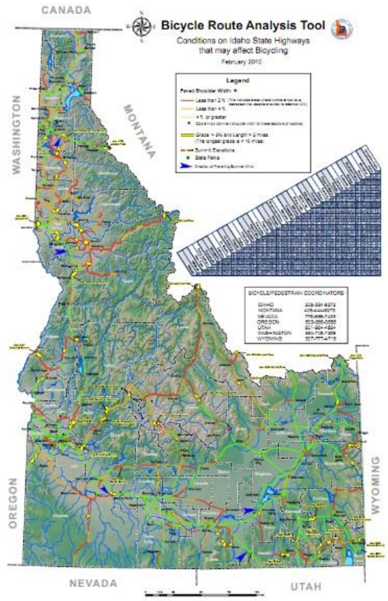


Figure 2. Idaho Bike Map

IPLAN

http://iplan.maps.arcgis.com/home/index.html

IPLAN is ITD's primary means to share and display authoritative spatial data.[9] IPLAN is a web-based portal hosted by ArcGIS™ Online. A person can see data through public "map windows" and if the person has log-in credentials, he or she can access additional data and maps. Data include: General Information; Highway safety corridor Analysis; Idaho historical markers; and Road characteristics. Each of these categories leads to an online map with viewing options like road, labels, speed zones, mileposts, etc. The data of IPLAN primarily resides in ITD's "GIS Warehouse."

Figure 3. IPLAN Website

Idaho's Transportation Asset Management System (TAMS)

The *Transportation Asset Management System (TAMS)* is a database that includes ITD's transportation assets such as: highways; bridges; guardrails; signs; lights; and virtually anything related to highways.[10] TAMS provides information on the state highway system and helps determine how to apply resources most effectively. TAMS data has spatial attributes but is not a GIS. And the data is not available to the public. Data is extracted from TAMS and other sources to fulfill the requirements of the Highway Performance Monitoring System (HPMS).

ITD Highway Video Log

http://pathweb.pathwayservices.com/idaho/

ITD hosts a P*athWeb* online video data log that allows users to search for road sections through a dialog or GPS map hosted by ArcGIS™ Online.[11] Data types that are available include: video from perspective, right shoulder, left shoulder, and rear view camera positions; images of the road surface; IRI (international roughness index) profile graphs; and rutting (transverse) profile graphs. This data is available for download.

INSIDE Idaho

https://insideidaho.org/

INSIDE (Interactive Numeric and Spatial Information Data Engine) Idaho is the official geospatial data clearinghouse for the State of Idaho.[12] The system was developed in 1999 by the University of Idaho as a location to archive GIS data pertinent to the state of Idaho.

Maps Idaho

http://maps.idaho.gov/

Maps Idaho is an ArcGIS Online site for the state of Idaho similar to ITD's IPLAN. The website provides various maps and layers for the public to download and interact with data.

Idaho Trails

www.trails.idaho.gov/

Idaho Parks and Recreation sponsors *Idaho Trails*, a GIS web viewer displaying trail data in Idaho.[13] The dataset includes the following data fields: trailhead; highway legal; highway legal seasonal; automobile; automobile seasonal; jeep; jeep seasonal; ATV; ATV seasonal; motorcycle; motorcycle seasonal; non-motorized; and other road. The dataset is not available for download in GIS format, but it is available as a kmz (Google Earth™ file).

Stay on Trails ATV Maps

http://www.stayontrails.com/

Idaho Fish and Game along with a consortium of partners sponsor *Stay on Trails ATV Maps* which displays 50 ATV trails within Idaho. Each trail has its own web page with a trail description, a video from a portion of the trail, and links to current weather and trail conditions.(14) *Stay on Trails ATV Maps* does not provide an online data viewer, but they do have trail maps in pdf format for downloading.

Google Maps Bicycle Layer

https://www.google.com/maps

Google Maps™ Bicycle Layer shows bike data in the US within Google Maps.™ (15) This feature includes step-by-step bicycling directions and bike-specific routing suggestions – similar to the directions provided by Google's driving, walking, or public transit modes. The feature also includes bike trails that are outlined directly on the map and include: dedicated bike-only trail; dedicated bike lane along a road; bicycle-friendly roads (roads without bike lanes but are appropriate for biking, based on factors such as terrain, traffic, and intersections); and dirt/unpaved trails. Google encourages bikers to send feedback and route information for inclusion on the map using a reporting tool at the bottom of the map.

Open Street Map

https://www.openstreetmap.org

Open Street Map (OSM) is a free online map that is comprised of "crowdsourced" data, i.e. people create and edit the map similar to Wikipedia. (16) OSM began in 2004 and now has more than 2 million registered user who regularly edit and update the world wide map. Many communities worldwide and in the United States include data for sidewalks, bike lanes, multiuse pathways, and crosswalks. The data can be downloaded or embedded into other online mapping applications.

Trail Link

http://www.traillink.com/

TrailLink is an online database of more than 30,000 miles of trail around the country created by the Rails-to-Trails Conservancy.(17) The website allows a user to search for trails by location, trail name, or activity type (such as bicycling). Search results shows trails on an interactive online map that uses Google Maps™ platform. Also provided are trail descriptions, surface type, and GPS data. TrailLink distinguishes between road/hybrid bike trails and mountain biking trails based on surface type and general trail condition.

Neighboring State DOTs

Four neighboring state DOTs were contacted and investigated for this report: Oregon Department of Transportation (ODOT), Washington Department of Transportation (WSDOT), Montana Transportation Department (MTD), and Utah Department of Transportation (UDOT).

State DOT Bicycle and Pedestrian Information Websites

All four DOTs maintain a bicycle and pedestrian website similar to ITD's website (Figure 34 above):

MTD: http://www.mdt.mt.gov/travinfo/bikeped/bikes/default.shtml

ODOT: http://www.oregon.gov/odot/hwy/bikeped/Pages/index.aspx

UDOT: http://www.udot.utah.gov/main/f?p=100:pg:0:::1:T,V:11,

WSDOT: http://www.wsdot.wa.gov/bike/default.htm and http://www.wsdot.wa.gov/walk/

These websites provide web links to bicycle and pedestrian manuals, laws, regulations, safety tips, and other information.

State DOT Static Bike Maps

All four DOTs provide a "static" i.e. pdf format, state-wide bike map, similar to ITD's bike map (Figure 35 above):

MTD: http://www.mdt.mt.gov/travinfo/docs/bike_map.pdf

ODOT: http://www.oregon.gov/ODOT/HWY/BIKEPED/bike_map/Bike-Map_book.pdf

UDOT: http://udot.utah.gov/main/uconowner.gf?n=200404201454221

WSDOT: http://www.wsdot.wa.gov/NR/rdonlyres/A7039698-EDB9-4C91-A5CC-77677E269E8C/0/bikemapfront.pdf

However, none of the maps actually provide much facility information other than shoulder width, speed limit, and AADT on the state highway system. All four DOTs provide web links to the webpages of other agencies that presumably host bicycle maps for local areas. However, a spot check revealed a lot of out-of-date webpages and only a few web links that eventually lead to pdf maps.

State DOT Online GIS Data

All four DOT's maintain an ArcGIS online website similar to ITD's IPLAN (Figure 36 above).

MTD: http://gis.mdt.opendata.arcgis.com/

ODOT: https://gis.odot.state.or.us/transgis/

UDOT: http://udot.uplan.opendata.arcgis.com/

WSDOT: http://data.wsdot.opendata.arcgis.com/

These websites vary considerably in terms of the data that is available and the functionality for analysis and downloading the data.

MTD's GIS website does not provide any specific bicycle data.

ODOT's GIS website includes two layers specifically related to bicycle travel: Bicycle Facilities and Bicycle Facility Needs. Bicycle Facilities includes attributes about width, type of facility (bike lane, shared lane, or paved shoulder), condition, and an indicator for locations where bicycle facilities are needed but missing. The feature classes were created in 2008 and updated in 2014. They cannot be downloaded from the website but can be obtained from ODOT upon request. The data is only available for the state highways system.

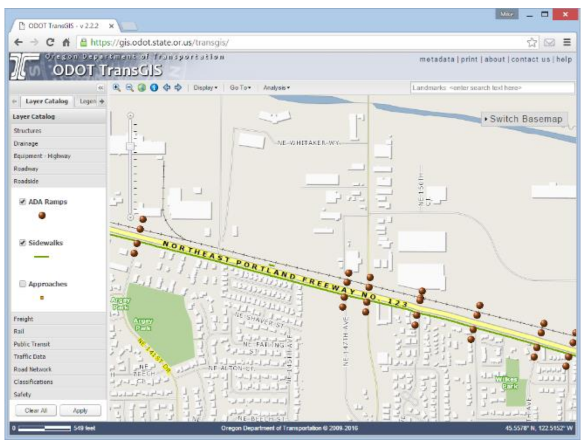


Figure 4. ODOT TransGIS

UDOT's GIS website has one bicycle feature classes that can be downloaded: ADA Ramp Inventory and Bike Lanes. The Bike Lanes dataset was collected via LiDAR and is updated every two years, with the next release scheduled for 2016. The only attribute is the presence of a bike lane. The dataset is only available for the state highway system.

UDOT also provides many more additional maps and layers that can be viewed, but not downloaded. They are viewed through the map center portion of their online GIS website, located at http://uplan.maps.arcgis.com/home/index.html . Some of the layers require a password to be viewed, but most can be obtained by request. Maps and layers relevant to bicycle travel include: Regional bike plans, Bicycle-Vehicle Conflict Hotspots, Popular Rides in Utah, Priority Routes, Latent Demand Analysis (a rating of demand potential), Touring Routes, and Existing bicycle infrastructure on state and local roads. Figure 5 shows UDOT's Bicycle Network Plan.

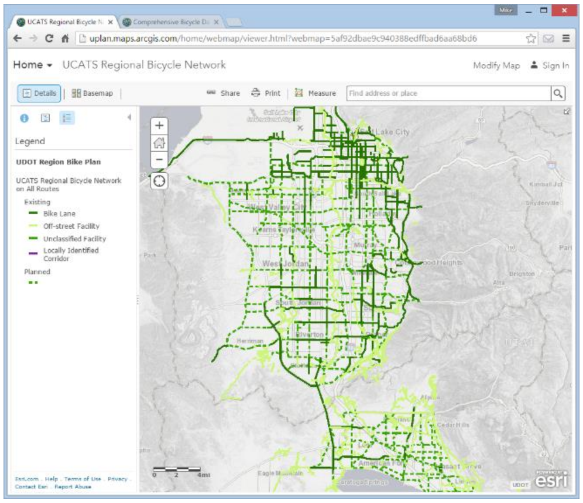


Figure 5. UDOT Bicycle Network Plan

WSDOT's GIS website does not provide any specific bicycle facility layers. However, the website does have maps and layers for their bicycle count program. The data includes permanent automatic counters around the state and short-duration manual counts collected every fall through a community-volunteer effort. Figure 6 shows WSDOT's bicycle count data.

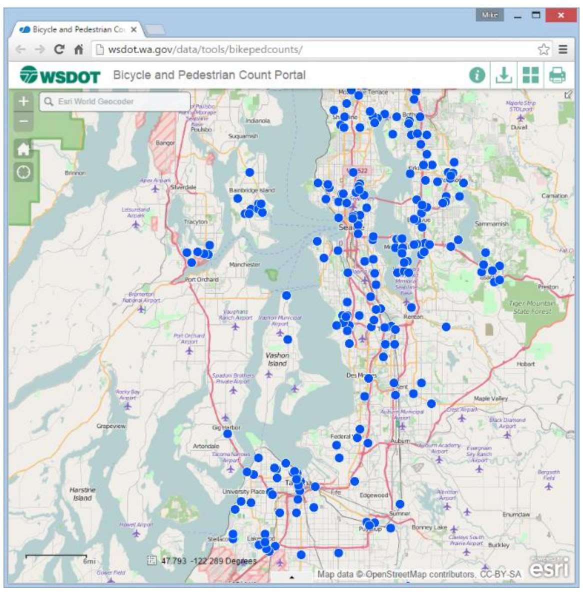


Figure 6. WSDOT Bicycle Count Data

Metropolitan Planning Organizations

There are five metropolitan planning organizations (MPOs) in Idaho with varying amounts of bicycle GIS data.

The *Bannock Planning Organization* (BPO) for the Pocatello area maintains an ArcGIS online website, however bicycle data are not currently available. BPO does have bicycle GIS data, with plans to add it to the website soon.

The *Bonneville Metropolitan Planning Organization* (BMPO) for the Idaho Falls area does not provide an online data viewer or GIS data downloads. They do have a Bicycle Master Plan available in pdf format. The bicycle facilities are: Bike Lane and Multi-use Path.

The *Community Planning Association of Southwest Idaho (COMPASS) MPO* in Boise, Idaho does not provide an online data viewer or GIS data downloads. However they do maintain a substantial amount of GIS data. They also provide a pdf of Level of Service for bicycles. They are currently compiling bicycle GIS data from their member agencies for internal use. Since different agencies call facilities varying names, one data field will contain bike facility attribute names used by COMPASS. Another data field will indicate the bicycle facility attribute name used by the original agency.

The *Kootenai MPO* in Coeur D'Alene, Idaho does not provide an online data viewer or GIS data downloads. A user may submit a request for data for a fee. However, they do not maintain any specific bicycle data.

The *Lewis Clark Valley MPO* in the Lewiston, Idaho / Clarkston, Washington area does not provide an online data viewer or GIS data downloads. They do have a Bike Master Plan available in pdf format. The bicycle facilities are: Pathway, Marked Bicycle Route, Bicycle Boulevard, Bike Lane, and Protected Bike Lane.

Other MPOs, outside of Idaho, vary in terms of the bicycle GIS data. Small MPOs, like the MPO for the Great Falls Montana area, are similar to Idaho's MPOs without much data. While large MPOs, like the MPOs for the Seattle area and Portland area, have a rich collection of bicycle infrastructure data.

Other Local Agencies

There are a variety of other local agencies that may or may not maintain bicycle GIS data, including Idaho's Highway Districts, counties, cities, and advocacy groups. For example, the Ada County Highway District (ACHD) maintains GIS Data for bicycle facilities. The bicycle facility categories are: Walking Trail, Multi-Use Path, Shared Bike Route, Highway Bike Route, Neighborhood Bike Route, Bike Lane, Planned Bike Lane, and Planned Bike Route. ACHD does not maintain an online GIS database for the public to view and download data. Meanwhile, Ada County provides an online GIS data viewer, but does not maintain any bike data. The City of Boise also hosts an online data viewer called BoiseMaps Express, which includes a Trails dataset with the following attributes: Pathway outside city limits; greenbelt – native material; greenbelt – paved; federal way trail – paved; ridge to rivers; pathway outside city limits.

Often cities are the best source for finding data bicycle facilities because they maintain and operate the facilities and because bicycle travel is primarily a local activity. However, in Idaho it seems many communities do not use GIS to archive their bicycle data. A survey funded by ITD in 2011 was sent to nearly 300 people on the Association of Idaho Cities contact database. There were 115 responses, of which only 33% reported having GIS data for on-street bike lanes and 36% reported having GIS data for off-street bike paths. (18)

Outside of Idaho, there are various examples of cities maintaining and providing to the public very detailed GIS data. Seattle hosts several different services for bicyclists. A web page called *Seattle Bike Facilities and How to Use Them* explains how to use various bicycle facilities such as bike boxes, two-stage left turns, etc. There are 18 additional web pages with numerous links that contain valuable bike information, such as maps, parking, racks, rules of the road, and descriptions of specific trails and neighborhood greenways.

Seattle's online GIS portal contains the following bicycle GIS datasets: Bike Racks, Bike Traffic, Signed Bicycle Routes, Bike Counts, and Bike Lanes. Some of the datasets are shown in map view with no data fields. Others are shown in table view with data fields, such as the Bike Racks dataset includes data fields: width; location; capacity; finish; surface; installation date; mount type; color; manufacturer; model; and condition. The Bike Lanes dataset includes data fields: side; distance; end distance; width; lane width; lane length; lane ID; traffic direction; lane locations; and lane type. An interactive map for the data allows a user to indicate if they are a frequent, average, or occasional rider and the map will offer suitable route suggestions. Figure 7 shows the map with route suggestions for strong and fearless bicyclists.

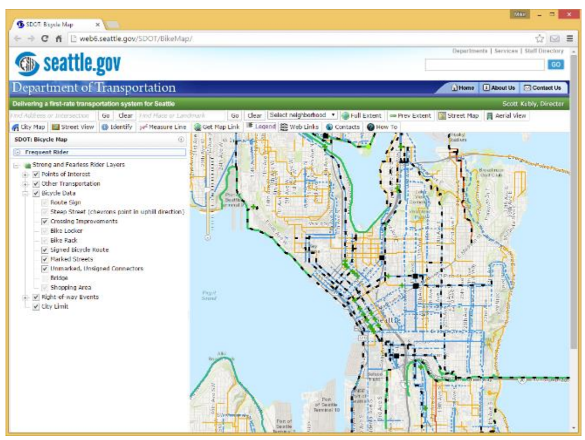


Figure 7. Seattle Bike Map Showing Route Suggestions for Strong and Fearless Bicyclists

Seattle's webpage explains how to use bicycle facilities and contains a wealth of valuable bike information, including a number of instructional videos. Figure 8 shows a screenshot of Seattle's webpage.

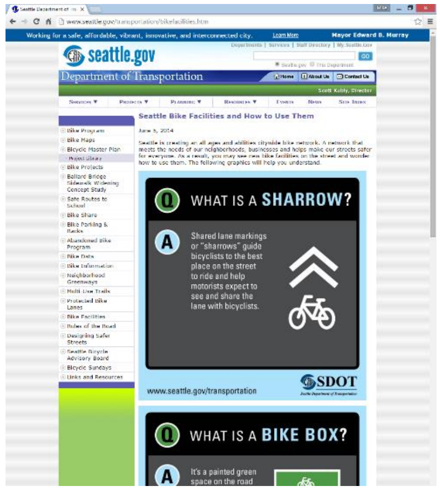


Figure 8. Seattle DOT's webpage "Bike Facilities and How to Use Them."

Chapter 3
Key Data Elements

Information relevant to bicycle travel that would provide value to the State for making informed planning and programming decisions can be organized into seven categories:

1. Roadway characteristics (e.g. vehicle volumes, speed limit, shoulder width)
2. Facilities (infrastructure and paint markings, e.g. paths, pathways, bike lanes)
3. Route designations (e.g. US Bicycle Routes, local snow removal routes, scenic byways)
4. Amenities (e.g. bike racks, retail stores, information kiosks)
5. Demand (e.g. volume counts)
6. Safety (e.g. crashes and near misses)
7. Geographic and environmental conditions (e.g. prevailing wind, weather, topography)

The first two categories are essential for a statewide bicycle inventory. This chapter explains how roadway characteristics can be used to evaluate the quality of bicycle travel. The second section of this chapter describes key bicycle facilities.

3.1 Roadway Characteristics

Level of service (LOS) is a qualitative rating used by transportation professionals to help plan, evaluate, and operate transportation facilities. LOS ratings are calculated through mathematical equations that take into account various attributes of a facility. There are numerous LOS methods (also called suitability assessment methods) for bicycle facilities. (18) The most well-known method is found in the Highway Capacity Manual (HCM) and produces letter grades A through F, where F represents a facility with undesirable conditions. (19) Other methods might use other rating categories, such as “Poor”, “Good”, and “Excellent.”

Although ITD uses LOS ratings more frequently for automobile facilities then for bicycle facilities, it might be worth including the attributes needed to calculate LOS in ITD’s bicycle inventory. This chapter presents the attributes required for the HCM and other methods.

Bicycle LOS Attributes

The 2010 HCM presents LOS equations for four types of bicycle facilities: two-lane highways (HCM Chapter 15), urban street segments (HCM Chapter 17), signalized intersections (HCM Chapter 18), and off-street shared use trails (HCM Chapter 23). (6) Figure 4 shows the resulting street segment Bicycle LOS (BLOS) for Moscow, Idaho. Table 1 shows the attributes required for the four types of facilities.

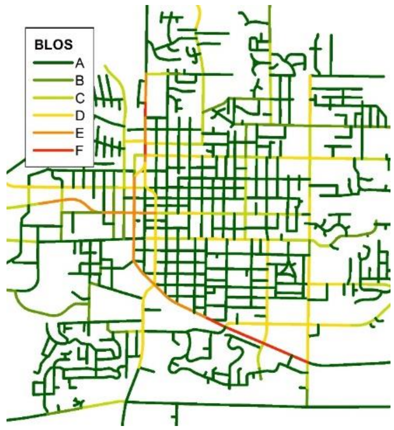


Figure 9. Bicycle Level of Service for Moscow, Idaho.

Table 1. Required Attributes for HCM Bicycle LOS Analysis

Attribute	Two-Lane Highways	Urban Street Segments	Signalized Intersections	Off-Street Shared Use
Width of Outside Lane	x	x	x	
Width of Bike Lane		x	x	
Width of Shoulder	x	x	x	
On-Street Parking	x	x	x	
Presence of Curb		x		
Vehicle Traffic Volumes	x	x	x	
Number of Lanes	x	x	x	
Speed Limit	x	x		
Percent Heavy Vehicles	x	x		
Pavement Condition	x	x		
Width of the Cross Street			x	
Path Width				x
Presence of Centerline				x
User Volumes				x

There are many other methods to assess LOS besides the HCM method, although often they do not use the term “Level of Service”. A more generic term for LOS is “suitability rating”. Table 2 lists several other bicycle suitability rating methods. At a recent Annual Meeting of the Transportation Research Board we counted 7 new methods or proposed modifications to existing methods. Furthermore, many communities simply use local knowledge to create bicycle suitability maps for residents and tourists. [(19)]

Table 3 compares the attributes needed for the HCM and three other methods. Bicycle Suitability Assessment (BSA) is a popular method intended for non-professionals. [(20)] Bicycle Compatibility Index (BCI) was developed by FHWA in the late 1990s. [(21)] Bicycle Stress Level (BSL) only requires three attributes, which are common in most methods. [(22)]

Table 2. Bicycle LOS Methods [18]

Name of Method	Acronym	Author/Organization	Date
Bicycle Safety Index Rating	BSIR	Davis	1987
Bicycle Stress Level	BSL	Sorton and Walsh	1994
Road Condition Index	RCI	Epperson	1994
Interaction Hazard Score	HIS	Landis	1994
Bicycle Suitability Rating	BSR	Davis	1995
Bicycle Level-of-Service	BLOS	Botma	1995
Bicycle Level-of-Service	BLOS	Dixon	1996
Bicycle Suitability Score	BSS	Turner et al	1997
Bicycle Compatibility Index	BCI	Harkey et al	1998
Bicycle Suitability Assessment	BSA	Emery and Crump	2003
Rural Bicycle Compatibility Index	RBCI	Jones and Carlson	2003
Compatibility of Roads for Cyclists	CRC	Noel et al	2003
Bicycle Level-of-Service	BLOS	Zolnik and Cromley	2007
Bicycle Level-of-Service	BLOS	Jensen	2007
Bicycle Level-of-Service	BLOS	Petritsch et al	2007
Bicycle Environmental Quality Index	BEQI	SFDPH	2009
Bicycle Quality Index	BQI	Birk et al	2010
Bicycle Level-of-Service	BLOS	HCM	2011
Level of Traffic Stress	LTS	Furth	2014

Table 3. Attributes Required for Selected LOS Methods

	Method			
Attribute	**BLOS**	**BSA**	**BCI**	**BSL**
Width of Outside Lane	x	x	x	x
Width of Bike Lane	x	x	x	
Width of Shoulder	x	x	x	
On-Street Parking	x	x	x	
Presence of Curb	x	x		
Vehicle Traffic Volume	x	x	x	x
Number of Lanes	x	x		
Speed Limit	x	x	x	x
Percent Heavy Vehicles	x		x	
Pavement Condition	x	x		
Elevation Grades		x		
Adjacent Land Use		x	x	
Storm Drain Grate		x		
Physical Median		x		
Turn Lanes		x	x	
Frequent Curves		x		
Restricted Sight Distance		x		
Numerous Driveways		x		
Presence of Sidewalks		x		

BLOS (HCM) – Bicycle Level of Service (Highway Capacity Manual), BSA – Bicycle Suitability Assessment, BCI – Bicycle Compatibility Index, BSL – Bicycle Stress Level

Data Availability

ITD is already collecting and archiving some of these data elements, although mostly for roads that have a high functional classification and are part of the State Highway System.

We calculated the percent of roadway miles for which ITD has data for 7 key roadway characteristics that are required to calculate BLOS. The findings are shown in Table 4. Many road segments are missing one or two required data elements. Only about 17% of the roadway miles in the database have sufficient GIS-archived ITD data to calculate BLOS.

Table 4. Percent of roadway miles with GIS-archived ITD data

Roadway Characteristic	Interstate (%)	Freeways and Expressways (%)	Principal Arterial (%)	Minor Arterial (%)	Major Collector (%)	Minor Collector (%)	Local Street[a] (%)
Vehicle volumes	100	92	98	96	92	75	3
Speed limit	100	69	84	57	16	<1	<1
Number of lanes	100	82	86	58	16	<1	<1
Width of lane	100	82	86	58	16	<1	<1
Width of shoulder	100	82	86	58	16	<1	<1
Pavement rating	100	82	86	58	16	<1	<1
Parking regulation	100	59	31	49	15	<1	<1

[a] Roads in urban areas that have not been given a functional classification by ITD.

Yet, while all of the data elements in Appendix B are important, it may not be sensible for ITD to collect and archive all of them everywhere. For example, some roadway characteristics can be reasonably estimated to calculate an approximate BLOS value that can be meaningful and useful for some engineering and planning purposes. Vehicle volume, speed limit, and bicycle facility width are the most critical data elements in the BLOS equation. However, for some planning purposes, all that is needed is an order of magnitude value. For vehicle volume this means determining if the daily traffic volume is very high (more than 15,000 vehicles per day), high (7,000 to 15,000 vehicles per day), moderate (2,000 to 7,000 vehicles per day), or low (less than 2,000 vehicles per day). For speed limit, a rough estimate is high (more than 40 mph), moderate (30 mph to 40 mph), or low (less than 30 mph).

With rough estimates for vehicle volume and speed limit and data about bike facility width, other roadway characteristics like lane width and pavement condition have very little impact on BLOS. In fact, for most street segments with low vehicle volumes (less than 2,000 AADT) the equation will produce a BLOS score equal to “A” or “B” regardless of the other roadway characteristics. Vehicle volume and speed limit can often be estimated based on functional classification. Thus, the truly critical data element that ITD does not collect, and which cannot be estimated, is knowing if a bicycle facility is present and the type of facility.

Consequently, a reasonable BLOS score can be obtained by using estimated values for the missing data. This is true even for Minor Collectors and Local Streets with the assumption that ITD is collecting AADT on every roadway in the state that exhibits moderate to high volumes (more than 3,000 AADT). Furthermore, in recognition of using estimated values, we aggregate the BLOS letter grades into three broad categories as follows:

- BLOS A and BLOS B --> Low Bicycling Stress,
- BLOS C and BLOS D --> Moderate Bicycling Stress, and
- BLOS E and BLOS F --> High Bicycling Stress.

Types of Bicyclists

Unlike any other mode of transportation, there is substantial variability within the population regarding tolerance for different bicycle facilities. In 2006 Roger Geller proposed a now very well-known classification of types of bicyclists. [23] Subsequent research has sought to identify the proportion of each type of bicyclist within the general public. [24] The following are the categories and accepted proportions:

- *Strong and Fearless* (6%): willing to ride under any conditions,
- *Enthused and Confident* (9%): willing to ride with minimal bicycle accommodations,
- *Interested but Concerned* (60%): uncomfortable negotiating fast, high volume traffic,
- *No Way No How* (25%): no interest in riding regardless of bicycle accommodations.

The majority of the population is *Interested but Concerned* (aka “Concerned”). The HCM has been heavily criticized because the LOS method in the HCM was not developed for Concerned Bicyclists, but rather for the *Strong and Fearless* and *Enthused and Confident*, collectively called “Confident” Bicyclists. Mekuria et al. [20] showed that for Concerned Bicyclists, many communities exhibit “islands” of connectivity that preclude access to important daily destinations, like schools and grocery stores (see Figure 10). Consequently, many experts in Bicycle Planning argue that DOTs and local communities should strive to accommodate Concerned Bicyclists and that the next version of the HCM should provide LOS ratings that target this segment of the population. [20]

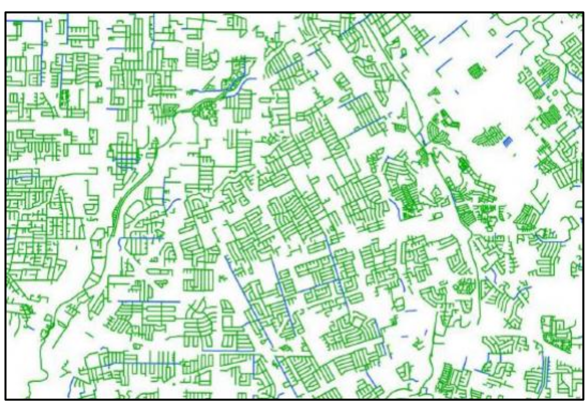


Figure 10. “Islands” of Connectivity Faced by the Majority of Bicyclists [25]

3.2 Bicycle Facilities

This chapter presents bicycle facility descriptions and terminology that are important to understand and use consistently when collecting and organizing bicycle infrastructure data. Although different agencies use varying terminology, the research team suggests the following terminology. Furthermore, we categorize the facilities as bicycle segment features (line features) or intersection features (point features).

Bicycle Segment Features

Bicycle segment features include the network of roads used by motorists, except those roads restricted to bicyclists. It also includes additional bikeways that are not available to motor vehicles.

Signed Bicycle Route

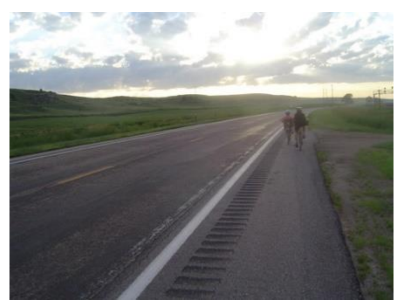
Signed bicycle routes are indicated as such only by a sign. There are no pavement markings, such as symbols or lines. It is possible that bicycle signs accompany other bicycle facility types, such as a bike lane, but in accordance with MIRE, we suggest a distinct facility type for when there is a sign only.

Sharrow

A sharrow, also called shared lane marking, is a road marking used to indicate a shared lane environment for bicycles and automobiles. The presence of sharrows reinforce the legitimacy of bicycle traffic on the street, show proper bicyclist positioning and alert motorists to the location that bicycles are likely to occupy, and may be configured to offer directional and wayfinding guidance. [4]

Paved Shoulder

Paved shoulders provide separated space for the operation of confident bicyclists. Paved shoulders have no bicycle signs or pavement markings. Paved shoulders are not vehicle travel lanes but they may be used for other purposes such as temporary storage of disabled vehicles and vehicle parking. Furthermore, debris often collects in a road's shoulder and bicyclists are permitted to avoid these hazards by riding in the lane of vehicle traffic. Rumble strips should be milled with gaps of 10 to 12 feet at intervals of 40 to 60 feet to allow bicyclists to comfortably leave the shoulder.[27] Paved shoulders should be at least 6 feet wide to accommodate confident bicyclists. The majority of the population, however, will not bicycle on a high volume or high speed roadway regardless of shoulder width.



Bike Lane

Bike lanes use of pavement markings and signage to designate an exclusive space within the roadway for bicyclists. A bike lane, designated by pavement markings. Bike lanes are located adjacent to motor vehicle travel lanes and flow in the same direction as motor vehicle traffic. Bike lanes are for one-way travel, are normally provided on both sides on two-way streets, and may be located on the left side when installed on one-way streets. Bike lanes enable bicyclists to ride at their preferred speed without interference from prevailing traffic conditions. Bike lanes also facilitate predictable behavior and movements between bicyclists and motorists.[1]

The MUTCD bike lane pavement marking types are bike symbol, helmeted bicyclist symbol, and word legends as shown in Figure 11. An arrow indicating direction of traffic may or may not accompany these symbols. Figure 12 shows colored pavement that is sometimes used to distinguish bike lanes from motor vehicle lanes.

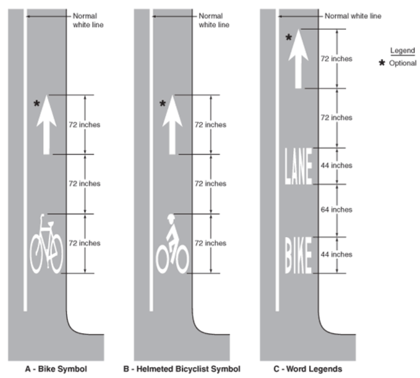


Figure 11. Pavement Markings [8]

Figure 12. Continuous Colored Pavement Marking for Bike Lane

Buffered Bike Lane

Buffered bike lanes are conventional bicycle lanes paired with a designated buffer space separating the bicycle lane from the adjacent motor vehicle travel lane and/or parking lane. The buffer is typically marked with 2 solid white lines, although the inner line may be dashed. If the buffer area is 3 feet in width or wider it will have interior diagonal cross hatching or chevron markings.[6]

Buffered bike lanes provide greater distance between motor vehicles and bicyclists. By placing buffers between parked cars and the bike lane, bicyclists are encouraged to ride outside of the door zone. Buffers also provide space for bicyclists to pass other bicyclists without encroaching into the adjacent motor vehicle travel lane.

Protected Bike Lane

Protected bike lanes, also referred to as cycle tracks and separated bike lanes, are bicycle facilities that run alongside a roadway separated from automobile traffic by a horizontal and vertical barrier, such as parked cars, bollards, a landscaped buffer, or a curb.[14] The protected bike lane is for bicycle use only and is distinct from a sidewalk. Protected bike lanes may be one-way or two-way and can be raised or at street-level. If at sidewalk level, a curb or median separates the lane from motor traffic, while different pavement color/texture separates the protected bike lane from the sidewalk. If at street level, they can be separated from motor traffic by raised medians, on-street parking, or bollards.[1] By separating bicyclists from motor traffic, protected bike lanes offer a higher level of security than conventional bike lanes. They also eliminate risk and fear of collisions with over-taking vehicles. Therefore, they are attractive to a wider spectrum of the public.

Neighborhood Greenway

Neighborhood greenways are also referred to as bicycle boulevards, bicycle priority streets, quiet streets, neighborhood connectors, neighborhood byways, bicycle friendly streets/corridors, bicycle/neighborhood parkways, bike/walk streets, and local bicycle streets.[12] Neighborhood greenways are streets with low motorized traffic volumes and speeds that are designed to give bicycle travel priority. Signs and pavement markings create the basic elements of a bicycle boulevard. They indicate that a roadway is intended as a shared, slow street, and reinforce the priority for bicyclists along a given route. In addition to signs and pavement markings, traffic calming and operational changes made to the roadway help create a safe and effective neighborhood greenway.

Bicycle Intersection Features

Bike Box

A bike box is a designated area at the head of a traffic lane typically painted green with a white bicycle symbol inside. The box allows bicyclists to position themselves ahead of motor vehicle traffic at an intersection. The main goal of the bike box is to improve safety by: increasing awareness and visibility of bicyclists; helping bicyclists make safer intersection crossings; encouraging bicyclists to make more predictable approaches to and through an intersection; and providing space at the front of an intersection to help bicyclists avoid breathing vehicle fumes.[2]

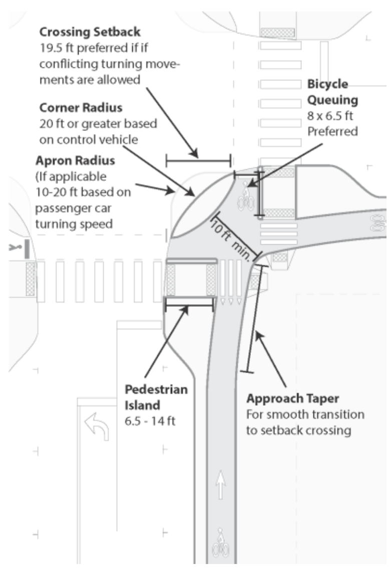
Two-Stage Left Turn

Two-stage left turn boxes offer bicyclists a safe way to make left turns at intersections. The turn box is an area designated to hold queuing bicyclists. The pavement markings include a bicycle symbol and a turn arrow to clearly indicate proper bicycle direction and positioning. The turning box is placed in a protected area, typically within an on-street parking lane between the bicycle lane and the pedestrian crossing. Bicyclists need to receive two separate green signal indications (one for the through street, followed by one for the cross street) to turn. At unsignalized intersections, bicyclists need to wait for appropriate gaps in crossing motor vehicle traffic. While two-stage turns may increase bicyclist comfort in many locations, this configuration typically results in increased delays for bicyclists waiting for two green signal indications or waiting for gaps in crossing motor vehicle traffic.[2]

Protected Bicycle Intersection

Intersections need to be just as safe and secure as the lanes that lead into them. Protected bike lanes lose their benefits when they reach intersections. The buffer falls away and a bicyclist is faced with an intersection where cars and bikes share the lane. The protected intersection brings the physical protection of a protected bike lane along with the rider through the crossing. A collection of design elements makes left turns simple and secure, right turns protected and fast, and provides straight through movements that minimize or eliminate conflicts from turning cars. [24]

There are four main elements to protected intersection designs: a corner refuge Island; a forward stop bar for bicyclists; a setback bike and pedestrian crossing; and a bicycle friendly signal phasing. [29]



Chapter 4
Project Products and Recommendations

This chapter describes three products that were created for this project:

1. Instructional Video and Chart for Bicycle Facility Classification
2. Bicycle Information Map Webpage
3. Online Story Map for USBR 10

The following sections provide recommendations for ITD to use, maintain, and improve these products.

4.1 Instructional Video and Charts for Bicycle Facility Classification

First, we recommend ITD begin collecting information about bicycle facilities by integrating MIRE elements 40 and 41 into ITD´s HPMS data collection process. These data elements are shown in Figure 15.

40. Presence/Type of Bicycle Facility

Definition: The presence and type of bicycle facility on the segment.

Attributes:

- None
- Wide curb lane with no bicycle markings
- Wide curb lane with bicycle markings (e.g., sharrows)
- Marked bicyle lane
- Separate parallel bicycle path
- Signed bicycle route only (no designated bicycle facility)
- Other

41. Width of Bicycle Facility

Definition: The width of the bicycle facility; either the width of the marked bicycle lane or bicycle path.

Attributes:

- Feet

Figure 15. MIRE Data Elements for Bicycle Facilities

Next we recommend ITD adopt a bicycle facility classification system as has been done in other states. We propose the following classes:

- Class I: Off-street Pathway
- Class II: Protected Bike Lane
- Class III: Bike Lane
- Class IV: Bicycle Street

Every roadway <u>with a bicycle facility</u> can be ascribed one of these four classes (roads without a bicycle facility can be deemed Class V if bicycling is permitted and Class VI if bicycling is prohibited). This class system is based on the idea that bicyclists feel safer the farther they are from vehicle traffic.

Class I facilities are physically separated from vehicle traffic and although they might briefly share a road´s right-of-way, they are primarily detached from the road and utilize a separate right-of-way. Since MIRE is focused on roadway characteristics, Class I facilities are not included as data elements. Nevertheless, we recommend ITD begin archiving the presence and width of paved Class I facilities throughout Idaho.

(a) shared-use isolated path **(b) detached shared-use side path**

Figure 16. Class I: Pathways

Class II facilities share the road´s right-of-way and have vertical and horizontal separation from traffic. The separation might be parked cars, bollards, or armadillo humps. Furthermore, Class II facilities are exclusive to bicycle travel. Class II facilities correspond with the MIRE attribute “Separate parallel bicycle path.”

(a) flexible bollards **(b) armadillo humps**

Figure 17. Class II: Protected Bike Lanes

Class III facilities share the road´s right-of-way and have horizontal (but not vertical) separation from traffic. These facilities include standard bike lanes, buffered bike lanes, and painted bike lanes (without vertical separation). Class III facilities correspond with the MIRE attribute “Marked bicycle lane.”

(a) painted bike lane **(b) buffered bike lane**

Figure 18. Class III: Bike Lanes

Class IV facilities have no separation from traffic, also called mixed traffic facilities. They include streets with sharrows, streets that have no bicycle accommodations except signage, and streets designated as neighborhood greenways or bicycle boulevards. Class IV facilities correspond with the MIRE attribute “Wide curb lane with bicycle markings (e.g. sharrows).”

(a) shared lane **(b) neighborhood bicycle street**

Figure 19. Class IV: Bicycle Streets

We created an instructional video to help explain the history, benefits, and rational for establishing a bicycle facility classification system. The video can be found online at: https://youtu.be/28V5BrA0PI8 Furthermore, we created two charts related to the classification. The flow chart shown in Figure 21 can be used to help determine the bicycle class of an existing facility. The chart shown in Figure 22 can be used to help ITD and community partners determine the most appropriate bicycle facility for a given level of traffic volume and speed limit.

Before adopting the classification system and accompanying charts, ITD might want to conduct stake holder meetings with engineers, planners, bicycle advocates, community leaders, and the general public. Such meetings might improve and refine the class names, definitions, and speed-volume thresholds.

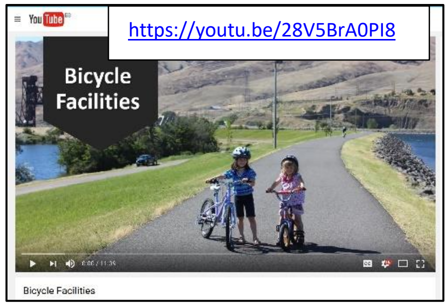


Figure 20. Instructional video about bicycle facility classification

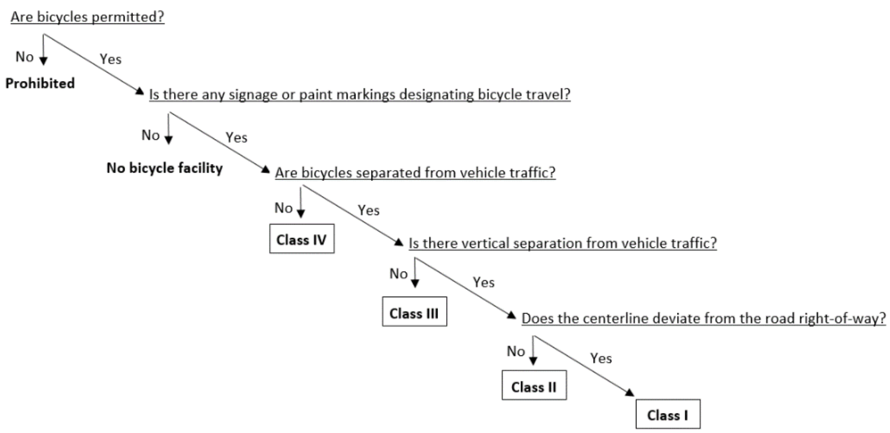


Figure 21. Chart for classifying existing bicycle facilities

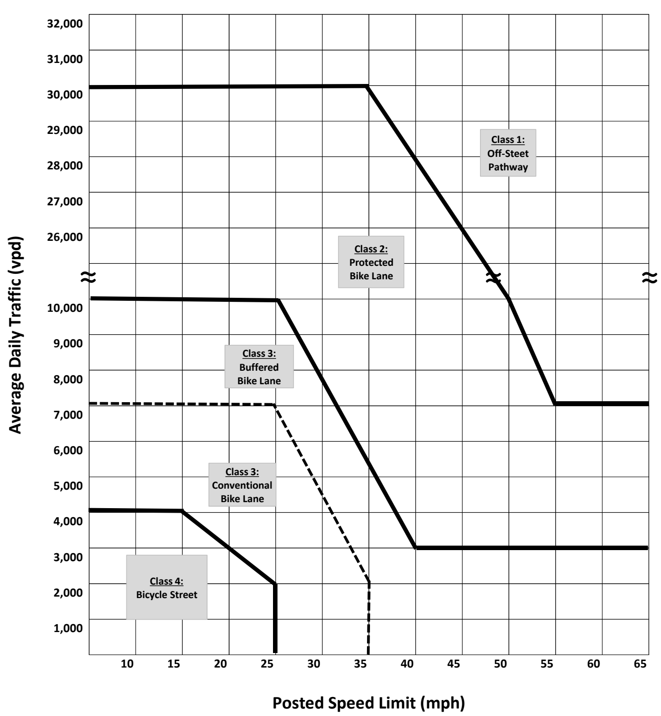


Figure 22. Chart for determining the most appropriate bicycle facility

4.2 Bicycle Information Map Webpage

We created the *Bicycle Information Map* to be ITD´s online database (inventory) for bicycle data. The map provides various GIS layers that can be turned on and off. A screenshot is shown in Figure 23.

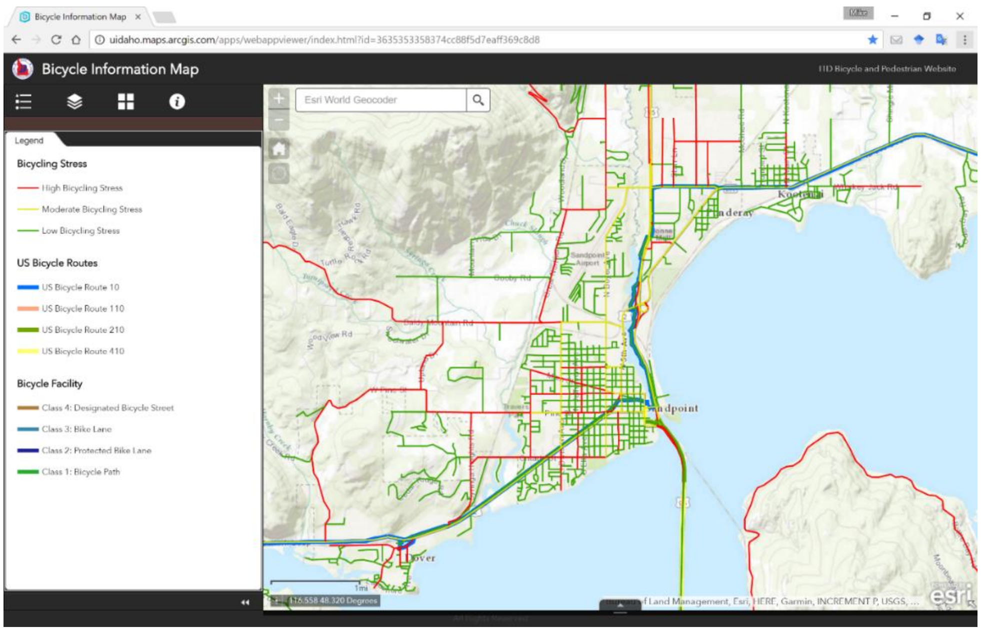


Figure 23. Bicycle Information Map

The geodatabase that underlies the *Bicycle Information Map* has three feature classes (See Appendix A for definitions of GIS terms such as feature class and field). Figure 24 shows the structure of the geodatabase. The data elements (fields) in the two DATA feature classes are exactly the same and are listed in Table 6. The EXISTING_DATA comes from an ITD GIS repository located here: http://gis.itd.idaho.gov/arcgisprod/rest/services/ArcGISOnline/IdahoTransportationLayers/MapServer

For EXISTING_DATA, if ITD does not have data for a street segment, then the field value is "Null". In ESTIMATED_DATA the "Null" values are replaced with estimated values. Appendix C describes the process for estimating values.

The geodatabase can be downloaded from the website or accessed via a REST API.

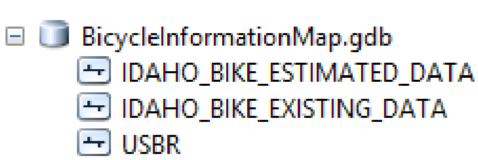


Figure 24. Geodatabase for the Bicycle Information Map

Table 6. Data elements in Bicycle Information Map

Id	Field	Description
1	SegCode	ITD's segment code[a]
2	USBR	US Bicycle Route[b]
3	Scenic	Idaho Scenic Byway[a,b]
	ScenicName	Idaho Scenic Byway Name[a]
4	Context	Urban or Rural[a]
5	Func_ID	FHWA's functional class ID[a]
6	Func	FHWA's functional class name[a]
7	Highway	Indicator as highway[a]
8	Terrain	Flat, Rolling, or Mountainous[a]
9	AADT	Annual Average Daily Traffic[a]
10	CAADT	Commercial AADT[a]
11	HV	Percent heavy vehicle CAADT/AADT[a]
12	K	Design hour K-factor
13	D	Design hour directional split
14	v	Design hour volume[a]
15	PHF	Peak Hour Factor
16	S	Speed limit[a]
17	Nth	Number of through lanes in one direction[a]
18	Wol	Width of the outside lane[a]
19	Wos	Width of the paved shoulder, including parking[a]
20	c	Presence of curb
21	Pc_text	Pavement condition text rating[a]
22	Pc	Pavement condition numeric rating[a]
23	pk	Parking regulation[a]
24	ppk	Proportion of on-street parking blockage
25	Bike_Class	Bicycle class
26	Wbl	Width of the bike lane
27	AADT_Cat	AADT category[a,b]
28	HV_Cat	Heavy vehicle category[a,b]
29	Speed_Cat	Speed limit category[a,b]
30	Wos_Cat	Highway paved shoulder category[a,b]
31	BLOS_Score	Bicycle level of service[a,b]
32	BLOS_Cat	Bicycle level of service category[a,b]
33	Stress_Cat	Stress level category[a,b]
34	Comment	"All values are based on ITD data." or "Some values were estimated."

[a] *Data obtained or derived from:*
http://gis.itd.idaho.gov/arcgisprod/rest/services/ArcGISOnline/IdahoTransportationLayers/MapServer
[b] *Used for map layer.*

ITD already archives most of the data elements in Table 6 for the State Highway System, and even provides a web map for much of this data as part of IPLAN. Thus, the intent of the *Bicycle Information Map* is to

4. consolidate all relevant bicycle information into a single database,
5. establish a repository for bicycle data elements that ITD does not currently archive, but might begin collecting in the future, and
6. provide map layers and layer categories that are specific to bicycling.

Figure 25 shows the map layers for the *Bicycle Information Map*. Some categories are ordered from undesirable to more desirable and are intentionally broad because often the values are only rough estimates. The categories of Bicycling Stress are based on BLOS as follows:

- BLOS A and BLOS B --> Low Bicycling Stress,
- BLOS C and BLOS D --> Moderate Bicycling Stress, and
- BLOS E and BLOS F --> High Bicycling Stress.

The data elements in Table 6 are required to calculate BLOS. The research team recommends that ITD begin collecting bicycle facility class and width. For the State Highway System this can be accomplished by adding two additional data elements (MIRE 40 and 41). For local streets and for off-street paths this will be more difficult.

As part of this project we created an innovative process to extract bicycle facility data throughout Idaho from *Open Street Map* (OSM). OSM is a free online world map comprised of “crowdsourced” data, i.e. people create and edit the map similar to Wikipedia. We wrote Python computer code that (1) connects to the OSM database and (2) downloads bicycle facility data for any Idaho community for which ITD does not have local data (for example, since Ada County Highway District has given ITD local data, then ACHD´s data negates the need for OSM data). OSM data does not include width, so this is asserted by the computer code as follows:

- Class I: Off-street Pathway -> 8 feet
- Class II: Protected Bike Lane -> 6 feet
- Class III: Bike Lane -> 5 feet
- Class IV: Bicycle Street -> 0 feet

The Python computer code for extracting OSM data and all the other computer code needed to create the *Bicycle Information Map* is found in Appendix D with annotation. We recommend ITD add the *Bicycle Information Map* to IPLAN and run this Python script on the same schedule of ITD´s other scripts that update the maps and layers of IPLAN.

<u>Bicycling Stress</u>
- High Bicycling Stress
- Moderate Bicycling Stress
- Low Bicycling Stress

<u>US Bicycle Routes</u>
- US Bicycle Route 10
- US Bicycle Route 110
- US Bicycle Route 210
- US Bicycle Route 410
- Us Bicycle Route 210 and 410

<u>Scenic Byway</u>
- Idaho Scenic Byway

<u>Bicycle Facility</u>
- Class IV: Bicycle Street
- Class III: Bike Lane
- Class II: Protected Bike Lane
- Class I: Off-street Pathway

<u>Daily Vehicle Traffic</u>
- Very high vehicle traffic (More than 15,000 per day)
- High vehicle traffic (7,000 to 15,000 per day)
- Moderate vehicle traffic (2,000 to 7,000 per day)
- Low vehicle traffic (Less than 2,000 per day)

<u>Large Truck Traffic</u>
- High truck traffic (More than 10%)
- Moderate truck traffic (5% to 10%)
- Low truck traffic (Less than 5%)

<u>Vehicle Speed Limit</u>
- High vehicle speeds (More than 40 mph)
- Moderate vehicle speeds (30 mph to 40 mph)
- Low vehicle speeds (Less than 30 mph)

<u>Highway Shoulder Width</u>
- No paved shoulder
- Narrow paved shoulder (Less than 4 feet)
- Moderate paved shoulder (4 to 6 feet)
- Wide paved shoulder (More than 6 feet)

<u>Bicycle Level of Service</u>
- F
- E
- D
- C
- B
- A

Figure 25. Layers for the Bicycle Information Map

4.3 Online Story Map for USBR 10

We created the *U.S. Bicycle Route 10 – Idaho* Story Map for ITD to provide the public with information about USBR 10 through Idaho. It is primarily intended to serve as a resource for those considering riding the route. Users of the story map are provided information about towns they will pass through along the route, services available in those towns, riding conditions along the route (e.g. shoulder width, speed limit), and directions to navigate the route. The application can be accessed using a web browser on a desktop computer or mobile device.

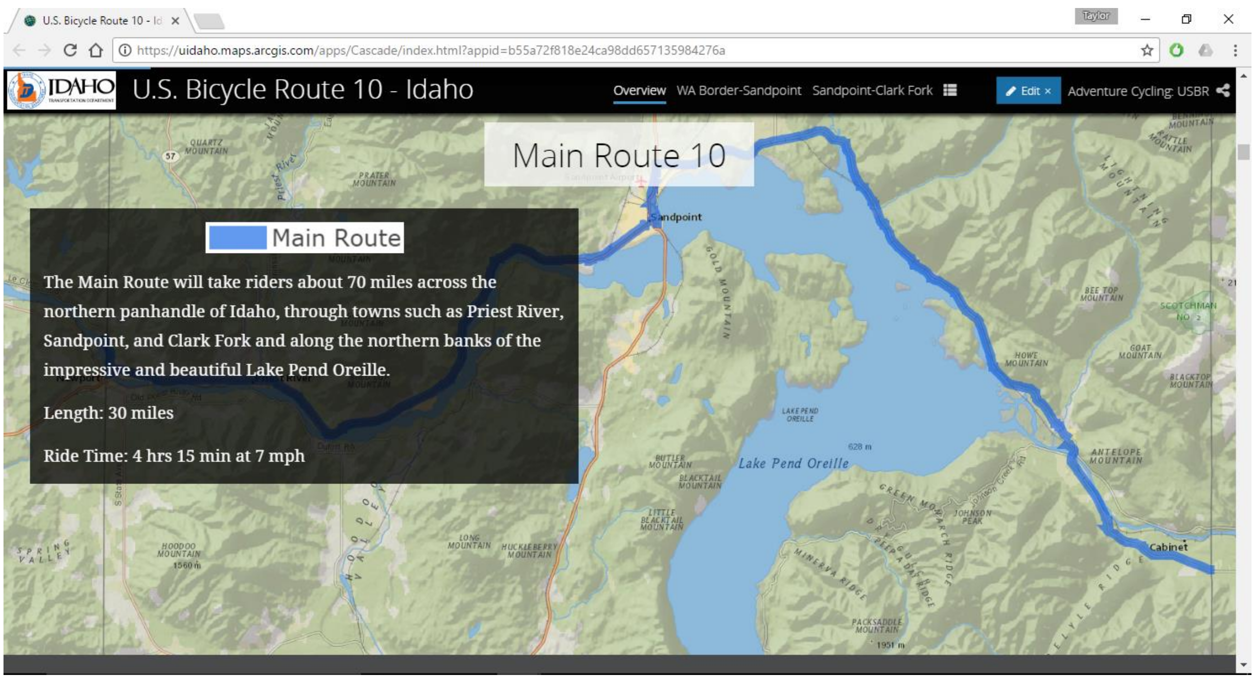


Figure 26. U.S. Bicycle Route 10 – Idaho Story Map

U.S. Bicycle Route 10 – Idaho is divided into different "chapters" that are webpage sections with themed information. The first chapter, *Overview*, gives a brief description of USBR 10 through Idaho, enticing the user to continue through the application. Then the user begins the chapters for each route. The first three chapters describe individual sections of the Main Route (the Washington border to Sandpoint, Sandpoint to Clark Fork, and Clark Fork to the Montana Border). These are followed by chapters for Alternate Route 210, Alternate Route 410, and Spur Route 110 respectively.

Each chapter begins with a map of the route section, navigation instructions to guide the rider, and an elevation profile to help riders determine the change in elevation. For each section, the route is described in terms of length in miles, ride time, and what the riders can expect to see. Each town is highlighted with a paragraph describing it and enticing the rider to spend some time there. A link is provided with to a PDF containing pertinent services to riders that they will find in each town. These "Services" PDFs contain live links to the Google Maps location of each service so that riders can easily locate them.

After the towns have been highlighted, metrics for the section are laid out for riders to know more about the route before riding it. These metrics are Traffic Volume, Speed Limits present, and Shoulder Width. Finally, each section ends with a YouTube video of a Google Earth fly-over to give the riders a bird's eye view of their ride before leaving.

Appendix G shows the items relevant to the story map. The *Elevation Profile Web Application* is stored on a web server. The videos are hosted on YouTube and can be accessed through YouTube's interface. All other data, files, and applications are stored on ArcGIS Online and can be accessed and edited there.

Maintenance

Applications

The *U.S. Bicycle Route 10 – Idaho* Story Map application can be accessed and edited through ArcGIS Online. It should remain stable, but going through it and making sure there are no errors as time passes would be good maintenance practice.

The *Elevation Profile Web Application* requires no maintenance barring changes to USBR 10, but can be accessed through ArcGIS Online as well. Should changes need to be made to the *Elevation Profile Web Application*, parameters are passed to the application through the URL used to link to it. Example URL with parameters set for Washington Border to Sandpoint at Zoom level 11:
https://example.website.com/~name/bike-ped/e-profile-final/index.html?OBJECTID=3&ZOOM=11

Feature Layers

Feature layers should remain the same barring any changes to USBR 10, such as roadworks or navigation changes. If the navigation for USBR 10 changes, access the feature layers through ArcGIS Online and edit them in ArcMap to reflect those changes. If uploading new copies, make sure to change the Story Map application by including the correct feature layer (or map) to accurately reflect the new data.

Data/Tables and CSVs

The tables contain the navigation directions for USBR 10, including the Main Route, Alternate Routes, and Spur Route. If USBR 10 changes in such a way as to affect navigation instructions, these tables and CSVs will need to be changed accordingly. This can be done in small scales by editing them directly in ArcGIS Online, but large changes should likely be done by downloading the CSV, making the changes in an editor such as Excel, uploading the new CSV to ArcGIS Online as a hosted feature layer, sharing the CSV and the Hosted layer so that they are public, copying the link to the hosted feature layer, and embedding that into the *Elevation Profile Web Application* so that the directions show up correctly. New PDFs of the navigation directions would also need made.

PDFs

The "Services" PDFs should be checked on as time goes by to make sure that the places that provide the services still exist, and that the documents are comprehensive. This can be done by following the links on the PDFs on ArcGIS Online and making sure the places are still there and open. In addition, each service should be Googled for each town to make sure that all the relevant businesses are included in the PDF. If changes need done, a new PDF will need created and uploaded to ArcGIS Online. At that point, the new PDF should be linked to in the Story Map application instead of the old one.

Should large changes to USBR 10 occur, *USBR 10 Maps, USBR Nav - PDF – WE,* and *USBR Nav - PDF – EW* will need to be replaced with PDFs that are accurate.

Images

The images are vague enough that small changes to USBR 10 should not necessitate the creation of new images. However, large changes to USBR 10 would create the need to create new images to be used for backgrounds, as well as feature layers, PDF's, Data/Tables, and CSVs. The geoprocessing models would need to be run to reflect changes in the source data.

Videos

Should changes to USBR 10 occur, new videos will need to be made to replace the out-of-date ones. The feature layers that will also need be changed can be used to create new videos. Save the new feature layers as KML files, which will likely be saved as KMZ files in ArcMap. Open them in Google Earth and see if they go the desired direction when making a 'Tour'. If so, create a screen capture video of the tour and upload that to YouTube and replace the embedded video in the Story Map Application using the share-able link from YouTube. If the direction is not as desired, save them as KML's in Google Earth, upload them to http://bikehike.co.uk/mapview.php by clicking "Load Route" (or another application that allows you to reverse KML direction), click the "Reverse Route" button, download the resulting KML with "Save Route," and open that KML in Google Earth. From there, create the tour, make a screen capture video, upload it to YouTube, and replace the old on in the Story Map application.

Chapter 5
Conclusions

ITD needs to know where bicycle acilities currently exist throughout Idaho to help identify safety concerns, plan new facilities, prioritize projects, and manage the system. ITD currently maintains substantial data about the state highway system and other roadways. Much of this information is relevant to bicycle travel. However, there are a number of key bicycle data elements currently not archived by ITD.

The findings of this project and all electronical files (charts, videos, computer code, geodatabases, and web-map applications) have been provided to ITD. These tools can help ITD to define, collect, and share important bicycle data.

This report lists and describes more than 100 potential data elements about bicycle travel that ITD could potentially collect and archive. The research team reviewed manuals and guidebooks related to bicycle facilities and contacted neighboring state DOTs to gather information about the state-of-the-practice. The Federal Highway Administration (FHWA) has recommended that state DOTs begin collecting some of these data elements as part of the MIRE initiative (See Chapter 2 for more information about MIRE). The attributes recommend in this report could be used by ITD and partners to conduct Level of Service Analysis using the HCM, safety analysis using the HSM, and provide useful information for tourism and commuter bicycling.

This project created three example database products. The first product is a video and classification chart that ITD can use to define bicycle facilities. Before adopting the classification system, ITD might want to conduct stake holder meetings with engineers, planners, bicycle advocates, community leaders, and the general public. Such meetings might improve and refine the class names, definitions, and speed-volume thresholds. The second product is an online database and data sharing platform called the *Bicycle Information Map*. This database can be used by ITD for data storage, visualization, and inventory. In a future project ITD should seek to develop a similar information map for pedestrian travel. The process of updating and creating the map is completely automated through computer code that connects to existing ITD GIS databases. An important innovation of the computer code is the ability to extract Open Street Map data for bicycle facilities everywhere in the state for which ITD does not have local data. The third product is an online story map for US Bicycle Route 10. This resource can provide recreational cyclists information about towns they will pass through along the route, services available in those towns, and riding conditions along the route. ITD should seek input from Idaho Chambers of Commerce and the Idaho State Division of Tourism to enhance and improve the concept of a story map for USBR 10.

References

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Photo	**Source**	**Photographer**
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Colored bike lane	https://www.pedbikeimages.org/index.cfm	Kristen Landford
Buffered bike lane	https://www.pedbikeimages.org/index.cfm	Jonathan DiGioia
Protected bike lane	http://www.cityclubofboise.org/events/1799-2/	Unknown Photographer
Neighborhood greenway	https://www.pedbikeimages.org/index.cfm	Adam Fukushima
Bicycle boulevard	https://www.pedbikeimages.org/index.cfm	Adam Fukushima
Bike box	https://www.pedbikeimages.org/index.cfm	Unknown Photographer
Two-stage left turn	https://www.pedbikeimages.org/index.cfm	Unknown Photographer
Bike racks	https://www.pedbikeimages.org/index.cfm	Dan Burden

Appendix A. GIS Concepts and Terms

A geodatabase is a database that is optimized to store spatial data. A geographic information system (GIS) is an integrated collection of computer software and data used to view and manage information about geographic places, analyze spatial relationships, and model spatial processes. Due to the spatial nature of bicycle facilities, a GIS is the most appropriate database management system for these data.

There are a variety of GIS software packages that can be used to organize, display, and analyze spatial data and related information, such as ArcGIS™, QGIS, PostGIS, and GRASS GIS. The suite of software commonly known as ArcGIS is developed and sold by the company Esri. ITD uses ArcGIS and in general ArcGIS is the most widely used commercial GIS software.

A data element is a unit of data with precise meaning and description. In GIS parlance, a spatial data element is called a feature and represents a real-world object on a map, such as a line on a map representing a river. A feature class is a collection of features. There are three common feature types: points; lines; and polygons, as shown in Figure A1. For ITD's bicycle inventory, different types of facilities will need to be represented as one of these feature types. Points are a single coordinate pair and are typically used to represent singular, discrete features such as buildings, power poles, and bike rack locations. Lines (also called polylines and arcs) are one-dimensional features composed of multiple, explicitly connected points. Lines are used to represent linear features such as roads and bike lanes. Lines have the property of length. Polygons are two-dimensional features created by multiple lines that loop back to create a "closed" feature. Polygons are used to represent features such as city boundaries, lakes, and pedestrian malls. Polygons have the properties of area and perimeter.

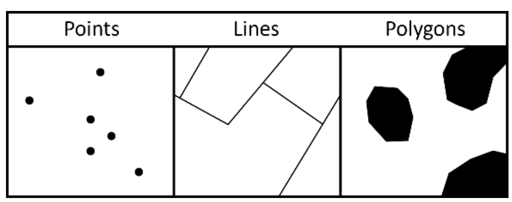
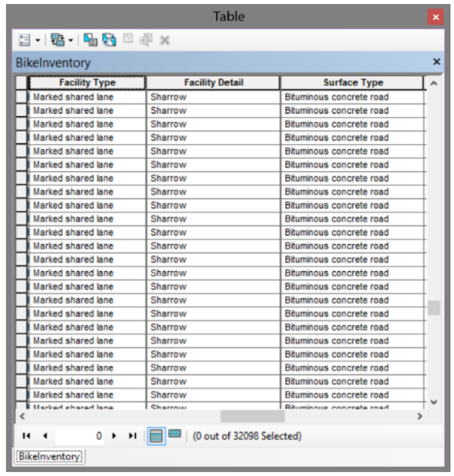


Figure A1. Point, Line, and Polygon Features

Point, line, and polygon features contain data attributes, which are nonspatial information about a geographic feature in GIS. Data attributes are stored in an attribute table which is arranged so that each row represents a feature and each column represents one attribute. Figure A2 shows an example attribute table for bicycle facilities maintained by MassDOT. [28] This is a line feature class with three attributes: Facility Type, Facility Detail, and Surface Type. The spatial information and the attribute information for these features are linked via an identification number, also called object ID, which is given to each feature in a map.



Facility Type	Facility Detail	Surface Type
Marked shared lane	Sharrow	Bituminous concrete road
Marked shared lane	Sharrow	Bituminous concrete road
Marked shared lane	Sharrow	Bituminous concrete road
Marked shared lane	Sharrow	Bituminous concrete road
Marked shared lane	Sharrow	Bituminous concrete road
Marked shared lane	Sharrow	Bituminous concrete road
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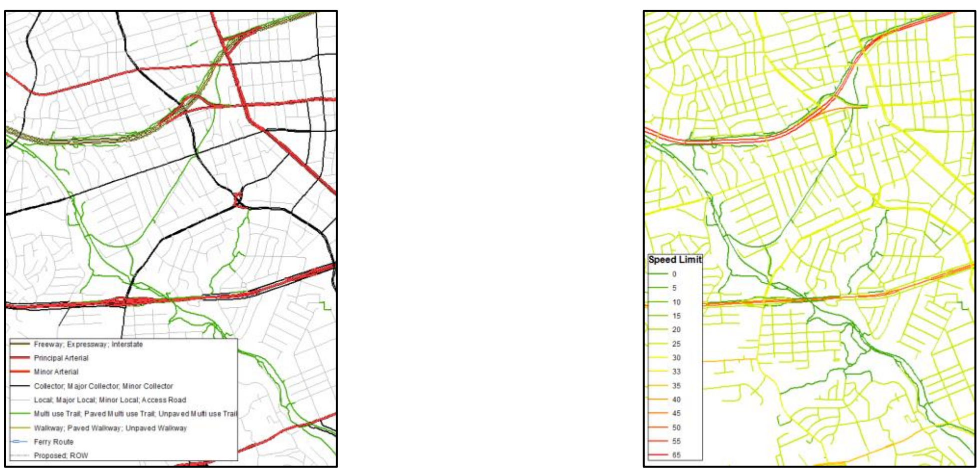
Marked shared lane	Sharrow	Bituminous concrete road
Marked shared lane	Sharrow	Bituminous concrete road
Marked shared lane	Sharrow	Bituminous concrete road
Marked shared lane	Sharrow	Bituminous concrete road

Figure A2. ArcGIS Attribute Table [(2)]

A feature layer is a stylized display of a feature class based on attributes. Figure 3 shows two feature layers for the same feature class, one layer is based on the attribute "functional class" and the other layer is based on "speed limit." The data source is the same for both layers.

A GIS data web service is online medium for accessing GIS data. Many communities provide a GIS data service to view feature layers and download feature class data. A wide range of functionality is possible – from only allowing the user of the GIS data service to view pre-defined layers to providing the ability to create, edit, and download layers.



(a) **(b)**

Figure A3. Two Layers for the Same Feature Class

Metadata is descriptive information about data, such as the source and date for data as well as acceptable domain values and coding protocol for the attributes. For example, metadata would include information about whether an attribute is to be coded as "Yes/No" or "0/1". A data dictionary is another word for metadata that describes domain values and coding protocol. Feature classes might have relationships with each other. The term schema refers to the organization of the feature classes and their attributes.

Appendix B. Potential Data Elements

This appendix presents data elements relevant to bicycle travel. The table shows the MIRE ID and HPMS ID. The table indicates if the data element is already collected by ITD, if it is a common data element used in the Highway Safety Manual, or a required data element for the Highway Capacity Manual.

Data Element	MIRE ID	HPMS ID	ITD Currently Collects	Highway Safety Manual	Highway Capacity Manual
Segment Identifier	12		x	x	
Functional Class	19	1	x	x	
Access Control	22	5	non-SHS sample panel		
Surface Type	23	49	SHS and non-SHS sample panel	x	
Pavement Condition (Present Serviceability Rating)	29	48	non-SHS sample panel		x
Number of Through Lanes	31	7	Federal Aid system	x	x
Outside Through Lane Width	32		SHS and non-SHS sample panel	x	x
Presence/Type of Bicycle Facility	40				x
Width of Bicycle Facility	41				x
Right Shoulder Type	43	37	SHS and non-SHS sample panel	x	
Right Shoulder Total Width	44	38	SHS and non-SHS sample panel	x	
Right Paved Shoulder Width	45		SHS	x	x
Right Shoulder Rumble Strip Presence/Type	46				
Sidewalk Presence	51				x
Curb Presence	52				x
Curb Type	53				
Median Type	54	35	SHS and non-SHS sample panel	x	
Median Width	55	36	SHS and non-SHS sample panel	x	
Median Barrier Presence/Type	56	35			
Major Commercial Driveway Count	68			x	
Minor Commercial Driveway Count	69			x	
Major Residential Driveway Count	70			x	
Minor Residential Driveway Count	71			x	

Data Element	MIRE ID	HPMS ID	ITD Currently Collects	Highway Safety Manual	Highway Capacity Manual
Segment Identifier	12		x	x	
Major Industrial/Institutional Driveway Count	72			x	
Minor Industrial/Institutional Driveway Count	73			x	
Other Driveway Count	74			x	
Terrain Type	75	44	SHS and non-SHS sample panel		
Number of Signalized Intersections in Segment	76	31	SHS and non-SHS sample panel		
Number of Stop-Controlled Intersections in Segment	77	32	SHS and non-SHS sample panel		
Number of Uncontrolled/Other Intersections in Segment	78	33	SHS and non-SHS sample panel		
Annual Average Daily Traffic (AADT)	79	21	Federal Aid system	x	x
Percentage Trucks or Truck AADT	84		SHS and non-SHS sample panel		x
Total Daily Two-Way Pedestrian Count/Exposure	85				
Bicycle Count/Exposure	86				
Hourly Traffic Volumes (or Peak and Off-Peak AADT)	88		SHS		x
K-Factor	89	26	SHS and non-SHS sample panel		x
Directional Factor	90	27	SHS and non-SHS sample panel		x
One/Two-Way Operations	91	3	x	x	x
Speed Limit	92	14	SHS and non-SHS sample panel	x	x
School Zone Indicator	97				
On-Street Parking Presence	98		SHS and non-SHS sample panel	x	x
On-Street Parking Type	99	40	SHS and non-SHS sample panel	x	
Roadway Lighting	100			x	
Unique Junction Identifier	120			x	
Type of Intersection/Junction	121			x	
Intersection/Junction Geometry	126			x	
School Zone Indicator	127				
Circular Intersection—Bicycle Facility	137				
Intersection Identifier for this Approach	138			x	

Data Element	MIRE ID	HPMS ID	ITD Currently Collects	Highway Safety Manual	Highway Capacity Manual
Segment Identifier	12		x	x	
Unique Approach Identifier	139			x	
Approach AADT	140			x	x
Approach Mode	142				x
Approach Directional Flow	143			x	x
Number of Approach Through Lanes	144			x	x
Left Turn Lane Type	145		SHS and non-SHS sample panel		
Traffic Control of Exclusive Right Turn Lanes	149				
Number of Exclusive Right Turn Lanes	150			x	x
Median Type at Intersection	153				x
Approach Traffic Control	154				
Crosswalk Presence/Type	157				x
Pedestrian Signalization Type	158				x
Pedestrian Signal Special Features	159				x
Crossing Pedestrian Count/Exposure	160				x
Left Turn Counts/Percent	163		On request only		x
Right Turn Counts/Percent	165		On request only		x
Circular Intersection—Pedestrian Facility	175				
Circular Intersection—Crosswalk Location (Distance From Yield Line)	176				
Presence/Type of Bike/Ped Amenity					
ADA Ramp Compliance					
Truncated Dome Pad Presence					
Pedestrian Crossing Safety Island Width					
Bicycle Crossing Accommodation Presence/Type					
Width of Multi-use Path					x
Presence of Centerline on Path					x
Path Surface Type					x

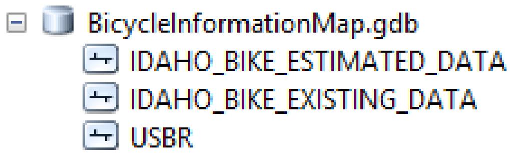
Data Element	MIRE ID	HPMS ID	ITD Currently Collects	Highway Safety Manual	Highway Capacity Manual
Segment Identifier	12		x	x	
Sidewalk Offset					x
Sidewalk Buffer Type					x
Bicycle Pavement Marking Type					
Bike Lane Buffer Width					
Protected Bike Lane Vertical Barrier Type					
Protected Bike Lane Orientation					
Neighborhood Greenway Designation					
Idaho Scenic Touring Route					
United States Bicycle Route System			x		

Appendix C. Bicycle Information Map User Guide

There are three ways to interact with the data associated with *Bicycle Information Map*.

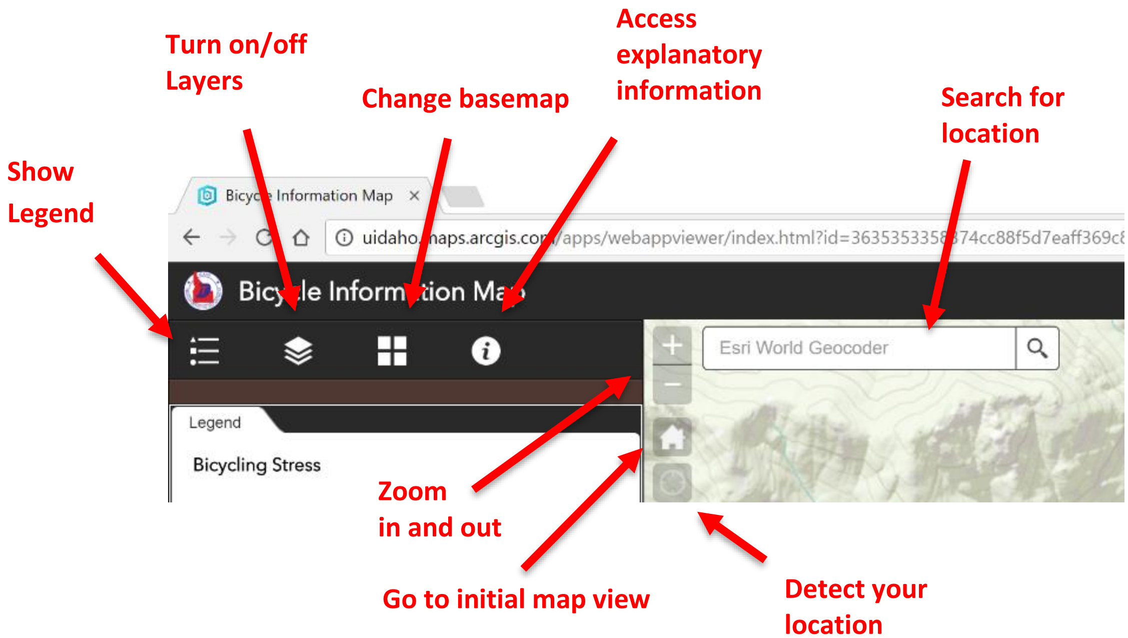
1. The data can be accessed through the REST service located here: http://services.arcgis.com/WLhB60Nqwp4NnHz3/ArcGIS/rest/services/BicycleMap/FeatureServer

2. The data can be downloaded.

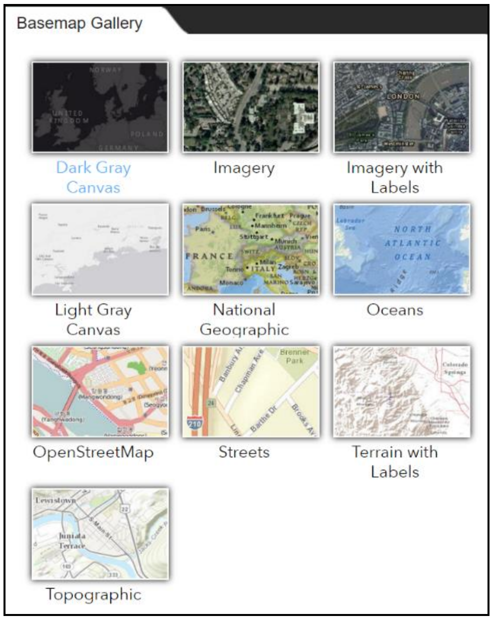


3. The data can be viewed and maps can be made directly through the website.

The website has various tools for viewing the data.

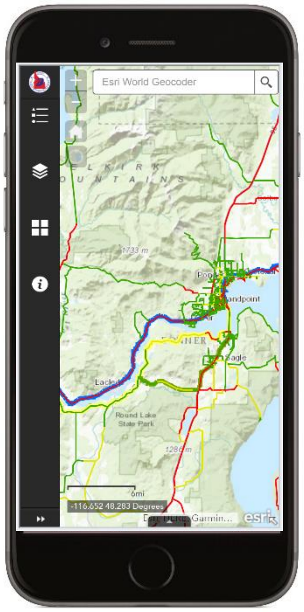


The legend is displayed for all layers that are turned on and visible at the current zoom level. The various layers all draw from the same geodatabase. Some layers are only visible when zoomed in to city level. Layers that overlap each other will not be visible. There are 9 basemap layers to choose from.



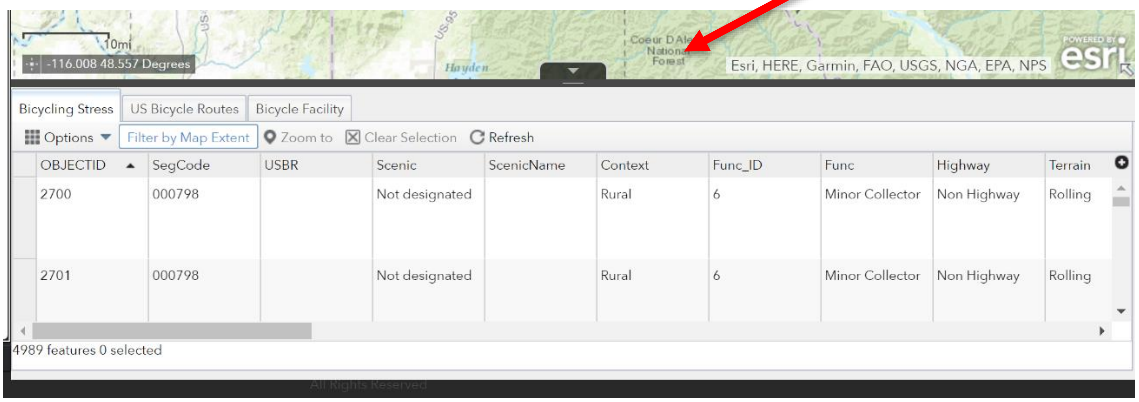
The about button provides a list of the attributes and links to information about the data. Zooming in and out can be achieved using the buttons or scrolling with a computer mouse. Search can be done for cities, landmarks, or specific street addresses. Location detection is possible if enabled in your browser.

The layout for the website is slightly different on small screen devices such as mobile phones and tablets.

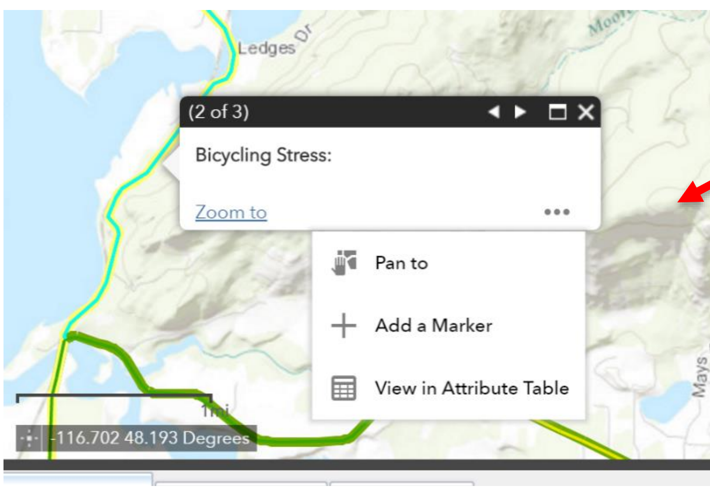


The attribute table for the database can be opened and closed by clicking on the tab on the bottom of the map.

Open and close the attribute table



The attributes for specific segments can be viewed by clicking on the segment and then clicking on the three dots in the pop-up window.



To view the attributes of a specific feature.

Appendix D. Estimation Assumptions and Process

The estimation process for the Bicycle Information Map is automated with a python computer programming script. The creation of the geodatabase takes about 60 minutes on a typical desktop computer. It is anticipated that ITD would run the python script in conjunction with ITD's regular GIS updating process.

Existing data, including the road network centerline file, were obtained from ITD´s online REST service located here:
https://gis.itd.idaho.gov/arcgisprod/rest/services/ArcGISOnline/IdahoTransportationLayers/MapServer/

Segments within urban areas were assigned Context = "Urban" and all other segments were labeled "Rural."

Roadways with undefined functional class in rural areas were removed. Roadways with undefined functional class in urban areas were assigned Func = "Local Street"

The estimation of missing values is done using look-up tables for functional class and context, regardless of whether or not variation exists across these attributes (for consistency and to allow for easy modification). The tables used January 2017 are shown below. See Appendix A for a description of each variable.

AADT

Functional Class	Urban	Rural
Interstate	80,000	30,000
Freeways and Expressways	15,000	20,000
Principal Arterial	10,000	7,000
Minor Arterial	7,000	3,000
Major Collector	2,000	900
Minor Collector	500	300
Local	100	50

HV

Functional Class	Urban	Rural
Interstate	0.17	0.15
Freeways and Expressways	0.10	0.12
Principal Arterial	0.07	0.10
Minor Arterial	0.03	0.05
Major Collector	0.01	0.03
Minor Collector	0.00	0.00
Local	0.00	0.00

K

Functional Class	Urban	Rural
Interstate	0.10	0.10
Freeways and Expressways	0.10	0.10
Principal Arterial	0.10	0.10
Minor Arterial	0.10	0.10
Major Collector	0.10	0.10
Minor Collector	0.10	0.10
Local	0.10	0.10

D

Functional Class	Urban	Rural
Interstate	0.6	0.6
Freeways and Expressways	0.6	0.6
Principal Arterial	0.6	0.6
Minor Arterial	0.6	0.6
Major Collector	0.6	0.6
Minor Collector	0.6	0.6
Local	0.6	0.6

1.0 for one-way road segments

PHF

Functional Class	Urban	Rural
Interstate	0.92	0.88
Freeways and Expressways	0.92	0.88
Principal Arterial	0.95	0.88
Minor Arterial	0.92	0.88
Major Collector	0.92	0.88
Minor Collector	0.92	0.88
Local	0.90	0.88

S

Functional Class	Urban	Rural
Interstate	65	75
Freeways and Expressways	35	60
Principal Arterial	35	55
Minor Arterial	35	40
Major Collector	25	35
Minor Collector	25	30
Local	25	30

Nth

Functional Class	Urban	Rural
Interstate	2	2
Freeways and Expressways	2	2
Principal Arterial	3	2
Minor Arterial	2	2
Major Collector	1	2
Minor Collector	1	1
Local	1	1

Wol

Functional Class	Urban	Rural
Interstate	15	15
Freeways and Expressways	15	15
Principal Arterial	12	12
Minor Arterial	12	12
Major Collector	12	12
Minor Collector	12	12
Local	12	12

Wos

Functional Class	Urban	Rural
Interstate	10	10
Freeways and Expressways	10	10
Principal Arterial	2	4
Minor Arterial	2	4
Major Collector	6	2
Minor Collector	6	1
Local	10	10

c

Functional Class	Urban	Rural
Interstate	0	0
Freeways and Expressways	0	0
Principal Arterial	1	0
Minor Arterial	1	0
Major Collector	1	0
Minor Collector	1	0
Local	1	0

Pc

Functional Class	Urban	Rural
Interstate	4.5	4
Freeways and Expressways	4.5	4
Principal Arterial	4.5	4
Minor Arterial	4.5	4
Major Collector	4.5	4
Minor Collector	4.5	4
Local	4.5	4

ppk

Functional Class	Urban	Rural
Interstate	0.01	0.01
Freeways and Expressways	0.01	0.01
Principal Arterial	0.00	0.00
Minor Arterial	0.10	0.10
Major Collector	0.30	0.10
Minor Collector	0.40	0.40
Local	0.60	0.60

Appendix E. Response to Feedback

Members of ITD´s Bicycle Pedestrian Advisory Committee (BPAC) and the Technical Advisory Committee (TAC) for this project were given access to a draft version of the online Bicycle Information Map. The draft map presents nine layers that can be turned on and off for the following data items:

- Level of Bicycling Stress
- US Bicycle Route 10
- Idaho's Scenic Byways
- Bicycle facilities
- Daily traffic
- Truck traffic
- Speed limits
- Shoulder width
- Bicycle Level-of-Service

The majority of the comments concerned Level of Bicycling Stress, which indicates High, Moderate, or Low Bicycling Stress with colors red, yellow, or green respectively. Various comments suggested the coloring was wrong (e.g. should be red instead of green or vice versa). Level of Bicycling Stress is determined based on characteristics of a roadway, including vehicle volume, speed limit, and number of lanes. ITD archives this data for some roadways. In locations where the data is not available, roadway characteristics were assumed based on the known functional classification of the roadway. Many of the issues that were identified were addressed by changing the assumptions.

The following table lists each comment/suggestion that was received and the action taken to resolve the issue.

#	Location	Issue/Concern/Suggestion	Reasons for situation	Resolution
1	Boise, River Run Drive	Bicycle stress is red, but should be green. Shows high speed, but should have low speed.	Mistake in computer code.	Fixed. Roadway segmentation is now working properly.
2	Boise, Law Ave	Bicycle stress is red, but should be green. Shows high speed, but should have low speed.	Incorrect AADT data from ITD? ITD data says Law Ave has 21% truck traffic, that is very high. We do not have speed limit data, but ITD calls it a Major Collector so speed was assumed to be 35mph and shoulder width assumed to be 4ft. The actual speed is 25 mph and shoulder width about 10 feet.	Partially Fixed. Changed to yellow with new assumptions for Major collectors: speed 25 mph and shoulder width 6 feet. Update ITD´s AADT data to get it to green?
3	Boise, East Parkcenter Boulevard	Bicycle stress is yellow, but should be red. It has 3 travel lanes, no shoulder, and speed limit of 35 mph.	Incorrect bike facility data from ACHD? And weakness of the BLOS equation. The data provided by ACHD indicates there is a bike lane present. If this is true, then the BLOS equation results in moderate stress (for the given vehicle volume). If this is not true, then the BLOS equation results in high stress. Even if there is a bike lane this example illustrates a known criticism of the BLOS equation, that is, that the equation is too forgiving with the presence of a bike lane. Many critics have complained that the equation is geared toward confident bicyclists, instead of most of the public. Often a “protected bike lane” would be better for most of the public.	Unresolved. Update ACHD´s data? Wait for improved equation from the federal government.
4	Boise, W Commerce	Bicycle stress is yellow, but should be red. Should have very high truck percent.	Incorrect AADT data from ITD? ITD data says W Commerce only has 5% truck traffic and 5,800 vpd.	Unresolved. Update ITD´s AADT data?
5	Boise, Enterprise Road	Bicycle stress is yellow, but should be red. Should have very high truck percent.	Mistake in computer code. And yes, ITD data says 17% truck traffic.	Fixed. Roadway segmentation is now working properly.
6	Everywhere	The GIS data should include information about parking regulations.	This was an oversight.	Fixed. The geodatabase now includes a field indicating if parking is allowed on the road segment.

#	Location	Issue/Concern/Suggestion	Reasons for situation	Resolution
7	Everywhere	The GIS data should indicate when values come from existing ITD data or when the data have been estimated.	This was an oversight.	Fixed. The geodatabase now includes two feature classes: 1. "Existing Data" and 2. "Estimated Data." In the former, if data is not available it is indicated with Null values. In the latter, if data was estimated it is indicated with a new field indicating as such.
8	Everywhere	At times the map was very sluggish. Maybe you could look into only showing certain data sets depending on the extent/amount you zoom in?	The layers were visible at all levels of zoom.	Fixed. Most layers are now only visible when zoomed in (an exception is the USBR layer).
9	Everywhere	Can you provide explanation of how BLOS is calculated?	Documentation had not been written yet.	Fixed. We now include a document explaining that BLOS is calculated according to the method recommended by the federal government (HCM method).
10	Everywhere	Can you provide explanation of Bicycling Stress?	Documentation had not been written yet.	Fixed. We now include a document explaining stress is merely a consolidation of the BLOS output: BLOS A and B = “Low stress” BLOS C and D = “Moderate stress” BLOS E and F = “High stress”
11	Moscow US95	Labeled as a freeway!	ITD data says it is a freeway!	No change This is true.
12	Moscow, Ring road	Phantom road that does not exist.	ITD data says this road is a minor arterial, but it does not exist.	Fixed. Changed the ITD functional class layer that is referenced.
13	Everywhere	The variables in the database should be defined.	Documentation had not been written yet.	Fixed. Documentation has now been written including a tab on the website with variable definitions.
14	Everywhere	Popup windows with layers, legend are confusing because they float all over the map.	Design preference.	Fixed. The layers and legend are now tabs rather than floating pop-up windows.
15	Everywhere	Until we can ensure that there is statewide consistency in the installation of in-street bike facilities based on volume and speed, we're not ready for mapping.	ITD does not currently have a standard for the installation of bicycle facilities based on volume and speed.	Partially Fixed. Created a video that prescribes a particular "class" of bike facility for a given volume and speed. Further work is needed for this system to be adopted by ITD, including defining standards for each class of facility.

#	Location	Issue/Concern/Suggestion	Reasons for situation	Resolution
16	Everywhere	Creating a map of our bike facilities and routes is basically implying that these suggested routes are safe for use.	The ultimate goal of this project is to improve safety. The first step is to know what and where bicycle facilities currently exist throughout the state. An inventory of existing facilities can assist to identify safety concerns, plan new facilities, prioritize projects and manage the existing system.	Partially Fixed. Added to the documentation a note to the user that neither bicycling stress nor any other layer implies a roadway is safe.
17	Lewiston	Clearwater Snake River National Recreation Trail not included.	Paths are local data and not currently archived by ITD.	Fixed. Devised protocol for collecting local data and to use Open Street Map data when local data is not available.
18	Boise and Kuna	Phantom road that does not exist: E Amity Road crossing I-84 near the Boise airport. Kuna-Mora Road near Swan Falls Road near Kuna.	ITD data says this road is a minor arterial, but it does not exist!	Fixed. Changed the ITD functional class layer that is referenced.
19	Boise, Curtis Road	Curtis Road south of Overland to Targee should probably be green. While there are no bike lanes, there is very little traffic.	Incorrect AADT data from ITD? ITD data says Curtis Road has 18% truck traffic,that is very high.	Unresolved. Update ITD´s AADT data?
20	Boise, Targee Road	Targee from Curtis to Orchard should probably be green. While there are no bike lanes, there is very little traffic on these streets and the roads are comfortably wide.	Incorrect AADT data from ITD? ITD data says Targee Road has 8% truck traffic (maybe due to buses). We do not have speed limit data, but ITD calls it a Major Collector so speed was incorrectly assumed to be 35mph and shoulder width assumed to be 4ft. The actual speed is 25 mph and shoulder width about 10 feet.	Partially Fixed. Changed to yellow with new assumptions for Major collectors: speed 25 mph and shoulder width 6 feet. Update ITD´s AADT data to get it to green?
21	Boise, Overland Road	Overland is currently correctly red from Cole to Orchard but why not the rest of Overland from Orchard to Vista and from Five Mile to Cole?	Incorrect AADT data from ITD? ITD data says 0% truck traffic. This is unlikely for a Principal Arterial with such a high AADT 32,000 vpd. Even a small increase in truck traffic, like 1%, moves the stress level to red.	Fixed. Changed to red with new assumption: minimum 1% truck traffic on Principal Arterials.

#	Location	Issue/Concern/Suggestion	Reasons for situation	Resolution
22	Boise, Cassia Road	Cassia between Borah HS and Orchard should be green, maybe yellow due to peak hour flow	ITD data says 10% truck traffic (maybe due to buses). We do not have speed limit data, but ITD calls it a Major Collector so speed was incorrectly assumed to be 35mph and shoulder width assumed to be 4ft.	Fixed. Changed to yellow with new assumptions for Major collectors: speed 25 mph and shoulder width 6 feet.
23	Boise, Franklin Road	Franklin from Maple Grove to Orchard should be red. East of Orchard, yellow is probably ok	This is due to a flaw in the BLOS equation: a street with no parking is given a better score under the assumption that there is no blockage. We are waiting for the Federal government to fix the equation (in the meantime I will do a workaround).	Fixed. With a workaround to the flawed BLOS equation (now using a minimum ppk of 0.1)
24	Boise, Victory	Doesn´t Victory from Maple Grove to Five Mile has bicycle lanes.	The bike lane data provided by ACHD does not indicate the presence of a bike lane, nor does Google Street View.	No change
25	Boise, Edna Street	Edna Street – Boise. Should it be Moderate Stress rather than High stress? Additionally for Large Truck Traffic: Edna is showing greater than 10 % when it should be less than 5%.	Incorrect AADT data from ITD? ITD data says Edna Street has between 11% and 18% truck traffic (maybe due to school buses).	Unresolved. Update ITD´s AADT data?
26	Everywhere	Other than that my only recommendation would be to clean up the tables a little bit, for example, when clicking on a segment in the Bicycle Facility network some extra information pops up (BMP, Seg Code, USBR) that could be hidden for the general public.	This was an oversight.	Fixed. Reduced the information in all layers except the primary "Stress layer" in which Brian suggested leaving everything for the interested user.
27	USBR 10	The overlap for USBR 210 and USBR 410 is confusing.	This was an oversight.	Fixed. Now labels overlap.

Appendix F. USBR 10 Story Map Items

The following table lists the items associated with the USBR 10 Story Map.

Type:	Name and Description
Applications	**U.S. Bicycle Route 10 – Idaho** *The US Bicycle Route 10 - Idaho Story Map application.*
	Elevation Profile Web Application *Web application that contains the navigation directions, an elevation widget, and a map for each section. Can be found embedded at the beginning of each USBR section in the story map application.*
Geoprocessing Models	**ZIP file** *Geoprocessing models have been included that produced the data that was used to create the charts/metrics (shoulder width; speed limit; daily traffic) for each section. An Excel document with the resulting data and charts are also included in the ZIP file.*
Feature Layers	**NewestForElevationApp (hosted):** *This map contains the single continuous line feature layer for the Elevation Web App*
	usbr10_4_story_map_final (hosted): *USBR 10 for ITD Story Map from original ITD data.*
	usbr10_4_story_map_final: *USBR 10 for ITD Story Map from original ITD data.*
Data/Tables	**USBR 10 EW NavigationSh2 3 (hosted):** *Table containing the navigation directions for USBR 10 from an East to West direction. This table is used to populate the web app that contains the elevation profile and the directions within the story map.*
	USBR 10 WE NavigationSh1 4 (hosted): *Table containing the navigation directions for USBR 10 from a West to East direction. This table is used to populate the web app that contains the elevation profile and the directions within the story map.*
Service Definitions	**NewestForElevationApp:** *A single feature map for use in the Elevation Web app. This is the service definition file for the feature service: NewestForElevationApp.*
	usbr10_4_story_map_final: *USBR 10 for ITD Story Map. This is the service definition file for the feature service: usbr10_4_story_map_final.*
PDFs	**Services_PriestRiver:** *Printable PDF with working links to the services available in Priest River.*
	Services_Dover: *Printable PDF with working links to the services available in Dover.*
	Services_Sandpoint: *Printable PDF with working links to the services available in Sandpoint.*
	Services_Hope-EastHope: *Printable PDF with working links to the services available in Hope and East Hope.*
	Services_ClarkFork: *Printable PDF with working links to the services available in Clark Fork.*
	Services_Sagle: *Printable PDF with working links to the services available in Sagle.*

	Services_Oldtown: *Printable PDF with working links to the services available in Oldtown.*
	Services_Ponderay: *Printable PDF with working links to the services available in Ponderay.*
	USBR 10 Maps: *Idaho Transportation Department's PDF maps of USBR 10.*
	USBR Nav - PDF – WE: *PDF of navigation directions riding West to East.*
	USBR Nav - PDF – EW: *PDF of navigation directions riding East to West.*
Images	**usbr-legend-large-main-route:** *Image showing the color of the Main Route used in the Overview.*
	usbr-legend-large-alt-route-410: *Image showing the color of Alternate Route 410 used in the Overview.*
	usbr-legend-large-spur-route-110: *Image showing the color of Spur Route 110 used in the Overview.*
	usbr-legend-large-alt-route-210: *Image showing the color of Alternate Route 210 used in the Overview.*
	Alt 210: *Static image of a map containing Alternate Route 210.*
	Alt 410: *Static image of a map containing Alternate Route 410.*
	Spur 110: *Static image ofa map containing Spur Route 110.*
	Main - CF-MT: *Static image of Main Route 10 - Clark Fork to Montana Border.*
	Main - Oldtown-Sandpoint: *Static image of Main Route 10 - Oldtown to Sandpoint.*
	Main - Sandpoint-CF: *Static image of Main Route 10 - Sandpoint to Clark Fork.*
	Main – Whole: *Static image of the entirety of Main Route 10 through Idaho.*
	overview-static: *Static image of the Northwestern US, highlighting the area in which USBR 10 through Idaho exists within a red box.*
	Whole Map: *Static image of Main Route 10, Alt. Route 210, Alt. Route 410, and Spur Route 110.*
	routes-static: *Static image of Main Route 10, Alt. Route 210, Alt. Route 410, and Spur Route 110.*
CSVs	**USBR 10 EW NavigationSh2 3:** *Comma Delineated Table containing the navigation directions for USBR 10 from an East to West direction. This table is used to populate the web app that contains the elevation profile and the directions within the story map.*
	USBR 10 WE NavigationSh1 4: *Comma Delineated Table containing the navigation directions for USBR 10 from a West to East direction. This table is used to populate the web app that contains the elevation profile and the directions within the story map.*

Videos	**Main Route 10: Clark Fork - Montana Border:** *"Flyover" videos were created using Google Earth and placed in a YouTube playlist called USBR 10 in an account called "Idaho Transportation" with the password "USBR2017" and **an email that needs to be changed to a ITD one**. The videos can be found embedded into the story map at the end of each route section.* *This video follows Main Route 10 from Clark Fork to the Montana Border. URL:* https://youtu.be/S33abBUu1Go?list=PLcsxGpPzAHImpwIYliCu5KJpy_PmOlx_S
	Main Route 10: Sandpoint - Clark Fork: *"Flyover" videos were created using Google Earth and placed in a YouTube playlist called USBR 10 in an account called "Idaho Transportation" with the password "USBR2017" and **an email that needs to be changed to a ITD one**. The videos can be found embedded into the story map at the end of each route section.* *This video follows Main Route 10 from Sandpoint to Clark Fork. URL:* https://youtu.be/Lc6iERybLH0?list=PLcsxGpPzAHImpwIYliCu5KJpy_PmOlx_S
	Main Route 10: Washington Border – Sandpoint: *"Flyover" videos were created using Google Earth and placed in a YouTube playlist called USBR 10 in an account called "Idaho Transportation" with the password "USBR2017" and **an email that needs to be changed to a ITD one**. The videos can be found embedded into the story map at the end of each route section.* *This video follows Main Route 10 from the Washington border to Sandpoint. URL:* https://youtu.be/Lfw6_ETc_-k?list=PLcsxGpPzAHImpwIYliCu5KJpy_PmOlx_S
	Alternate Route 210: *"Flyover" videos were created using Google Earth and placed in a YouTube playlist called USBR 10 in an account called "Idaho Transportation" with the password "USBR2017" and **an email that needs to be changed to a ITD one**. The videos can be found embedded into the story map at the end of each route section.* *This video follows the entirety of Alternative Route 210. URL:* https://youtu.be/ZpSNkfPLv_8?list=PLcsxGpPzAHImpwIYliCu5KJpy_PmOlx_S
	Alternate Route 410: *"Flyover" videos were created using Google Earth and placed in a YouTube playlist called USBR 10 in an account called "Idaho Transportation" with the password "USBR2017" and **an email that needs to be changed to a ITD one**. The videos can be found embedded into the story map at the end of each route section.* *This video follows the entirety of Alternative Route 410. URL:* https://youtu.be/1epFB69ySpk?list=PLcsxGpPzAHImpwIYliCu5KJpy_PmOlx_S
	Spur Route 110: *"Flyover" videos were created using Google Earth and placed in a YouTube playlist called USBR 10 in an account called "Idaho Transportation" with the password "USBR2017" and **an email that needs to be changed to a ITD one**. The videos can be found embedded into the story map at the end of each route section.* *This video follows the entirety of Spur Route 110. URL:* https://youtu.be/PJM8LU8xi7s?list=PLcsxGpPzAHImpwIYliCu5KJpy_PmOlx_S