

Highway Performance Monitoring System (HPMS): Concepts, Data Collection & Reporting Requirements

Module II



U.S. Department of Transportation
Federal Highway Administration



Module II Learning Outcomes

At the end of this module, you will be able to:

- Describe the structure and benefits of the of the HPMS data model
- Describe the various HPMS datasets
- Identify which datasets are to be submitted to FHWA

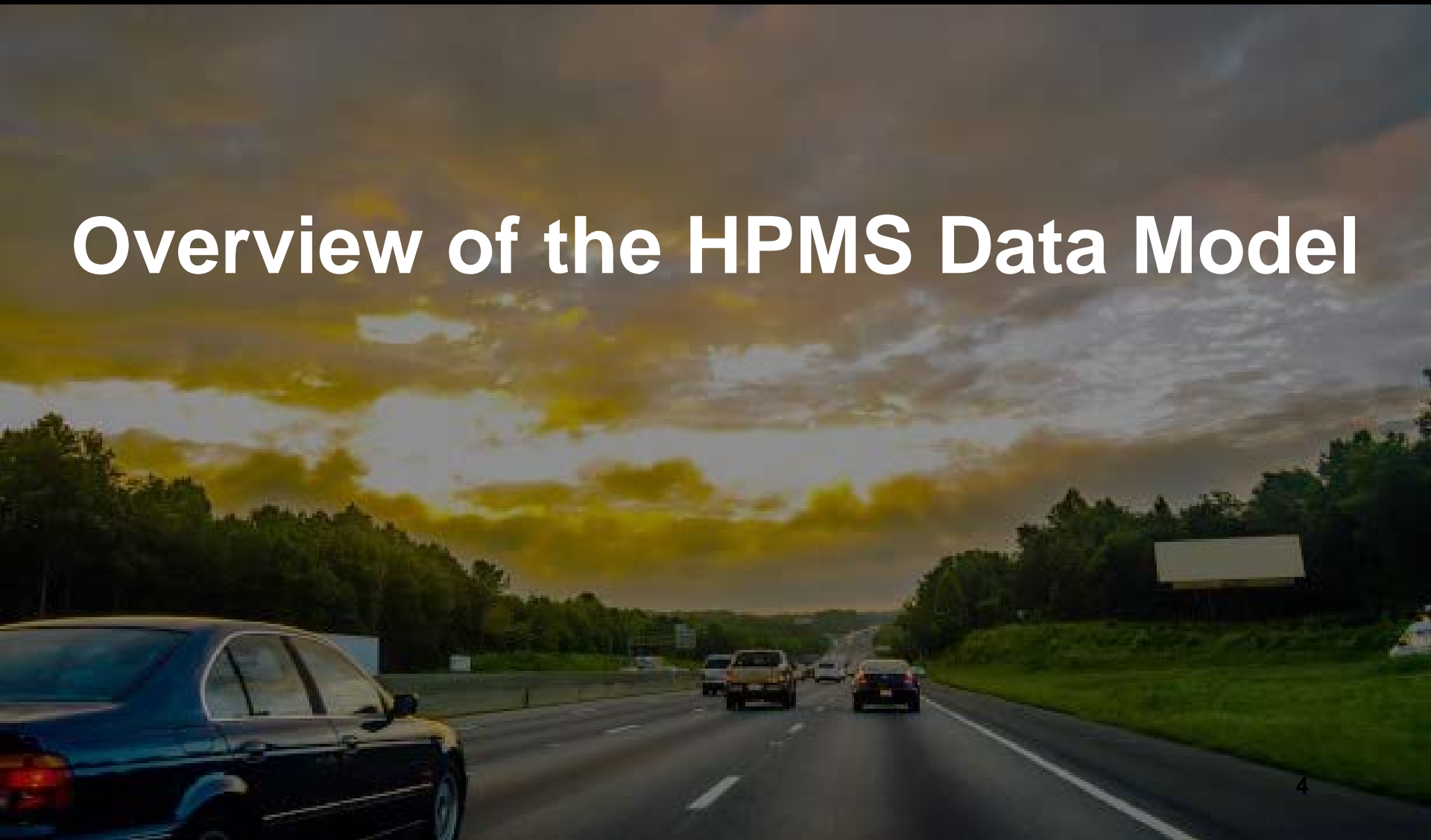
Data Model and Required Datasets

- Lesson 1
 - Overview of the HPMS Data Model
 - Examples of geospatial analysis using HPMS
- Lesson 2
 - Dataset Requirements and Specifications



Lesson One

Overview of the HPMS Data Model

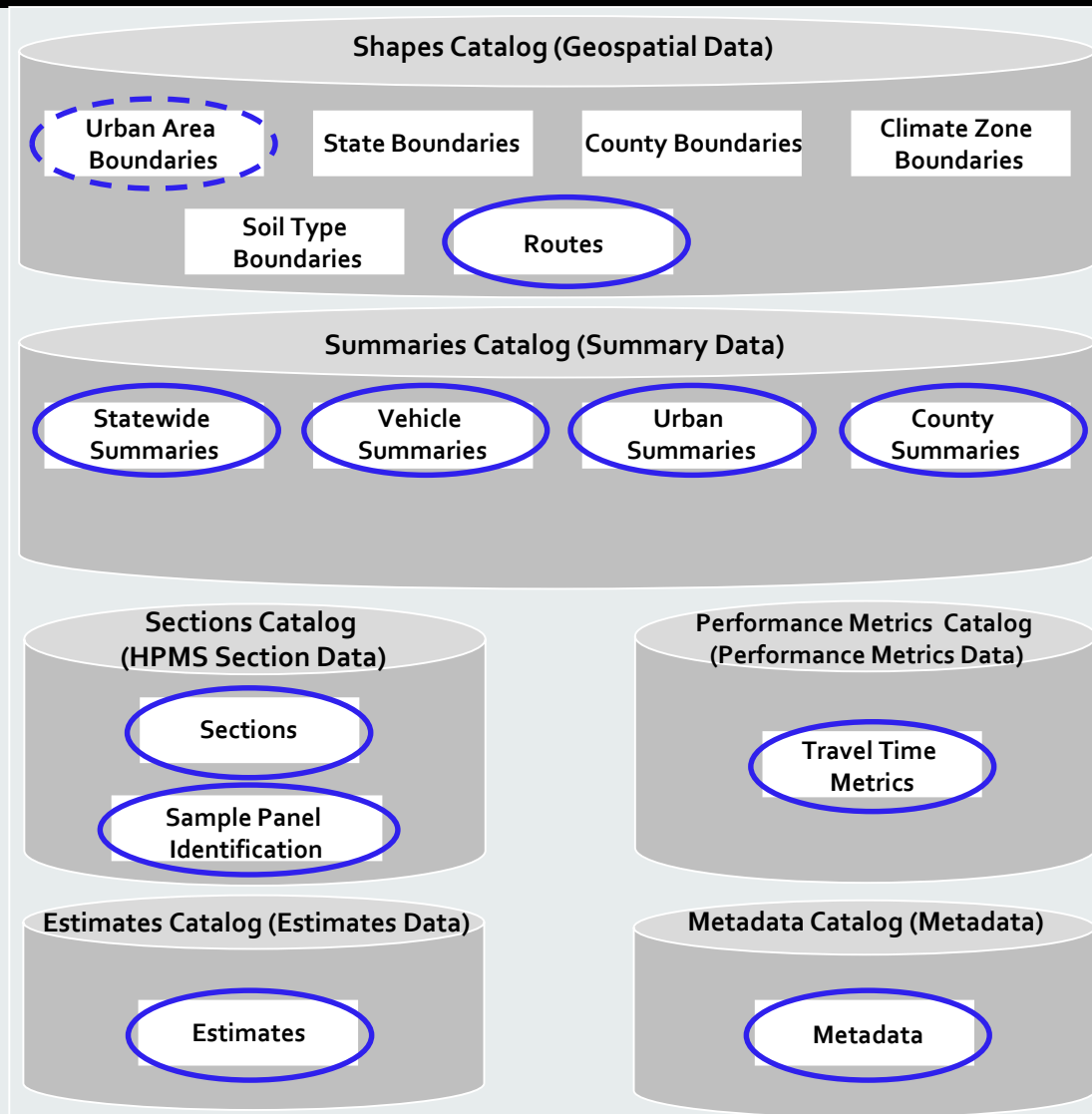


Data Model Key Concepts

- HPMS Data Model
 - Product of the 2010+ Reassessment
 - Transitional implementation in 2010
 - Full implementation in 2011
- Model improves HPMS program workflow
- GIS-enabled model enhances data management and analysis capabilities



HPMS Data Model Structure



Benefits of the Data Model

- Geo-spatially enables HPMS data for analysis purposes
- Exploits spatial relationships that exist between data elements
- Achieves flexibility in terms of data management
- Allows for the incorporation of external data

Uses of GIS-enabled Data

- Development of functional classification (FC) system maps
- Integration and analysis of various types of data
- QA/QC of HPMS section data attribute coding
- Generation of non-attainment area data



Data Integration (e.g., HPMS + NBI)

Active Item NBI **Active Query** SELECT Rads.Map_NBI_WKB.* FROM Rads.Map_NBI_WKB WHERE (**AQC:** 2205 **AHC:** 0

Map View (right-click map surface for tools)

Legend

Data Layers

- HPMS
- Vertex
- NBI

Distance 1

Status: Query results retrieved

IRI

- < 95
- 95 - 170
- > 170

Status: Query results retrieved

Age

- 1 - 10
- 11 - 20
- 21 - 30
- 31 - 40
- 41 - 50
- 51 and up

Identify Results

Matching Items

- NBI (search completed)
 - STRUCTURE_NUMBER_008='F-11-N'
 - STRUCTURE_NUMBER_008='F-11-O'
- HPMS (search completed)

Details for STRUCTURE_NUMBER_008='F-11-N'

OBJECTID	66469
DATA_YEAR	2010
STATE_CODE_001	8
State_Name	Colorado
County_FIPS	08037
STRUCTURE_NUMBER	F-11-N
RECORD_TYPE_005A	1
ROUTE_PREFIX_005B	1
SERVICE_LEVEL_005C	1
ROUTE_NUMBER_005	70A
DIRECTION_005E	0
HIGHWAY_DISTRICT_C	32
COUNTY_CODE_003	037
PLACE_CODE_004	80040
FEATURES_DESC_006	VAIL ROAD
CRITICAL_FACILITY_01	
FACILITY_CARRIED_01	1 70 ML WBND
LOCATION	IN VAIL
MIN_VERT_CLR_010	99.99
MI_PT	175.994
BASE_HWY_NETWORK	1
LRS_INV_ROUTE_013A	000000070A
SUBROUTE_NO_013B	0

Chart **Categorization:** Age **Data Table** **Statistics**

Questions???



Lesson Two

Dataset Requirements and Specifications

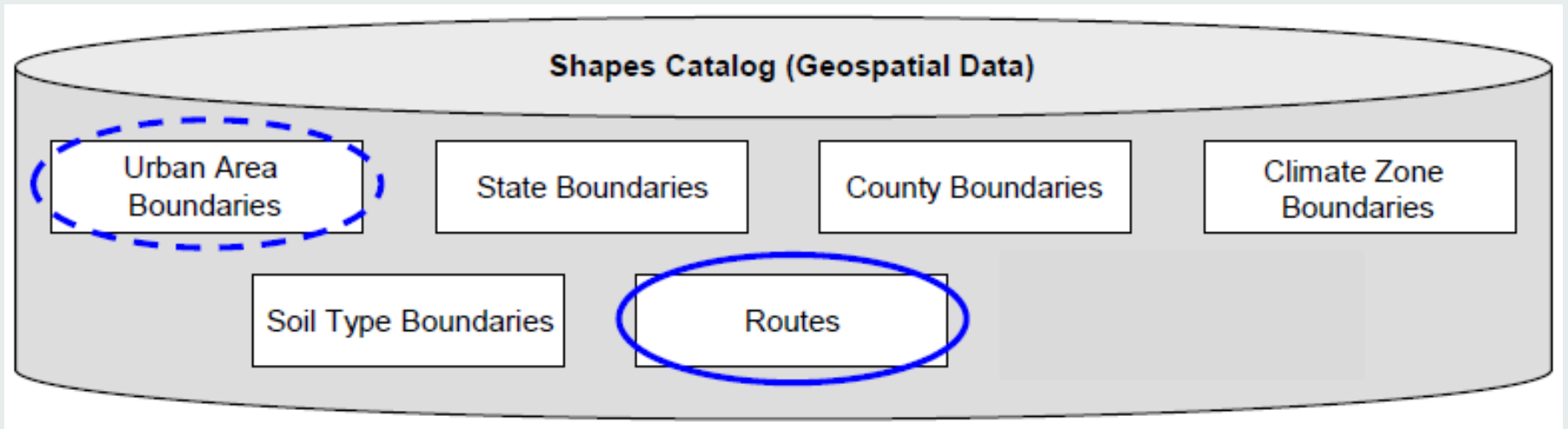
Datasets Overview

- States are required to develop/submit at most **11** datasets annually
 - Geospatial (2)
 - Non-Geospatial (**9**)
- Datasets have specific requirements
 - File Structure
 - Field Names
 - File Format
- Datasets convey roadway and system-wide attribute information

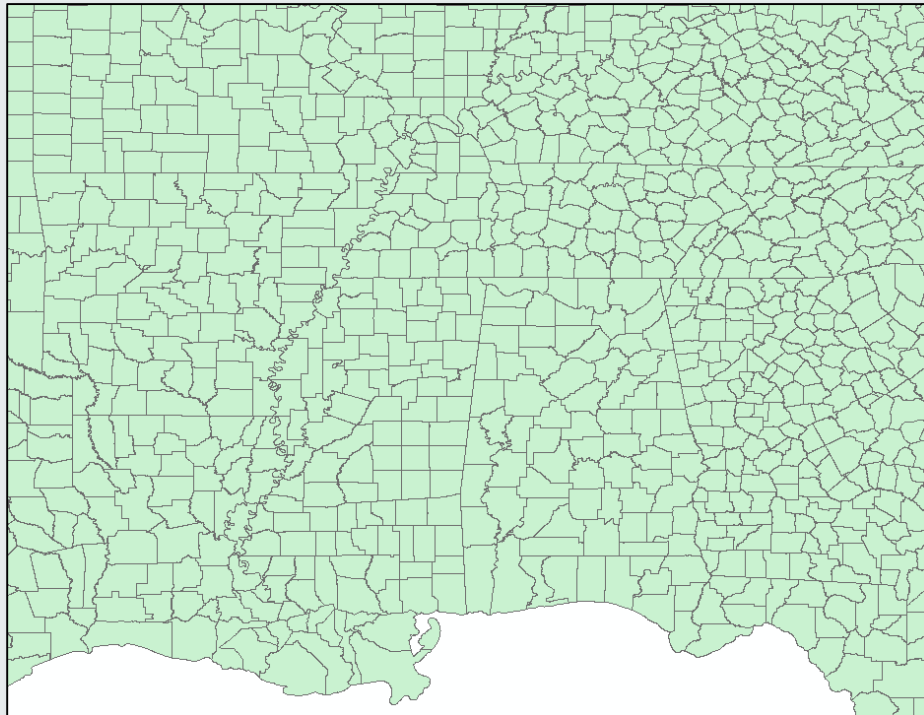
Datasets

- Stored as tables in FHWA's database
- Contain various fields of information
- Descriptors:
 - Field Constraints
 - Field Names (“English” and database names)
 - Data Types
 - Field Descriptions
- States are required to use field names specified by FHWA (i.e., database names)

Shapes Catalog



FHWA-MAINTAINED DATASETS

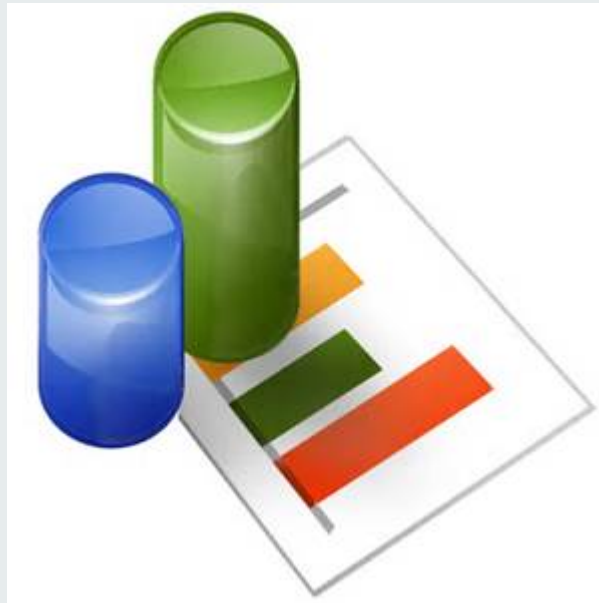


FHWA Maintained Datasets Summary

- Polygon feature datasets
- Dataset specifications can be found on pgs. 3-6 to 3-9 of the *HPMS Field Manual*

Name	Source	Key Fields
State Boundaries	US Census Bureau	State Code (FIPS)
County Boundaries	US Census Bureau	State Code and County Code (FIPS)
Climate Zone Boundaries	Long Term Pavement Performance (FHWA)	Climate Zone
Soil Type Boundaries	FHWA/AASHTO	Soil Type

STATE-PREPARED DATASETS



Routes Dataset

- Line feature dataset
- Depicts the States' public roadway networks (both paved and unpaved roadways)
- Developed and submitted by the States







Field Name	Description
Year_Record	Year for which the data apply
State_Code	State FIPS code
Route_ID	Unique ID for the linear feature
Comments (optional)	Text descriptor for the route
<i>Shape</i>	<i>Line feature</i>

Routes Dataset Requirements

- File Format Options:
 - ESRI Shapefile
 - Intergraph GeoMedia Access Warehouse
- Data Format Requirements:
 - Centerline geometry (for undivided highways)
 - Dual carriageway geometry (for divided highways)
 - Spatial Reference must be assigned
 - Projected or unprojected coordinates
 - Linear measures – miles, feet, etc.
 - Reference Scale - 1:100,000 or better

Related Guidance

SEPTEMBER 2014




ALL PUBLIC
ROADS GEOSPATIAL
REPRESENTATION STUDY

ALL ROAD NETWORK OF LINEAR REFERENCED DATA

ARNOLD

Reference Manual

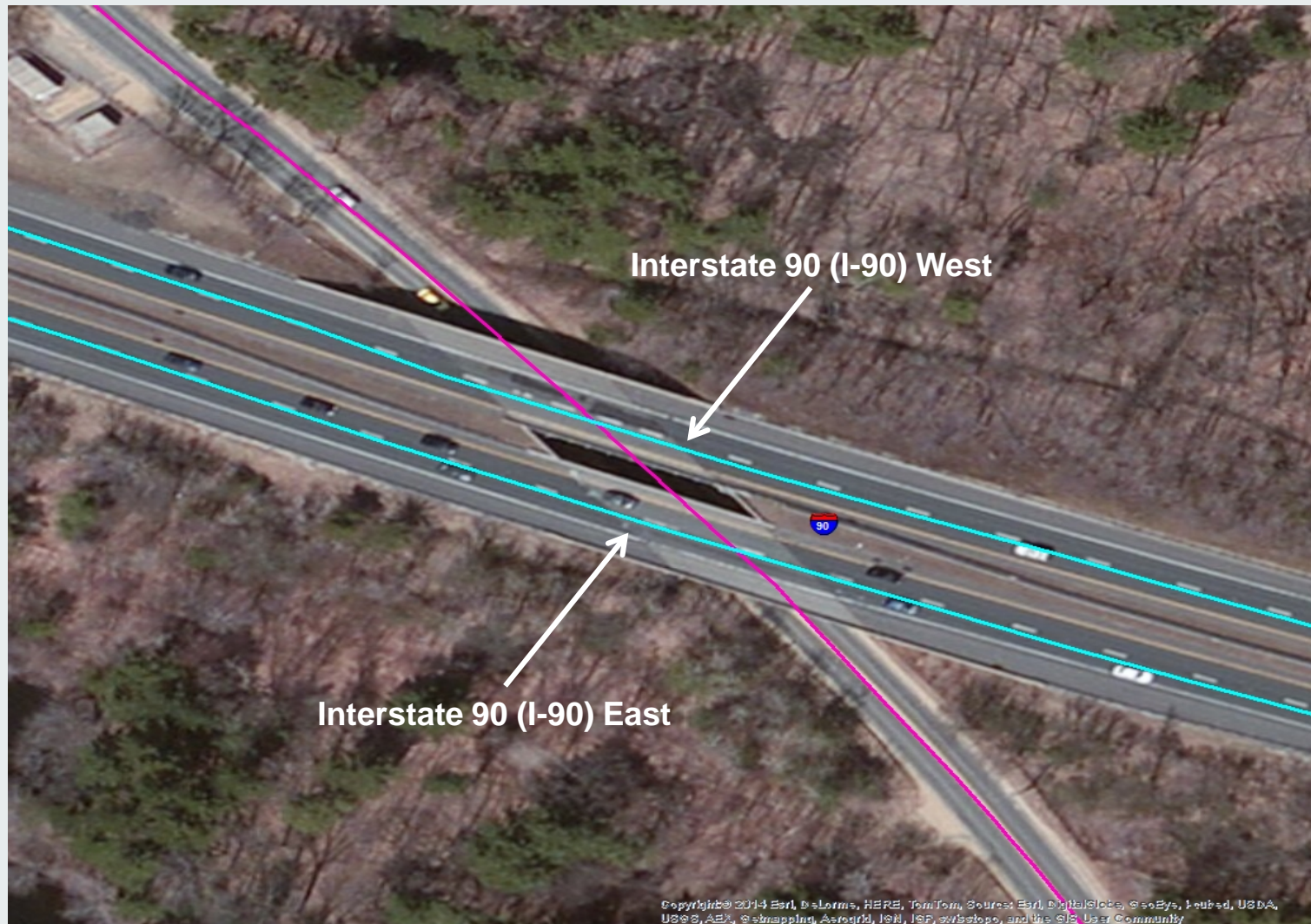


Federal Highway Administration
(FHWA)

Dual Carriageways (Divided Highways)

- Definition: “*Divided facility having a median with a positive barrier or width of at least 4 ft., with a length of at least 500 ft.*” (Source: FHWA)
- Key Considerations:
 - Predominant function of the roadway should be used to determine dual carriageway network configuration
 - Managed lane facilities (e.g., HOV lanes) may be best represented as LRS events rather than distinct linear features

Divided Highways Example

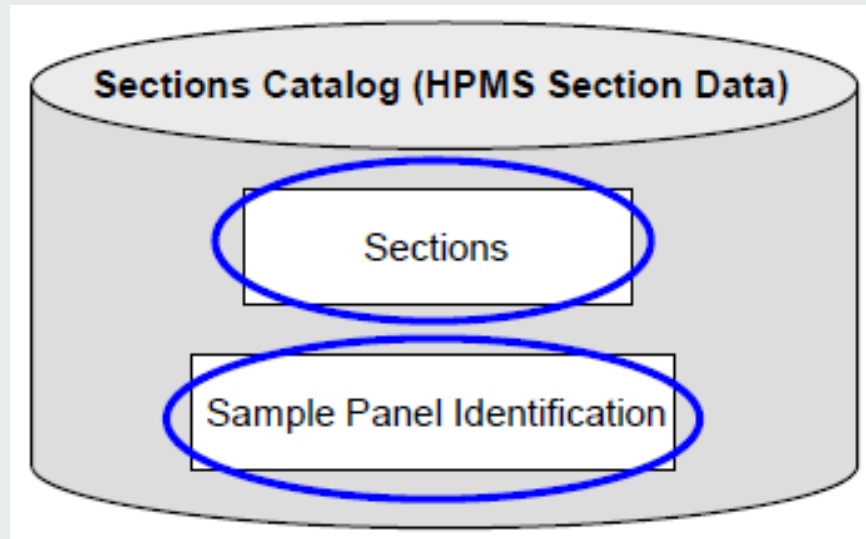


Urban Area Boundaries Dataset

- Polygon feature dataset
- Depicts Census-defined urbanized area boundaries
- Maintained by FHWA
- ***States are required to submit adjusted urbanized area boundaries***

Field Name	Description
Year_Record	Year for which the data apply
Urban_Code	Census urban code
Urban_Name	Urbanized area name
Census_Pop	Census population
Census_Land_Area	Census land area (in square miles)
<i>Shape</i>	<i>Polygon feature</i>

Sections Catalog



Sections Dataset

Field Name	Description
Year_Record	Year for which the data apply
State_Code	State FIPS code
Route_ID	Unique ID for the linear feature
Begin_Point	Beginning Milepoint
End_Point	Ending Milepoint
Data_Item	HPMS Data Item
Section_Length	Section length
Value_Numeric	Numeric value for the data item
Value_Text	Text value for the data item
Value_Date	Date value for the data item
Comments	Comment(s) for State-use

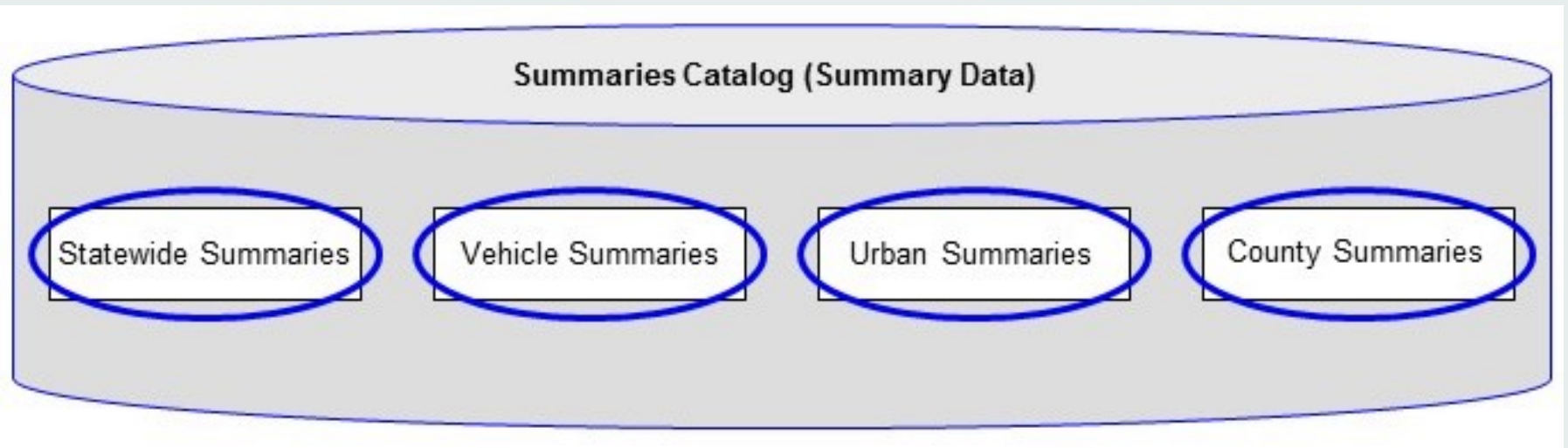
- Non-geospatial dataset
- Developed/submitted by the States
- Contains roadway section-level attribute data
- Extent: All Federal-aid roads and NHS routes

Sample Panel Identification Dataset

Field Name	Description
Year_Record	Year for which the data apply
State_Code	State FIPS code
Route_ID	ID for the linear feature
Begin_Point	Beginning Milepoint
End_Point	Ending Milepoint
Section_Length	Section length
Sample_ID	Sample Identifier
Comments	Comment for State use

- Non-geospatial dataset
- Developed/submitted by the States
- Contains the geographic limits of the sample panel (i.e., all sample sections)
- Used in conjunction with Sections data to create sample data file

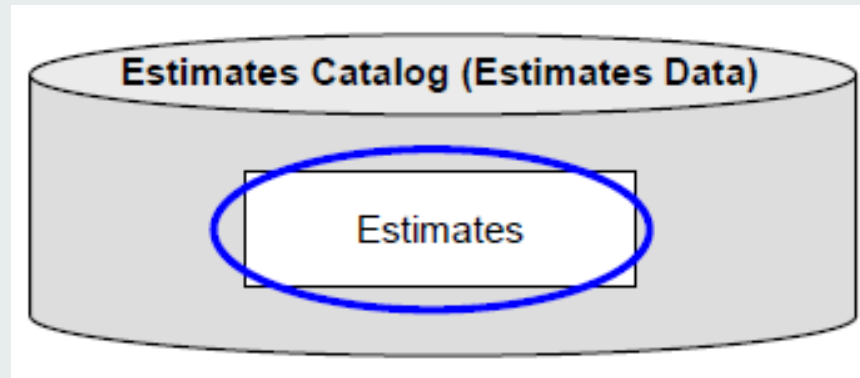
Summaries Catalog



Summary Dataset Overview

- Submitted annually
- Non-geospatial datasets
- Contains mix of data:
 - Demographic
 - System length
 - Vehicle-miles Traveled (VMT)
- Extent: varies by dataset –
 - Roads classified as rural minor collector or local (urban and rural)
 - Summarized by County, Urban Area, etc.

Estimates Catalog



Estimates Dataset

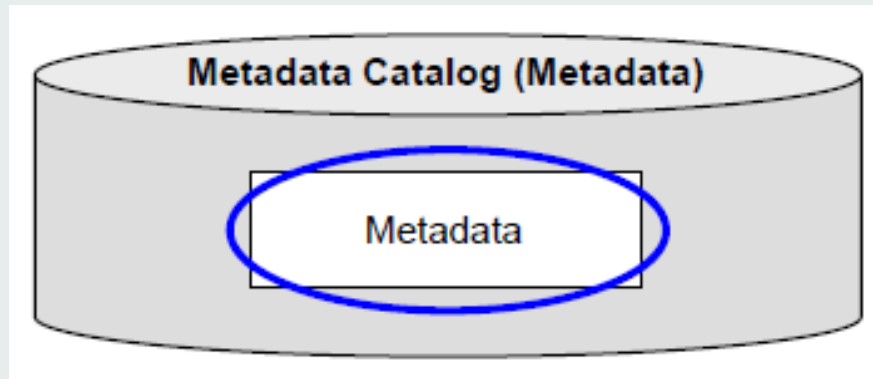
Field Name	Description
Year_Record	Calendar year for the data
State_Code	State FIPS code
Estimate_Type	Estimates Type
F_System	FHWA Approved Functional System
Is_Urban	Rural or Urban Area
Is_State_Owned	On-State/Off-State System
Value_Numeric	Numeric Value for Estimate

- Non-geospatial dataset
- Developed/submitted by the States
- Contains estimated values for pavement data

Current Estimate Items (8)

- Last Overlay Thickness
- Thickness Rigid
- Thickness Flexible
- Base Type
- Base Thickness
- Binder Type
- Dowel Bar (presence)
- Joint Spacing

Metadata Catalog



Metadata Dataset

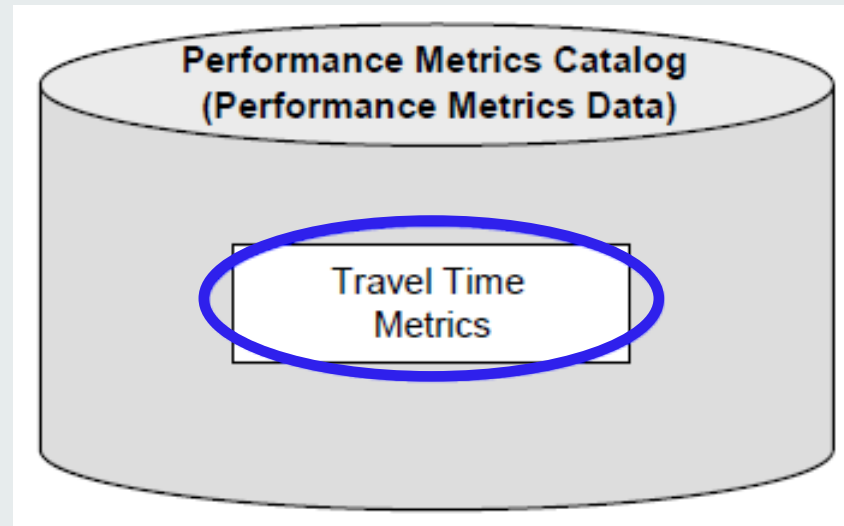
Field Name	Description
Year_Record	Calendar year for the data
State_Code	State FIPS code
Metadata_Type	Metadata Type
F_System	FHWA Approved Functional System
Is_Urban	Rural or Urban Area
Is_State_Owned	On-State/Off-State System
Value_Numeric	Numeric Value for Metadata

- Non-geospatial dataset
- Developed/submitted by the States
- Contains supplemental information on traffic and pavement data

Current Pavement Metadata Items (13)

- IRI
 - Reporting Interval, Sample Interval
- Rutting
 - Collection Method, Equipment Type, Sensors, Interval, Trans Profile Interval
- Faulting
 - Interval, Collection Method, Equipment Type
- Cracking Percent
 - Equipment Type, Collection Method
- Pavement Distress Reporting Method

Performance Metrics Catalog




Travel Time Metrics


- Directional Annual Average Daily Travel (AADT)
- Level of Travel Time Reliability (LOTTTR)*
 - AM, PM, Midday, Weekend
- Travel Time*
- Truck Travel Time Reliability*
 - AM, Midday, PM, Overnight, Weekend
- Truck Travel Time*
- Peak Hour Excessive Delay (PHED)*

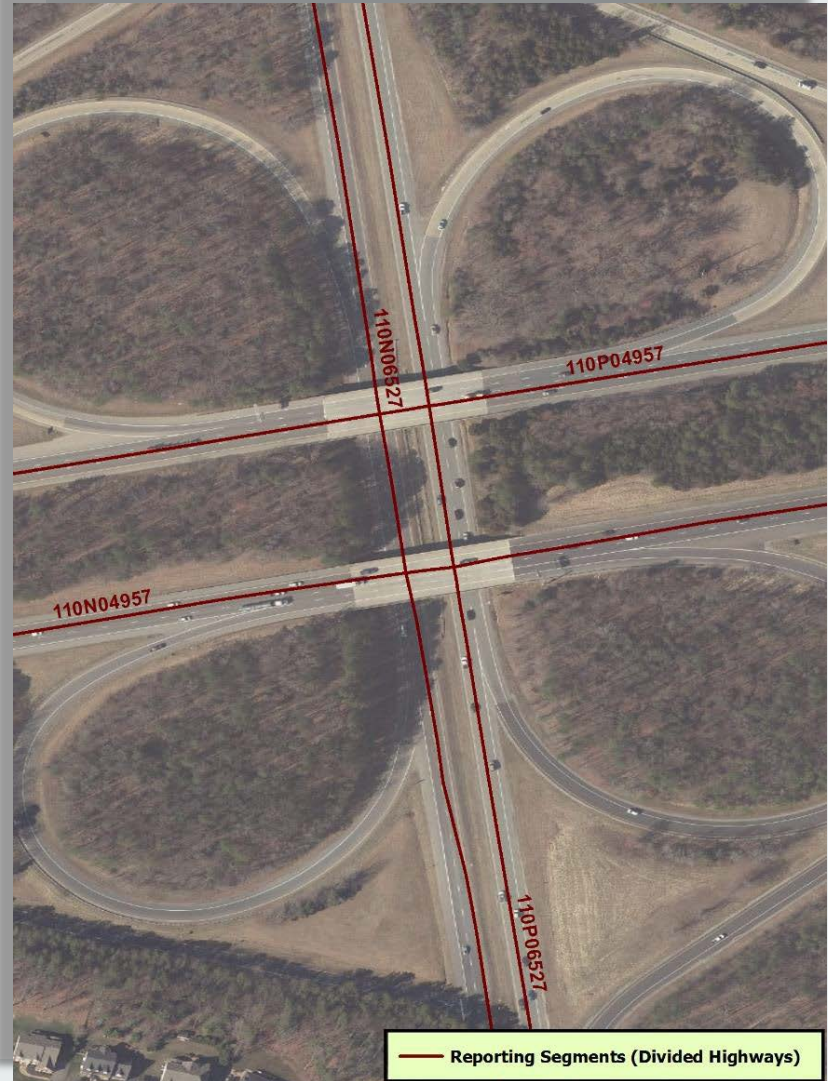


**The data needed to generate these metrics can be obtained either from the National Performance Management Research Dataset (NPMRDS), or an equivalent data source*

Travel Time Reporting Segments

 NPMRDS Reporting Segment

 HPMS Network Segment



Travel Time Metrics Dataset

- Non-geospatial dataset
- Developed/submitted by the States
- Contains roadway section (i.e., reporting segment)-level travel time and travel time reliability data
- Extent: All NHS roadways

Field Name	Description
Year_Record	Calendar year for the data
State_Code	State FIPS code
F_System	FHWA-approved functional classification system
Urban_Code	Census urban area code
Facility_Type	Operational characteristic of the roadway
NHS	FHWA-approved National Highway System designation
TT_Code	Unique identifier for a given reporting segment
Distance	Reporting segment length
Directionality	Direction of travel associated with a given reporting segment

NOTE: The dataset shall be developed per data obtained from either the National Performance Management Research Dataset (NPMRDS) or an equivalent data source

Travel Time Metrics Dataset (cont'd)

Field Name	Description
DIR_AADT	Annual Average Daily Travel (for a given direction of travel)
LOTTR_AMP	Level of travel time reliability (LOTTR) metric for "AM Peak."
TT_AMP50PCT	50 th percentile travel time for "AM Peak"
TT_AMP80PCT	80 th percentile travel time for "AM Peak"
LOTTR_MIDD	LOTTR metric for "Midday."
TT_MIDD50PCT	50 th percentile travel time for "Midday"
TT_MIDD80PCT	80 th percentile travel time for "Midday"
LOTTR_PMP	LOTTR metric for "PM Peak."
TT_PMP50PCT	50 th percentile travel time for "PM Peak"
TT_PMP80PCT	80 th percentile travel time for "PM Peak"
LOTTR_WE	LOTTR metric for "Weekend."
TT_WE50PCT	50 th percentile travel time for "Weekend"
TT_WE80PCT	80 th percentile travel time for "Weekend"
TTTR_AMP	Truck Travel Time Reliability (TTTR) metric for "AM Peak."
TTT_AMP50PCT	50 th percentile truck travel time for "AM Peak"
TTT_AMP95PCT	95 th percentile truck travel time for "AM Peak"
TTTR_MIDD	TTTR metric for "Midday."
TTT_MIDD50PCT	50 th percentile truck travel time for "Midday"
TTT_MIDD95PCT	95 th percentile truck travel time for "Midday"
TTTR_PMP	Truck Travel Time Reliability (TTTR) metric for "PM Peak."

Travel Time Metrics Dataset (cont'd)

Field Name	Description
TTT_PMP50PCT	50 th percentile truck travel time for "PM Peak"
TTT_PMP95PCT	95 th percentile truck travel time for "PM Peak"
TTTR_OVN	TTTR metric for "Overnight."
TTT_OVN50PCT	50 th percentile truck travel time for "Overnight"
TTT_OVN95PCT	95 th percentile truck travel time for "Overnight"
TTTR_WE	TTTR metric for "Weekend."
TTT_WE50PCT	50 th percentile truck travel time for "Weekend"
TTT_WE95PCT	95 th percentile truck travel time for "Weekend"
PHED	Total peak hour excessive delay (PHED) metric
<i>*OCC_FAC</i>	<i>Average vehicle occupancy factor</i>
METRIC_SOURCE	Travel time metric data source

Lesson 2 Summary

- State-prepared datasets consist of geospatial and non-geospatial data
- Each dataset has specific file structure and format requirements
- Datasets provide information on a roadway section-level and area-wide basis

Module II Quiz

1) At most, the States are required to develop and submit (to FHWA) how many datasets annually?

- a. 6
- b. 11
- c. 70
- d. 1



Module II Quiz

2) The LRS network that the States are required to develop and submit (to FHWA) annually must contain line-work (i.e. geometry) for which of the following?

- a. All Federal-aid roads
- b. The National Highway System (NHS)
- c. Principal Arterials only
- d. All public roads



Module II Quiz

3) Which of the following are acceptable median treatments for identifying divided highways in HPMS?

- a. Rigid barriers
- b. Mountable curb
- c. Medians of 4 feet wide or greater
- d. Both a and c



Module II Quiz

4) States are responsible for preparing and submitting which geospatial dataset annually?

- a. Routes
- b. Urban Area Boundaries
- c. Both a and b
- d. None of the above



Module II Quiz



5) Which of the following fields in the Routes dataset must contain a unique value for each record?

- a. Route ID
- b. Year of Record
- c. Beginning Milepoint
- d. Both a and c

Module II Quiz

6) The States are required to develop and submit the Urban Area Boundaries dataset to FHWA annually.

- a. True
- b. False



Module II Quiz

7) Which of the following datasets is to be used for reporting roadway attribute data?

- a. Sections dataset
- b. Urban Summaries dataset
- c. Routes dataset
- d. Estimates dataset



Module II Quiz

8) Which combination of fields in the Sections dataset is used to geo-locate attribute data?

- a. State Code, Beginning Milepoint, and Ending Milepoint
- b. Route ID, Beginning Milepoint, and Ending Milepoint
- c. Route ID, Section Length, and Data Item
- d. Year of Record, Data Item, and Comment



Module II Quiz

9) The Routes dataset must be submitted (to FHWA) as an ESRI shapefile?

- a. True
- b. False



Module II Quiz

10) Which field in the Sample Panel ID dataset serves as the unique identifier for a given sample section?

- a. Section Length
- b. Sample ID
- c. Route ID
- d. Both b and c



Questions???

