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

Module II

U.S. Department of Transportation
Federal Highway Administration

NHi
NATIONAL HIGHWAY INSTITUTE

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

Shapes Catalog (Geospatial Data)

Urban Area Boundaries

State Boundaries

County Boundaries

Climate Zone Boundaries

Soil Type Boundaries

Routes

NAAQS Area Boundaries

Summaries Catalog (Summary Data)

Statewide Summaries

Vehicle Summaries

Urban Summaries

County Summaries

NAAQS Summaries

Sections Catalog (HPMS Section Data)

Sections

Sample Panel Identification

Performance Metrics Catalog (Performance Metrics Data)

Travel Time Metrics

Estimates Catalog (Estimates Data)

Estimates

Metadata Catalog (Metadata)

Metadata

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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)

Questions???

Lesson Two

Dataset Requirements and Specifications

Datasets Overview

- States are required to develop/submit at most 12 datasets annually
  - Geospatial (2)
  - Non-Geospatial (10)
- 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
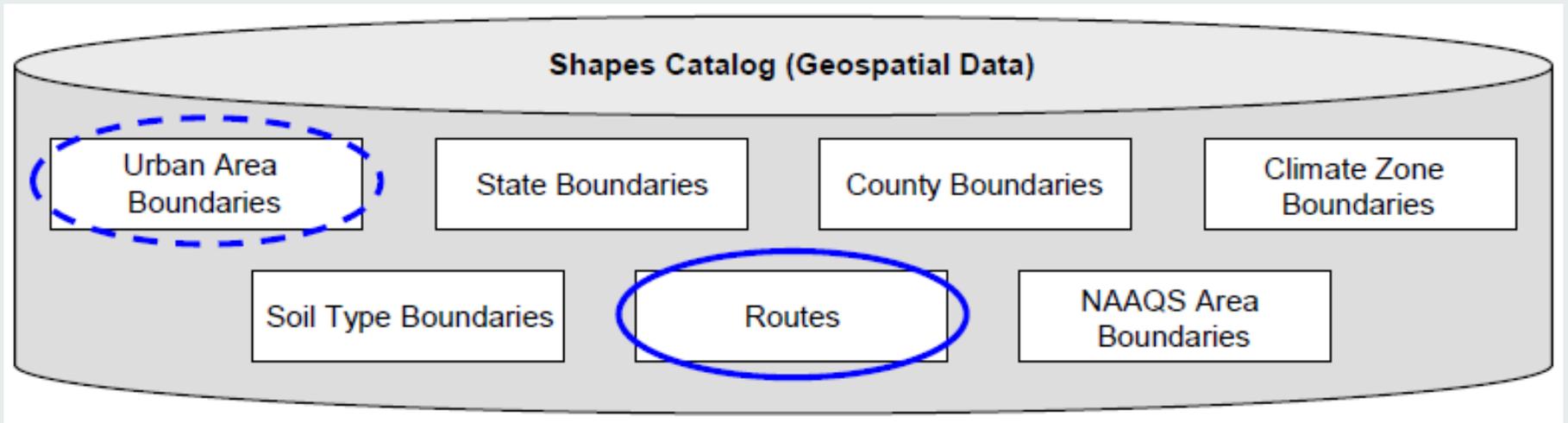
FHWA-MAINTAINED DATASETS
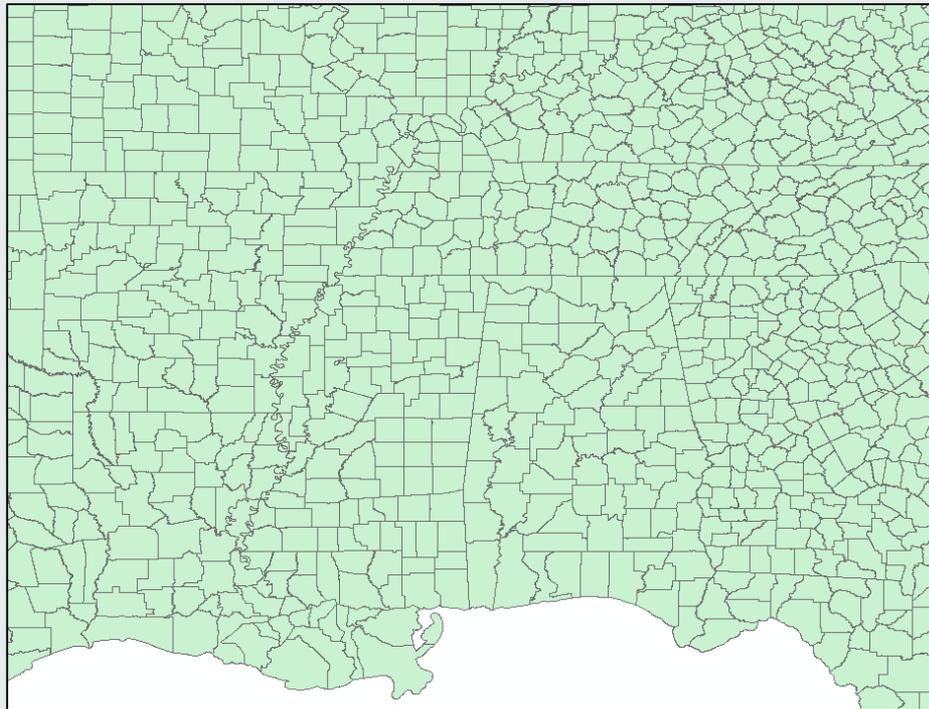
FHWA Maintained Datasets Summary

- 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
NAAQS (National Ambient Air Quality Standards)	EPA	Pollutant Standard

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STATE-PREPARED DATASETS
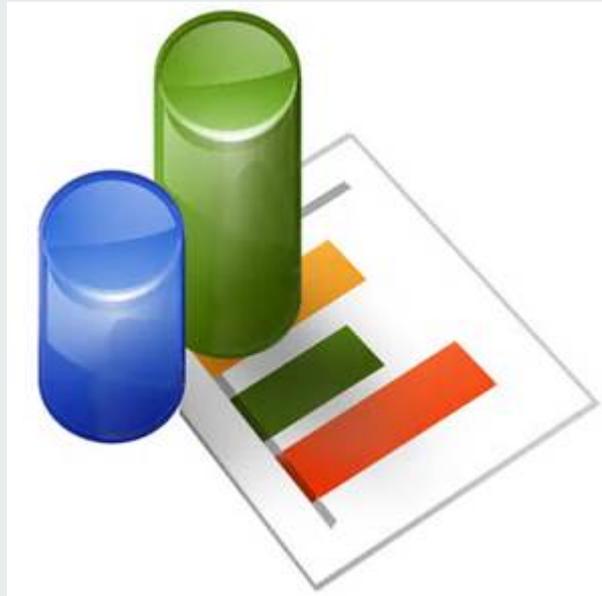
Routes Dataset

- 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
Shape	*Line feature*

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
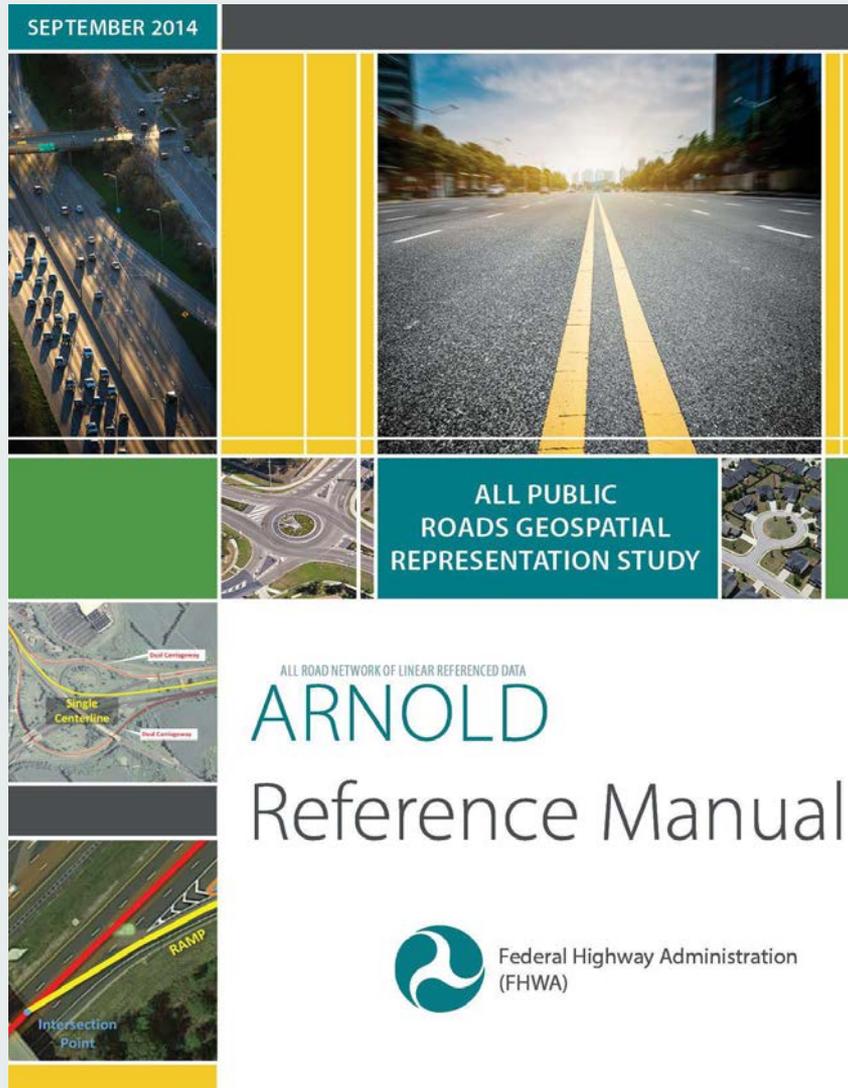
Dual Carriageways (Divided Highways)

- 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

Interstate 90 (I-90) West

Interstate 90 (I-90) East

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	Urban ized area name
Census_Pop	Census population
Census_Land_Area	Census land area (in square miles)
Shape	*Polygon feature*

Sections Catalog
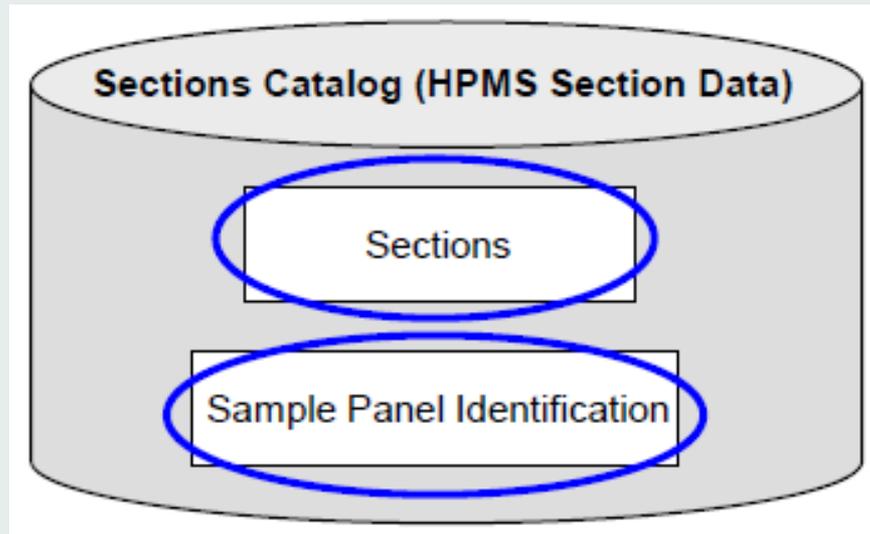
Sections Dataset

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
- <u>Extent</u>: 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
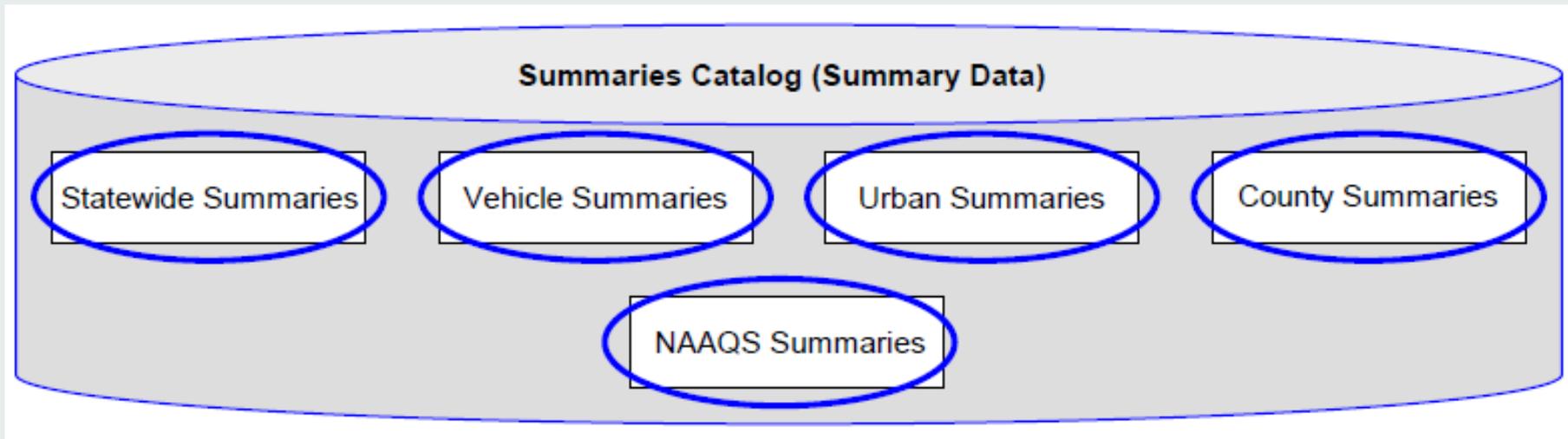
Summary Dataset Overview

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

Estimates Catalog
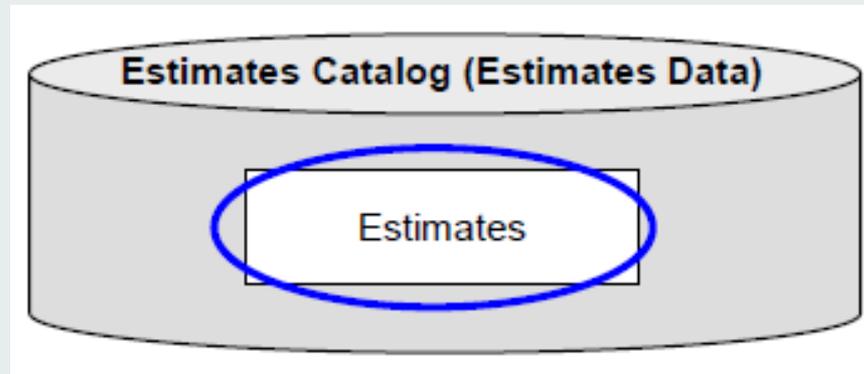
Estimates Dataset

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
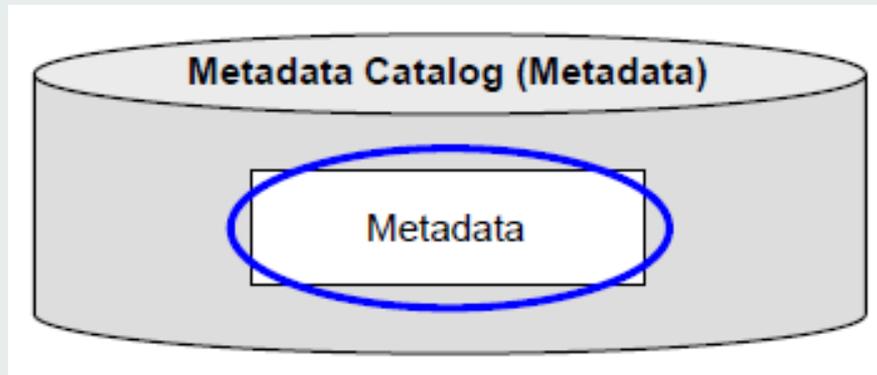
Metadata Dataset

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 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
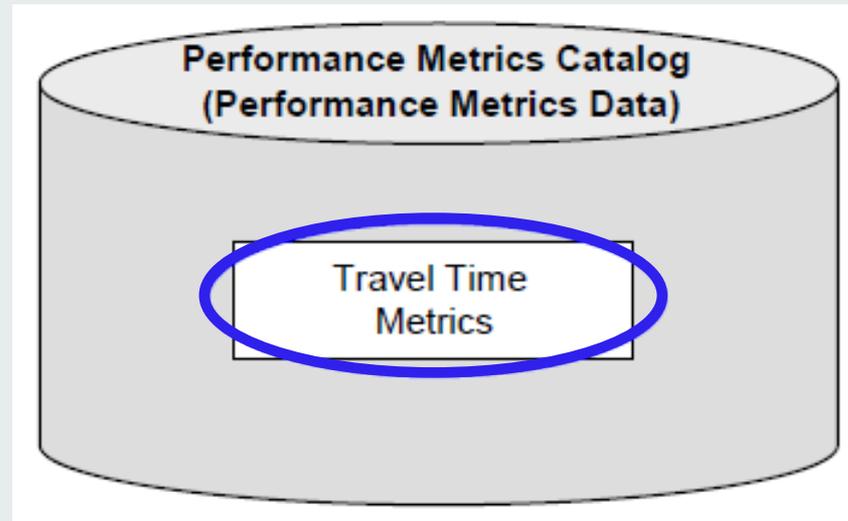
Travel Time Metrics Dataset

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

<u>NOTE</u>: 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	50th percentile travel time for "AM Peak"
TT_AMP80PCT	80th percentile travel time for "AM Peak"
LOTTR_MIDD	LOTTR metric for "Midday."
TT_MIDD50PCT	50th percentile travel time for "Midday"
TT_MIDD80PCT	80th percentile travel time for "Midday"
LOTTR_PMP	LOTTR metric for "PM Peak."
TT_PMP50PCT	50th percentile travel time for "PM Peak"
TT_PMP80PCT	80th percentile travel time for "PM Peak"
LOTTR_WE	LOTTR metric for "Weekend."
TT_WE50PCT	50 percentile travel time for "Weekend"
TT_WE80PCT	80 percentile travel time for "Weekend"
TTTR_AMP	Truck Travel Time Reliability (TTTR) metric for "AM Peak."
TTT_AMP50PCT	50th percentile truck travel time for "AM Peak"
TTT_AMP95PCT	95th percentile truck travel time for "AM Peak"
TTTR_MIDD	TTTR metric for "Midday."
TTT_MIDD50PCT	50th percentile truck travel time for "Midday"
TTT_MIDD95PCT	95th 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	50th percentile truck travel time for "PM Peak"
TTT_PMP95PCT	95th percentile truck travel time for "PM Peak"
TTTR_OVN	TTTR metric for "Overnight."
TTT_OVN50PCT	50th percentile truck travel time for "Overnight"
TTT_OVN95PCT	95th percentile truck travel time for "Overnight"
TTTR_WE	TTTR metric for "Weekend."
TTT_WE50PCT	50th percentile truck travel time for "Weekend"
TTT_WE95PCT	95th percentile truck travel time for "Weekend"
PHED	Total peak hour excessive delay (PHED) metric
*OCC_FAC	*Average vehicle occupancy factor*
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. 12
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) Which geospatial dataset is the States responsible for preparing and submitting 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???