Chapter 5 Presentation Script

Welcome to the Manual on Uniform Traffic Studies,
also called MUTS, computer based training!
This training module will cover Chapter 5 –
Data Collection for Transportation Safety Studies.
This training contains audio, so please adjust your speakers accordingly.
An alternate version is available on the resources page.
To begin select the start button or press Shift + N on your keyboard.

The purpose of this chapter is to provide guidance on the data collection requirements for transportation safety studies on non-freeway roadway segments and intersections data collection for conducting a transportation safety study.
The safety studies include those conducted through the application of the Highway Safety Manual, or HSM,
and the Safety Performance for Intersection Control Evaluation tool, also called SPICE tool.

Let’s take an initial look at the HSM Predictive Methods.
The HSM is organized by chapters and each of these shown on the slide cover a different facility type.

Chapter 10 is for 2 lane rural roads and Chapter 11 is for rural multi-lane highways.
For urban and suburban facilities, Chapter 12 is for urban and suburban streets between 2 and 5 lanes; NCHRP 17-58 is for urban and suburban streets between 6 and 8 lanes and one-way streets.
NCHRP 17-70 covers roundabout analysis and **Restricted** Crossing U-Turn also known as R CUT is covered through FDOT research.
We will revisit these resources later during this training -
it is helpful to have awareness of the sources, nonetheless,
it is crucial to understand the differences among the required data structure and how these will impact our data collection and subsequently our analysis.
Remember MUTS Chapter 5 covers data collection only as opposed to any analysis.
If further HSM training is needed please visit the FDOT Roadway Design/Quality Assurance/Training website for HSM webinars available on the resources page.

Let’s take a look at some safety studies basics.
The purpose of a transportation safety study is to identify potential hazards
and select possible safety countermeasures.
Transportation safety studies can be broadly classified as reactive to a given location's
crash history or **predictive** of a given location's potential crash frequency
based on its geometric and traffic characteristics.

During this training module, we will refer to sixteen data collection forms in excel format
stored on the MUTS online library through the FDOT’s Traffic Engineering
and Operations Office website.
Before continuing the training,
consider scanning the QR code using your phone camera
which directs you to the online library shown in this slide.
The link to the forms is also provided in resources page to this training.
Please open Forms 750-020-04 and 750-020-05a through 750-020-05o
as we will refer to them later in the module.

Before diving into the concepts, tools, and application,
we will go over the associated forms for this chapter.
These forms can be accessed by visiting the FDOT MUTS online library.
For purposes of this training, we will generalize the chapter forms in two bins:
one bin covers data collection forms for further transportation safety analysis
using HSM procedures while the second bin covers forms
for existing conditions reporting.
Let’s walk through each of these groups and forms.
We will begin with the data collection forms for safety analysis purposes.

We have four categories of roadway configuration:
Rural Two-Lane Roadway, Rural Multi-Lane Highway, Urban/Suburban Arterial for 2 to
5 lanes and Urban/Suburban Arterial for 6 to 8 lanes plus one-way roadways.
Each of these classifications has two data collection forms available:
one for segments and one for intersections.
Highlighted in red font are the forms associated to intersections only.
Lastly, we have data collection forms for safety analysis purposes
for Restricted Crossing U-Turn or RCUT**,** Roundabout, Oher Roadway Segments,
and Other Intersections.

Now let's now discuss existing conditions forms for reporting purposes.

Under existing conditions reporting, we have four available forms:
one is for condition diagrams, the next one is for collision diagrams –
intersection and segment templates, and the last one is for crash summaries.
We will walk through these in more detail later in the chapter.

Here is a snapshot of the data collection process for Transportation Safety Studies
and the corresponding forms available.
As previously noted, we have two general form bins:
one for data collection in order to conduct transportation safety studies
and the second one for existing conditions reporting.
The Roundabout and RCUT data collection spreadsheets correspond
to the SPICE tool for analysis.
These forms can be accessed by visiting the FDOT MUTS website
or by scanning the QR code
on the top right corner of this slide with a cellphone camera.

The predictive method presented in the HSM -
Part C allows for the computation of the predicted average crash frequency
and the expected average crash frequency at a given location.
The predicted average crash frequency consists of three primary components,
the safety performance function, also called SPF,
predicts average crash frequency for base conditions,
the crash modification factors, also called CMFs,
provides for modifications to the base condition for given geometric
or traffic control features, and the local calibration factors.
The expected average crash frequency
combines the predicted average crash frequency with historical crash data.
MUTS Chapter 5 describes the data collection components
required for the implementation of the predictive method.

The data collection steps outlined in this chapter support the implementation of HSM predictive analysis methods and the SPICE tool.
These analyses can be implemented using spreadsheet tools built to support the predictive method. The four spreadsheet-based tools include:

Number 1, the HSM Chapter 10 tool for rural two-lane roadways.
Number 2, the HSM Chapter 11 tool for rural divided and undivided highways.
Number 3, the HSM Chapter 12 tool for urban and suburban arterials.
Number 4, the NCHRP 17-58 tool for 6 to 8 lane roadways and one-way streets.

Note that while each of these spreadsheet-based tools have two corresponding forms for data collection – one for segments and one for intersections,
the analysis tools are built to accommodate both, intersections, and segments,
on a single excel and the same tool should be used for analyzing either one.
The analysis forms are described in further detail under MUTS Chapter 14.
Refer to Forms 750-020-21a through 750-020-21d for specifics on application.
These forms are detailed in the next slide.
Lastly, Number 5, **the** SPICE tool,
which applies only to intersections and is built to evaluate
and compare alternatives, including alternative intersection types such as roundabouts,
restricted crossing U-turns, and median U-turn intersections as part
of the Intersection Control Evaluation or ICE analysis.

Here is a snapshot of the process and the corresponding forms available under MUTS Chapter 14 – Roadway Lighting Justification Procedure.
The form selection in Step 2 will vary based on the facility type being analyzed.
These forms can be accessed by visiting the FDOT MUTS website or by scanning
the Q-R code on the top right corner of this slide with a cellphone camera.

Further detail and description of the HSM predictive method is available
through recorded webinars and training provided by FDOT Roadway Design/Quality Assurance/Training and can be found through links on the resources page.
Predictive method **implementation** tools, SPICE and the HSM spreadsheets,
can also be found on the FDOT website through the resources page.

The facility types falling within the HSM predictive method
are classified by their location,
rural versus urban or suburban, as well as their geometric layout,
number of lanes for segments and type of control for intersections.
HSM Section 12.3.1 provides the definition of "urban"
and "rural" based on FHWA guidelines.
"Rural" areas are defined as places outside urban areas
where the population is less than 5,000 persons.
The HSM uses the term "suburban" to refer to outlying portions of an urban area,
but the predictive method does not distinguish between suburban and urban.
"Urban" areas are defined as places inside urban boundaries where the population
is greater than 5,000 persons.

In Florida, we consider the urban boundary plus the one-mile buffer
to be urban/suburban.
A link to maps depicting Florida's Urban Areas
plus a 1-mile buffer from those Urban Areas can be found on the resources page
and are an excellent source to obtain this information.

This slide provides a visual representation for two examples:
the image to the left was taken in an urban setting while the image to the right
was taken in a rural setting.
Urban or rural classification for HSM analysis
has nothing to do with the existing roadway typical section.
If the roadway pictured to the right was within the urban boundary or 1-mile buffer,
it should be analyzed a as an urban / suburban roadway.

Facility types are further classified as intersections or segments for safety analysis.
A segment is measured from the midpoint of one intersection to the midpoint
of the next intersection.
Crashes are assigned to segments and intersections based on the crash characteristics
and the crash location.
Crashes occurring within the extended curb lines of the intersection are usually
classified as intersection crashes, while crashes occurring on intersection approaches
can be classified as intersection crashes if the crash occurrence
was influenced by the intersection or as segment crashes if the crash
was not influenced by the intersection.

As we discussed, facility types can range from rural roadways
to urban/suburban arterials.
When conducting data collection for segments,
we need to look at some considerations common to all roadway segments
regardless of the facility type.

Segments must be homogeneous,
meaning that a new segment is designated
when there is a change in any of the roadway characteristics
affecting the calculated average crash frequency.
For each segment facility type, **data** collection includes elements
for the calculation of the base safety performance function
or SPF as well as the applicable crash modification factor or CMF.
Each data collection form **is** color coded based on entry type,
yellow indicates that manual data entry is needed,
and blue indicates that data is entered by selection from a drop-down menu.

Facility types in the HSM predictive method include roadway segments and
intersections on undivided rural two-lane roads,
divided and undivided 4-lane rural multilane highways,
undivided urban and suburban arterials from 2 to 6 lanes,
divided urban and suburban arterials from 4 to 8 lanes,
and one-way urban and suburban arterials from 2 to 4 lanes.
Stop control and signalized intersections on these roadways are included
in the HSM predictive method.
Facility types not included within the HSM,
but available for analysis with the SPICE tool
include RCUTs, roundabouts, and 3-leg signalized intersections on rural roadways.

The recent development of safety performance functions for these facilities
has been incorporated in SPICE and may be added to future editions of the HSM.
Note that a corridor analysis can be done using the segment and intersection tabs
in a single analysis spreadsheet.
Refer to MUTS Chapter 14 for additional guidance on how to conduct the analysis
using the corresponding spreadsheets.

Now that we have covered the basic concepts for the data collection
for Transportation Safety Studies, let’s dive into the chapter forms.
The forms have a consistent format through the data collection sheets.
The heading of this form should be filled in completely. Identify the roadway ID,
roadway name, segment limits, location, analysis year, and project number.
Review the corresponding form notes prior commencing the data collection.
For each facility type and roadway configuration, the forms provide AADT thresholds
which are auto populated on the form.
Finally, record the data input based on the roadway conditions.

We will now discuss the data entry requirements for predictive analysis.
Initially we will focus on **HSM** Chapter 10 - Rural Two-Lane Two-Way Roads
and discuss both the segment and intersection analyses.

The next training slides will follow the order per facility type shown on this graphic.
Note that the table of contents on the left-hand side of the screen for this training can be
used to navigate to a facility type of interest or to different sections.

Form 750-020-05a is used for the collection of data
on rural two-lane two-way roadway segments.
Data required for this form include the AADT and segment length,
to be used to compute the base crash prediction,
as well as data for the completion of 15 CMFs.
Note the segment length is always recorded in miles.

The required data for CMF calculations include:
lane width, shoulder width and shoulder type for both right and left shoulders,
the length of any present horizontal curve, as well as the radius of curvature,
presence of spiral curve transition, and curve superelevation variance, grade,
driveway density, presence of centerline rumble strips, number of passing lanes,
presence of two-way-left-turn lanes, roadside hazard rating, presence of lighting,
presence of automated speed enforcement, and the last is the calibration factor.
We will cover **five** of these CMFs in more detail in the next slide.

For horizontal curve related data, it is important to note that the length of the curve applies to the entirety of the curve, even if it extends outside of the segment limits. The HSM states the base condition superelevation in a horizontal curve
is the amount of superelevation identified in the AASHTO Green Book.
The superelevation CMF is based upon the variation or the difference between the actual superelevation and the superelevation identified in the AASHTO Green Book.

When counting the number of driveways,
any driveways with at least once-daily use are to be counted.
Roadside Hazard Rating is determined on a 1 through 7 scale based on roadside design features such as side slope and clear zone width.
More detailed definitions of each rating and photographic examples
can be seen in the FHWA resource on the resources page.
Automated speed enforcement is currently not present for any roadway in Florida.

Let's take a look at an example for a two-lane two-way rural roadway.
This aerial shows a curved section of State Road 50 to be analyzed
to determine the safety effects of changing superelevation
and improving paved shoulders.
The data collection only focuses on the existing conditions.

First, we need to determine segmentation.
There are two unsignalized intersections:
one with County Road 755 and one with County Road 478A.
So, there will be **three** roadway segments from the beginning of study to the County Road 755 intersection as segment 1, between County Road 755 and County Road 478A intersections
as segment 2, and from the County Road 478A intersection to the end of study as segment 3. For this example, **we** will focus on segment 2.

It is important to understand where the data is going.
This slide shows the input tab in the analysis spreadsheet for rural two-lane,
two-way roadway segments.
This spreadsheet is known as the NCHRP 17-38 spreadsheet
and has three basic types of inputs.

First, for the SPF or safety performance function,
next for the CMF or crash modification factor and **the** last is the calibration factor.
We will address the calibration factors first which come from the FDOT Design Manual,
or FDM, Table 122.6.3 - HSM Calibration Factors for Florida.
The SPF and CMF inputs are the variables to be gathered
through the data collection effort for input in the analysis sheet.
Let’s take a closer look at the HSM Calibration Factors for Florida.

FDM Table 122.6.3 provides a summary of the available HSM Calibration Factors
for Florida by facility type. Where a Florida specific Calibration Factor is not available,
the analyst should use a value of 1.
The table is broken down by **segment** calibration factors and **intersection** calibration factors.
Note there are currently no Calibration Factors for 6 to 8 lanes and one-way facilities.
Also, there are no calibration factors for roundabouts.

It is also important to understand CMFs have "base conditions" as shown here.
The rural, two-lane, two-way roadway segment CMFs
are listed here with the base condition.
When the existing roadway condition matches the base condition, the CMF is 1.00.
Data needs to be gathered either from existing plans or supplemental information,
review of current aerial photography,
a field review or all three to complete the data collection form.
Much of the information contained on this table was developed from existing plans.

So, let’s look at Form 750-020-05a which is for data collection for the elements
to be entered into the NCHRP 17-38 spreadsheet
for rural two-lane roadway segments.
The length of segment can be determined from the roadway stationing
and is expressed in miles. It is 0.281 miles. The AADT is 5,380.

These are the two functions needed for the **SPF** calculation.
The remainder of data collection is for the CMFs
and most of this is determined from plan's review.
The lane width is 12 feet.
The shoulder widths on both sides are 4 feet
and are composite being a combination of paved and grass stabilized.

As was seen in the aerial, there is a horizontal curve
which extends beyond this roadway segment.
The length of the curve is **0.3** miles and has a radius of 1,433 feet.
The curve does not have any spiral transition curves.
The AASHTO superelevation for this curve is 0.092 feet per foot
and the actual superelevation is 0.073 feet per foot so the superelevation variance
is 0.019 feet per foot. The grade is flat or 0.

There are no driveways in this segment, so this value is 0.
There are no centerline rumble strips,
no passing lane nor two-way left turn lanes present.
The roadside hazard rating is 3 meaning an approximate 10-foot clear zone
with a 3 to 1 side slope.

There is no **roadway** lighting or automated speed enforcement in this segment.
The calibration factor from FDM Table 122.6.3 - HSM Calibration Factors
for Florida is 1.00.

Data collection for rural two-lane roadway intersections uses Form 750-020-05e.
This form covers intersection types included in HSM Chapter 10,
which are 3-leg stop-controlled intersections, 4-leg stop-controlled intersections,
and 4-leg signalized intersections.
Analysis for other intersection types, including 3-leg signalized intersections
can be completed using the SPICE tool and its corresponding data collection form.
Data collected on this form includes **intersection** type and AADT
for the major and minor roadways, which are used for calculating the base SPF.

The intersection skew angle, number of signalized or uncontrolled approaches
with a left-turn lane, number of signalized or uncontrolled approaches
with a right-turn lane, **presence** of intersection lighting,
and calibration factor are also to be collected on this form.
Data required for this form will be used to compute the base crash prediction,
as well as data for the completion of four CMFs.
Let’s take a closer look at **the** intersection skew angle CMF.

The intersection skew angle is measured as the deviation
of the intersection angle from 90 degrees.
If the skew angle differs for each minor road leg of a 4-leg stop-controlled intersection,
then a CMF is computed for each leg and then averaged together
to give a single CMF for the intersection.

Let's go back to the State Road 50 two lane example.
As you may recall, this roadway segment has two 3-leg, unsignalized intersections.
The one with County Road 478A was chosen for this example.
This intersection **has** single lane approaches on each of the 3-legs.

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Let's walk through completing Form 750-020-05e
for rural two-lane roadway intersection.
The intersection type being 3 or 4 leg stop control or 4 leg signalized
needs to be selected.
This is a 3 ST for 3 leg stop control intersection.

The major and minor roadway two-way AADTs are recorded as shown
on the corresponding fields.
If one leg has higher volumes than the opposite leg,
the higher volume is chosen.
The skew angle is entered, and this is 40 degrees.
The number of approaches with left or right turn lanes
can be determined from the aerial to be zero.
Intersection lighting is not present,
and the Florida Calibration Factor from FDM Table 122.6.3 is 1.27.
This completes the data collection for the rural two-lane roadway forms.

The next facility type we will cover is Rural Multilane Highway Segments
under HSM Chapter 11,
and we will discuss both the segment and intersection analyses.

Form 750-020-05b is used for the collection of data on rural multilane highway segments.
For the base SPF crash prediction, the roadway type - divided or undivided,
segment length and AADT are required.
Required data for CMF calculations include **lane** width, shoulder width and type,
median width, side slope, presence of lighting, presence of automated speed enforcement
and the last is the calibration factor.
We will cover three of these CMFs in more detail in the next slide.

Shoulder width and type refers to the right-side shoulder for divided highways,
and if shoulder width differs in each direction of travel, then the average should be used.
Possible shoulder types include paved, gravel, turf, or composite,
which is a combination of paved and turf.
Median width is not applicable to segments with median barriers,
as the CMF becomes 1 in this case.
The side slope measurement applies only to undivided highways and is recorded
as a ratio from 1-to-2 to 1-to-7.

Let's look at another example on State Road 50 for widening the existing two-lane road
to a four-lane divided roadway.
The proposed **typical** section is shown in this graphic.

First, we select this to be a **divided** roadway.
The segment length is entered in miles to be 2.02 miles.
We also enter the AADT.
In this case, we are using a future AADT based upon the future four-lane widening.
The proposed typical section provides us the lane width and the shoulder width.
The lane width is proposed as 12 feet.
The typical section identifies a 5-foot paved shoulder
and a 7-foot grass shoulder.
Per HSM definitions, this is a composite shoulder.

A 10-foot shoulder width is the maximum allowed for HSM calculations
and this is entered.
The median width is 40-foot.
The form says the "side slopes" CMF is only applicable to undivided roadways,
so this is left blank.
The roadway does not have lighting nor automated speed enforcement,
so both are "Not Present". Per FDM Table 122.6.3 the calibration factor is 1.63.
These values are for proposed condition and would be used
in something like a Project Development and Environment or PD&E Study.

Data collection for rural multilane highway intersections is completed utilizing Form 750-020-05f. Similar to rural two-lane roadway intersections,
this form covers the intersection types included in HSM Chapter 11,
which are 3-leg stop-controlled intersections, 4-leg stop-controlled intersections,
and 4-leg signalized intersections.

Again, analysis for other facility types,
including 3-leg signalized intersections can be carried out
using the SPICE tool and its corresponding data collection form.
The data elements collected for rural multilane highway intersections
are identical to those previously discussed for rural two-lane roadway intersections.
Data required for this form will be used to compute the **base** crash prediction,
as well as data for the completion of four CMFs.

Let's continue the State Road 50 example
showing a rural 4-leg stop-controlled intersection
on the future 4-lane State Road 50.
This drawing is from the PD&E study to widen State Road 50
and shows the proposed intersection at Porter Gap Road.
There will be left turns off the major roadway in both directions.
No improvements are proposed on the minor leg approaches.
Also notice the minor approaches cross the intersection
at a skew angle which measures
to be 70 degrees.

In completing Form 750-020-05f for rural multi-lane highway intersection,
the intersection type is identified as 4-leg stop controlled or 4TH.
The AADTs from the PD&E study are entered as well as the 70-degree skew angle.
The number of left turn lanes are 2
and notice this is only for non-STOP controlled approaches.
There are no right turn lanes but again this is only applicable
to non-STOP controlled approaches.
Intersection lighting is not present, and the calibration factor
taken from FDM Table 122.6.3 is 1.64.
This completes the data collection for the rural multilane highway forms.

The next facility type we will cover is Urban Suburban Arterials for 2 to 5 lanes under HSM Chapter 12, and we will discuss both the segment and intersection analyses.

Data collection for Urban and Suburban Arterial segments uses Form 750-020-05c. Corresponding with HSM Chapter 12, this applies to 2 lanes undivided roadways, 4-lane divided and undivided roadways, and 3 lane and 5 lane roadways with a two-way left turn lane.
The roadway type, segment length,
and AADT are required roadway features to compute
the SPF for base crash prediction.

The urban and suburban roadway types that are eligible for this form are:
2U or 2-lane undivided,
3T or 3-lane including a center two-way left-turn lane,
4U or 4-lane undivided, 4D or 4-lane divided,
and 5T or 5-lane including a center two-way left-turn lane.

Data collected for CMF calculation incudes type of on-street parking,
proportion of curb-length with on-street parking,
median width, presence of lighting,
presence of automated speed enforcement,
driveway counts for major commercial,
minor commercial, major industrial, minor industrial,
major residential, minor residential,
and other driveway types, speed category, roadside fixed object density,
offset distance to roadside fixed objects, and calibration factor.
We will cover four of these CMFs in more detail in the next slide.

Median width is not applicable to segments with median barriers,
as the CMF becomes 1 in this case.
Major driveways are defined as those serving sites
with 50 or more parking spaces.
The speed category indicates if the posted speed limit
is greater than 30 miles per hour,
or 30 miles per hour or less.
Roadside fixed objects are counted only on the right side of the roadway,
not in the median.

Objects are counted if they are at least 4 inches in diameter
and do not have a breakaway design.
Objects that are continuous such as a fence and not behind other point objects
are counted as 1 object for each 70 feet of length.

Let's look at this example on Orange Avenue south of Orlando.
This is an existing 5-lane roadway being evaluated to become 4-lane divided.
We are to conduct a predictive safety analysis for the existing condition.
The aerial shows the analysis begins at Office Court and continues to Lancaster Road.
There are four signalized intersections at Office Court,
Perkins Road, Nela Avenue and Lancaster Road.
There are 3 segments between these intersections.
We will focus on Segment 2 which extends from Perkins Road to Nela Avenue
for the analysis application.
The review of existing aerial photography combined
with a field review reveals the input data shown in the table.
Let’s focus on completing Form 750-020-05c using this information.

We start Form 750-020-05c with completing the heading
and identifying the roadway type.
In this case we have a five-lane roadway with a two-way left turn lane or 5T.

The mileposts for Segment #2 are provided and were obtained
from the FDOT straight line diagram.

Always enter length of segment in miles in this case it is 0.261 miles.
The AADT is obtained and entered.

The remainder of the entries are based upon a combination of aerial and field review. There is no parking present along the corridor. With the two-way left turn lane **there** is no median.

Further, there is no roadway lighting nor automated speed enforcement present. The definition of major and minor driveways is provided in HSM Section 12.6.1 and says major driveways serve sites with 50 or more parking spaces. Minor driveways are those serving less than 50 parking spaces. These values are determined using aerial photography and are entered on the form.

The posted speed limit is 45 miles per hour being greater than 30 miles per hour. The number of fixed objects is counted and converted to a per mile value and the average offset is 18 feet. The calibration factor from FDM Table 122.6.3 is 0.70.

Data collection for urban and suburban arterial intersections uses Form 750-020-05g. This is applicable to intersections of roadways with 2 to 5 lanes on the major street. Intersection type, AADT on the major and minor approaches, the presence of lighting, and the calibration factor are collected for both signalized and unsignalized intersections. These are the input for the base crash prediction.

For unsignalized intersections, the number of major-road approaches with left-turn lanes and the number of major-road approaches with right-turn lanes is also collected. For signalized intersections the following data elements are collected: the number of approaches with left-turn lanes, the number of approaches with right-turn lanes, the number of approaches with left-turn signal phasing, the type of left-turn signal phasing for each of those approaches, the number of approaches with right-turn-on-red prohibition, the presence of red-light cameras, the sum of all pedestrian crossing volumes, the maximum number of lanes crossed by a pedestrian, the number of bus stops within 1,000 feet, the number of schools within 1,000 feet, and the number of alcohol sales establishments within 1,000 feet.

For the CMFs, there is a CMF whether intersection lighting is present
in addition to 2 CMFs for unsignalized intersections
and 14 CMFs for signalized intersections.
We will cover **four** of the signalized intersection CMFs in more detail in the next slide.

The sum of all pedestrian crossing volumes is measured
across all legs for the entire day,
this value can be measured or estimated based on activity level.
The maximum number of lanes crossed by a pedestrian includes
both turning and through lanes that must be crossed in a single crossing movement
without the use of a refuge island.

For the number of schools within 1,000 feet of the intersection,
schools are counted if any portion of the school grounds falls within 1,000 feet
of the intersection.
The number of alcohol sales establishments
within 1,000 feet of the intersection
counts any type of business that sells alcohol, including liquor stores,
bars, restaurants, convenience stores, or grocery stores.

Let's continue with the Orange Avenue example;
we selected Nela Avenue as it is signalized
and requires more data for the analysis.
The nearby railroad crossing is not a factor in this safety analysis,
and it is not addressed.

The Nela Avenue approaches are a single shared thru/right/left-turn lane
on the west approach and an exclusive left-turn lane
plus a shared thru/right-turn lane on the east approach.
A field review was conducted to obtain the remainder
of the data shown on this table.

The completion of Form 750-020-05g is similar to the other forms.
The heading along with other data such as **intersection** type which in this case is 4SG or 4-leg, signalized, major and minor approaches AADT, presence of intersection lighting and the calibration factor are entered.

The data for unsignalized intersection is left blank as this information is not applicable.
As previously noted, when evaluating a signalized intersection for urban and suburban arterials more information is required.

First regards intersection geometry and signal operation.
The number of approaches with left and right turn lanes are recorded.

We have 3 approaches with left turn lanes and no approaches with right turn lanes.
We also need to note the number of approaches with left turn signal phasing and the type of signal phasing per leg.
These are pull down menus and it is important for the type of left turn phasing to use those on the pull down to avoid any typing errors.

The number of approached with right turn on red prohibited is recorded, in this example is 0.
Next, the analyst should record whether red light cameras are present.
In our example, there are no red-light cameras.
Some of the other unique entry data is the sum of pedestrian crossing volumes being for all four approaches and being a daily volume.

It also requests the maximum number of lanes crossed by a pedestrian which in this case is on Orange Avenue and would be 5 lanes.
The number of bus stops within 1,000 feet of the intersection are recorded and there are two at the intersection and one north, totaling 3 bus stops.

There are no nearby schools.
There is one alcohol sales establishment within 1,000 feet of the intersection.

As previously noted, these are defined as any establishment selling alcohol to include grocery stores and convenience stores.
This completes the data collection for the urban suburban arterials for 2 to 5 lanes forms.

The next facility type we will cover is Urban Suburban Arterials for 6 to 8 lanes and one-way streets completed through NCHRP 17-58, and we will discuss both the segment and intersection analyses.

Data collection for Urban and Suburban Arterial segments uses Form 750-020-05L. Corresponding with work completed through NCHRP 17-58, this applies to roadways with 6 to 8 lanes and one-way streets.

The urban and suburban roadway types that are eligible for this data collection form are: 6U or 6-lane undivided, 6D or 6-lane divided, 7T or 7-lane including a center two-way left-turn lane, 8D or 8-lane divided, 2O or 2-lane one-way, 3O or 3-lane one-way, and 4O or 4-lane one-way.

Roadway type, segment length, and AADT are required roadway features to compute the SPF for base crash prediction. Data collected for CMF calculation includes the type of on-street parking, proportion of curb-length with on-street parking, outside shoulder width, median width, presence of median barriers, number of highway-rail grade crossings, driveway counts for major commercial, major industrial, and minor driveways, roadside fixed object density, offset distance to roadside fixed objects, and calibration factor.

We will now look at the data collection requirements for a short section of State Road 535 just south of Interstate 4.

As seen in this aerial this roadway is 6 lanes divided and has a 22-foot-wide raised median. It has 40 and 45 miles per hour posted speed limits and the existing year AADT is 49,700 vehicles per day. The roadway has curb and gutter with sidewalk at the back of curb on the east side. Let's take a look at the data requirements shown on Form 750-020-05L.

The first requirement is to enter the roadway type
which is 6 lanes divided or 6D.
The roadway segment length is 0.21 miles which is from the center
of the I-4 intersection to the center of the signalized intersection
of Meadow Creek Drive and Lake Vining Drive to the south.
The AADT of 49,700 is entered.

The roadway does not have on-street parking, so none is selected from the pull-down menu. Since we selected none for parking the proportion of curb length is left blank.
The roadway is curb and gutter without a bike lane, so the outside shoulder width is 0 feet.
The median width is 22 feet and does not have a median barrier.
There are no highway rail grade crossings on this roadway.

The number of major commercial driveways being those serving 50 or more parking spaces is 3. Ski Holiday Drive being an unsignalized, right-in/right-out connection is considered
a major commercial driveway.
There are no major industrial driveways.
There are 5 additional minor driveways present.
There are 17 power poles in this 0.21-mile section or 81 fixed objects per mile.

The roadway has curb and gutter but there is overhead electrical along the eastern side about 16 feet from the edge of travel lane.
FDOT has not yet prepared calibration factors for these NCHRP SPFs
so the calibration factor would be 1.00.

Data collection Form 750-020-05m covers intersections
of urban and suburban arterials on roadways with either 6 to 8 lanes
on the major street or one-way streets.

Data collected for the entire intersection noted on the form as "Intersection Data"
include the area type, number of intersection legs, traffic control type,
presence of lighting, presence of red-light cameras,
daily pedestrian volume crossing all legs,
maximum number of lanes crossed by a pedestrian,
number of bus stops within 1,000 feet of the intersection,

presence of schools within 1,000 feet of the intersection,
and number of alcohol sales establishments within 1,000 feet of the intersection.

Data collected for each major and minor roadway
individually shown on the form as "Street Data" include the street configuration,
AADT, number of through lanes, number of approaches with left-turn lanes,
number of left-turn movements with protected phasing,
number of right-turn movements prohibited on red,
number of U-turn movements prohibited,
and the number of approaches with right-turn channelization.

These inputs are used to compute the SPF for base crash prediction,
and these values are used for the CMF calculation.
Let’s take a closer look at right turn channelization CMFs in the next slide.

An example of with and without right turn channelization are shown here.
It should be noted the channelization is only appropriate
for the major road approaches.

Right turn channelization is defined as having a marked or raised curb island
present to separate the right turn from the adjacent movements.

For this example, let’s go back to the State Road 535 corridor
and the signalized intersection with Meadow Creek Drive
and Lake Vining Drive at the southern end.

This intersection's major approaches have three through lanes and left turn lanes.
The southbound approach also has a right turn lane but does not meet the criteria
for right turn channelization as it is controlled by a stop bar
with no physical separation.

The minor street approaches have a left turn lane
and a shared through/right turn lane on Meadow Creek Drive
and a thorough/left turn lane plus a right turn slip lane on Lake Vining Drive.
The intersection also has pedestrian crosswalks on all four approaches.

In completing Form 750-020-05m,
the first is area type with urban and suburban selections.
The NCHRP 17-58 research defines urban where more than 50%
of the land use within 250 feet of the intersection is commercial.

Locations not meeting this criterion are considered to be suburban.
This intersection has apartments or residential in two intersection quadrants
and commercial development in the other two quadrants.
It is not more than 50% so the area type is defined as suburban.

The number of intersection legs is 4 and the traffic control type is signalized.
Intersection lighting is not present, and neither are red-light cameras.
The daily pedestrian volume is 50 persons and the maximum number of lanes
crossed by a pedestrian is 8 for the north intersection leg.
There are no bus stops nor schools within 1,000 feet of the intersection.
There are 7 alcohol sales establishments within 1,000 feet of the intersection.

The reporting of major and minor approach data is a bit different
than previous intersection analysis as it is separated into two columns.
For our example at State Road 535 and Meadow Creek Drive / Lake Vining Drive,
both the major and minor roadways are two-way.

The AADT for the major and minor approaches is entered
and remember this is the higher value from opposing legs.
The number of through lanes are entered and this is the total for both directions.
In this example it would be 6 lanes for the major street and 2 lanes for the minor street.

The number of approaches with left-turn lanes
is only for the major street approaches and will be 2.
The number of left-turn movements with protected phasing
only applies to State Road 535 approaches as both left turns have protected phasing.

Right turn on red is permitted at all approaches so it will be 0 for both major and minor.
U-turn movements are allowed so again it will be 0 for both approaches.
The major approaches do not have right turn channelization, so this is 0.

This completes the data collection for the urban suburban arterials
for 6 to 8 lanes and one-way streets forms.

The data collection forms we will cover next are those under SPICE which focus on alternative intersection including roundabouts and RCUTs.

SPICE was developed to provide an easy-to-use tool to automate the predictive safety analysis of intersections. It is a component of the Intersection Control Evaluation procedure, being used during both Stage 1 and Stage 2 analysis.

The SPICE tool includes analysis of the previously discussed facility types covered in the HSM and NCHRP 17-58 as well as additional intersection configurations. This tool can be downloaded from the FDOT Traffic Engineering and Operations Office website shown on this slide.

To initiate the SPICE analysis, the upper part of the Control Strategy tab must be completed with information common to all intersections.

This information is basic to all HSM Chapter 12 intersection analyses and will not be discussed during this training. The one thing the user should note from this tab which is common to the data collection forms we will be covering is the analysis, opening and design year.

SPICE looks at crashes over the project's life cycle. Now let’s look at the two intersection forms evaluated in SPICE and not previously discussed: RCUTs and roundabouts.

The first form we will cover today under SPICE
is the Restricted Crossing U-turn intersection also called RCUT.

Data collected at RCUT intersections for analysis in SPICE
can be collected using Form 750-020-05n.

Data recorded on this form include **the** number of U-turns,
number of major roadway lanes, **number** of minor roadway lanes,
total offset distance between center of intersection
and U-turns, number of driveways within RCUT footprint,
total U-turn deceleration length, total U-turn acceleration length,
number of left-turn lanes from major approach,
total median width, **maximum** median width, and major road speed limit.

Let’s look at an example to apply this form.

Most applications of the RCUT safety analysis will be as part
of the Intersection Control Evaluation or ICE process.
This example is for the proposed improvement of the State Road 44
and US 41 intersection in Citrus County.

In the ICE process the RCUT intersection
was evaluated and SPICE was used for the safety analysis.

The RCUT inputs are found in **SPICE’s** "At-Grade Inputs" tab.
Some of these input factors such as "Total Offset Distance"
and "Total Median Width" have pull down definitions to aid the user
in determining the value to be entered.

Here the **Total** Offset Distance is total distance
between the two U-turn intersections.
The Total Median Width is the sum of the median widths
at the two major street approaches.

Going back to our example and using the RCUT concept drawing,
let's complete Form 750-020-05n.
We see this intersection will have two U-turn locations on US 41.
Both the major and minor roadways have 2 through lanes
in each direction of travel.

The total offset distance is the distance between the two U-turn locations
which is 1,250 feet.
The number of driveways within the RCUT footprint
or between the U-turn locations is for both sides of US 41 and is 8 driveways.

The total U-turn deceleration length for the two U-turn locations is 400 feet.
The total U-turn acceleration length is only applicable
to unsignalized RCUTS and is left blank.
The number of left-turn lanes from major approach
is 2 for the US 41 southbound approach.
The total median width is for both major approaches which sums to 50 feet.

The maximum median width is for unsignalized RCUTs and is left blank.
The major road speed limit is 45 miles per hour.
This completes the data collection for the Restricted Crossing U-turn form.

Data collected for roundabout analysis using the SPICE tool
can be collected using Form 750-020-05o.
Data collected pertaining to the entire intersection includes the roundabout
configuration, location, and inscribed circle diameter.
For roundabout configuration, 31R means 3 legs and 1 circulating lane
and 42R means 4 legs and 2 circulating lanes.

Additional data is collected individually for each leg, including the entering AADT,
presence of a right-turn bypass, number of access points within 250 feet of the yield line
for single lane roundabouts only, entering width, number of entering lanes on the leg,
and **number** of circulating lanes at the leg.

Let’s take a closer look at three of these CMFs.

The inscribed circle diameter measures the diameter
of the circle making the outside edge of the circulating lanes.

The number of entering lanes is the total number of lanes on the given approach.
The number of circulating lanes is the total number of lanes
that an approach conflicts with upon entering the roundabout.

Let's take a look at an example for application of the data collection for roundabouts.

Continuing with the ICE analysis of the State Road 44 and US 41 intersection
in Citrus County, let's look at the roundabout option.
This concept drawing shows the roundabout lane requirements
based upon the operations analysis.

The concept has two right turn bypasses lanes,
and the circulating roadway is 2 lanes for all approaches
except for the US 41 northbound approach.

This is a two-lane roundabout.

The data collection requirements for SPICE analysis are shown on Form 750-020-05o.
The first is the roundabout configuration.
This is 42R being a four-leg, two-lane circulating roadway roundabout.
The location is within an urban service boundary, so it is urban/suburban.

The inscribed circle diameter is 150 feet.
The major leg and minor leg entering AADTs are carried forward
from the Control Strategy tab and the volumes are considered to be one-half
on each approach.
The next question is whether a right-turn bypass is present.

There is one on major leg #1 or northbound approach and minor leg #1
or the westbound approach so these are present and the other two legs are not present.

The number of access points within 250 feet of the yield line is only applicable to single lane roundabouts and **is** left blank.

All approaches have two entering lanes and a 30-foot entering width. All approaches except major leg #1 or the northbound approach have two circulating lanes.

This completes the data collection for the roundabout form.

For data collection on segments or intersection that do not fit into the previously discussed HSM, NCHRP 17-58, or SPICE facility types, data can be collected using Form 750-020-05d and Form 750-020-05h, respectively.

Let’s take a look at these two forms next.

Form 750-020-05d includes data elements from the previously discussed forms, as well as a few unique elements, such as the presence of crosswalks, school zones, and bike lanes.

Form 750-020-05h includes data elements from the previously discussed forms, as well as crosswalk presence for each intersection leg.

We have now completed the overview of the Data Collection forms for Transportation Safety Analysis.

Let’s take a look at the four forms available for Existing Conditions Reporting. We will begin with Condition Diagram.

A condition diagram is used to record existing field conditions
of the selected site and its surrounding area.

It can be used in conjunction with collision diagrams
to correlate existing conditions with crash history.

The condition diagram can be recorded
using Form 750-020-04 using the standard symbols provided
on the form or others approved by FDOT.

Alternatively, an annotated aerial may be used in the place of this form.
A sample condition diagram is shown on this slide.

The condition diagram should include information
such as intersection or roadway alignment; buildings, trees,
and other surroundings; lighting poles, fire hydrants, and other utilities;
traffic control devices; signal phasing; the number of lanes and lane use;
and the length of any turn lanes.

Let's take a look at the forms to develop Collision Diagrams
at segments and intersections.

Collision diagrams provide a visual representation of historical crash patterns
and can help identify crash clusters by crash type.

This tool can used to define existing conditions safety concerns and crash patterns.
Collision diagrams can also aid in countermeasure identification.

Historical crash data is available through FDOT's Crash Analysis Reporting System
also known as CARS.
Automated software for creation of collision diagrams is available,
and if used, should be spot-checked for accuracy.

Form 750-020-05i should be used for collision diagrams along segments,
an example is provided on this slide.

A summary of the crashes should be provided.
The MUTS provides examples of collision diagrams
for segments and intersections.
Note bi-directional data is recorded on the using the legend shown on the form.

The data is summarized in the table below or on the Collision Summary.
This form uses a **legend** of crash types to record crashes,
this legend can be modified and adapted to the conditions
at the location under evaluation.

Form 750-020-05j should be used for collision diagrams at intersections.
Depending upon the number of intersection crashes,
a separate diagram may be needed
for each year of analysis.
Similar to the segment collision diagram,
this form uses a legend of crash types to record crashes.

For both, intersection, and segment collision diagrams,
the crash location is extremely important and may require reviewing crash reports
to accurately represent crash conditions.

If multiple crashes of the same crash type occur on the same approach,
the Collision Summary crash numbers
can be recorded on the collision diagram
to indicate multiple crashes and potentially link to more detailed data.

Let’s take a look at the form to develop a Crash Summary.

Form 750-020-05k can be used for the Collision Summary.
An example of a completed Collision Summary is shown on this slide and provides a detailed summary of the crash information displayed in the collision diagrams.

The data shown in the Collision Summary is typically available in FDOT CARS reports.
The bottom of the Collision Summary provides the opportunity to summarize the crashes by **severity**, **by** crash type and by contributing causes.

The HSM has provided new safety prediction methods for different roadway segment and intersections.

This chapter focused on the data collection requirements to conduct predictive safety analysis and existing conditions reporting for transportation safety studies.

[Web]

This concludes the Manual on Uniform Traffic Studies computer based training, Chapter 5 - Data Collection for Transportation Safety Studies.
You will now be directed to a 10-question quiz to test your knowledge and understanding on the material presented in this computer-based training.

A passing grade of 70% is required to obtain the Certificate of Completion for the training.
If a grade below 70% is obtained, the trainees are required to re-take the full training until a passing grade of 70% or higher is obtained.

If you do not pass the quiz, please return to the Index page by selecting the Index button below and re-take this training.
Once you’ve received your certificate, please continue to the next chapter by selecting the “NEXT” button below this CBT.

On the next slide, please read the directions carefully before continuing to the quiz.
Thank you for your time and attention.

[LMS]

This concludes the Manual on Uniform Traffic Studies computer based training, Chapter 5 - Data Collection for Transportation Safety Studies.
You will now take a 10-question quiz to test your knowledge and understanding on the material presented in this computer-based training.

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If you do not pass the quiz, please return to the Course Content tab and re-take this training.

You will receive your certification after completing the full MUTS training and passing the quiz for each chapter.
please continue to the next chapter by returning to the MUTS course content tab and selecting the next chapter in the training.
On the next slide, please read the directions carefully before continuing to the quiz.
Thank you for your time and attention.