

## **UNIT III :Origins , Characteristics and uses of crash data**

### **Why are safety management systems important?**

The main purpose of a SMS is to provide a systematic approach to managing safety risks in the workplace. A SMS is crucial for high-risk industries such as manufacturing, transport and construction to improve safety by building on existing processes, demonstrating corporate due diligence, and reinforcing overall safety culture.

### **What are the key components of a safety management system?**

A SMS has four main components needed for successful implementation and maintenance of the system. These are described further below.

#### **1. Safety policy and objectives**

Employers should make safety an integral part of company values and demonstrate their commitment to a safety-first approach daily. Safety accountability and responsibilities should be clearly defined, and key safety personnel should be appointed to manage various elements of the SMS to ensure effective control of safety risks for your workplace.

#### **2. Safety risk management**

To effectively control and mitigate safety risks, designated staff should perform a series of processes that typically include four main steps in the risk management process:

Identify the hazards

Analyse the risks

Conduct a risk assessment and

Control the risks

Sample Risk Matrix for the safety Risk Assessment Element of a Safety Management System.

Sample Risk Matrix for the Safety Risk Assessment Element of a SMS.

#### **3. Safety assurance**

Safety assurance is the component of a SMS that involves monitoring risk controls during operations. It allows everyone to play their role in monitoring and mitigating safety risks.

Common functions of the safety assurance element can include safety audits and incident reporting systems. These systems are integral to the on-going improvement of the SMS, as well as enabling the implementation of preventative and corrective actions to eliminate and or reduce workplace risks.

#### **4. Safety promotion**

Safety promotion is important to support the successful integration of a SMS in an organisation. Activities include training and knowledge sharing, as well as clear safety communications.

### **Countermeasures for Road safety**

1. Enhanced Delineation and Friction for Horizontal Curves
2. Longitudinal Rumble Strips and Stripes
3. Safety Edges
4. Roadside Design Improvements at Curves
5. Median Barriers INTERSECTIONS
6. Backplates with Retroreflective Borders
7. Corridor Access Management
8. Left- and Right-Turn Lanes at Two-Way Stop-Controlled Intersections
9. Reduced Left-Turn Conflict Intersections
10. Roundabouts
11. Systemic Application of Multiple Low-Cost Countermeasures at Stop-Controlled Intersections
12. Yellow Change Intervals
13. Leading Pedestrian Intervals
14. Medians and Pedestrian Crossing Islands in Urban and Suburban Areas
15. Pedestrian Hybrid Beacons
16. Road Diets/Reconfigurations
17. Walkways CROSSCUTTING
18. Local Road Safety Plans
19. Road Safety Audits
20. USLIMITS2
13. Leading Pedestrian Intervals

### **WHAT'S A SAFETY SCORECARD?**

An Safety Scorecard is a set of leading indicators you can review weekly to track the effectiveness of

your company's safety program at a glance. You can use a simple Excel spreadsheet to track these numbers each week against your goal.

### **WHAT ARE THE BENEFITS OF A SAFETY SCORECARD?**

The most important reason to implement a safety scorecard is that what gets measured in your business tends to improve. The exercise of preparing and reporting on your scorecard numbers keeps you and your team on track and accountable for their goals.

Another benefit is that by reviewing your leading indicators weekly, you will be able to spot trends and issues in your marketing before they affect your bottom line. When you see a number that is not on track, you can act to correct it before an injury occurs.

### **WHAT METRICS SHOULD YOU INCLUDE?**

Keep it simple. If you make things too complicated it will be hard to keep the scorecard updated. While you may want to track the number of injuries at your site, keep in mind that by the time an injury happens it's too late to prevent it. For your scorecard, focus on the activities that help keep your employees safe, such as training, inspections, and safety meetings.

**It's easy to get started by setting up a simple Excel spreadsheet with these metrics.**

- Set up an excel spreadsheet and create a row for each of your safety leading indicators.
- Next to each item, list which member of your team is accountable for meeting each number.
- Determine your weekly goal for each number, and include it in each row.
- Decide who is accountable for preparing the scorecard each week and how that person will get the numbers from each team member.
- Review your scorecard each week with your safety team. If any numbers are off-track, discuss ideas for getting them on track the next week.

### **WHY DATA'S ARE REQUIRED FOR ROAD sAFETY ?**

using data to identify and predict hotspots, as well as to set up emergency-help systems to reach crash sites in a rapid manner are necessary interventions required to effectively manage road crashes and fatalities. When provided with data and evidence of issues, those at the top are more often than not, forced to act.

### **How to Improve Safety Performance**

Organisations continuously seek ways to improve safety performance. Several factors motivate them, including a genuine desire to have their workforce return home from work safely each day. There have

been decades of research that investigates how to measure and improve safety performance so that organisations can learn and make positive changes.

For this article, we review research that examines several studies to look at employee factors that determine and improve safety performance. The results suggest that both the employee and the environment are important factors related to workplace safety.

Organisations can select employees that espouse safety as a priority. They can train, support, encourage and reward them for safe behaviour within a positive safety climate. Which, in turn, maximises safety motivation and safety knowledge and leads to fewer accidents and injuries.

June is National Safety Month, which aims to highlight and reduce preventable deaths and injuries. We've taken a look at how surveys can be used as a data collection tool to accurately and efficiently gather data and keep records for risk assessments, safety audits, and staff training.

### **Importance of data Collection**

Health and Safety legislation focuses on employers' responsibilities to assess and minimize potential risks in the workplace. This requires data collection to complete forms, audits, inspections, and to track staff training; the data can then be used to monitor safety and prevent accidents.

#### **Assessments, audits, and inspections**

Regular assessments, audits, and inspections are essential to highlight hazards, risks, and areas of concern, as well as to evaluate safety measures and practices. Accurate records are required to monitor safety, and provide evidence of compliance with safety legislation.

An online survey can be set-up to undertake assessments, audits, and inspections. The questionnaire can ask all the relevant questions to gather required information, and it can be completed multiple times at regular intervals. The data will be stored securely, and can be compiled to provide an overview of risks and actions required.

#### **Training**

Within a workplace, employees need to be up-to-date with the risks, hazards, safety measures, and emergency procedures that are in place. Most employees require regular safety training, and further training when new equipment is purchased or working practices change.

Keep a record of training by setting up a survey to log each time an employee completes training. A survey can collect the employees' name, role, the training they've received, and also include their signature as acknowledgement that they understand what they've learnt. Accurate training records will also help to keep track of when employees need to be retrained.

## Recording accidents

Certain workplace injuries, accidents, or near-misses need to be recorded, but any personal employee details must be stored securely. An online survey will capture all the required details about an incident, and this data can be compiled to create reports that help identify patterns, and areas that need improvement. The data will be transferred and stored securely, and access to the details can be limited to relevant members of staff.

## Data Collection Tool: Health and Safety Surveys

Online surveys can be used as an effective and reliable data collection tool to help comply with Health and Safety regulations in a number of ways:

Accurate data collection – mandatory questions and answer validation can be used to ensure that all the necessary information is collected and that it's accurate.

Flexibility and transportability – online or mobile surveys can be completed anywhere, even without an internet connection, but they still have all the features and functionality to ensure accurate, secure data collection.

Keep accurate records – data collected in a survey can be stored securely and easily accessed when it's needed.

Reporting – survey software is more than just a data collection tool; it can provide automated, tailored reports that analyze the results and highlight trends, or areas of concern. It's also possible to compare data with previous results, or benchmark against other organisations.

Instant notifications – Email alerts can be set-up to alert relevant staff members when a certain response is given, meaning further action is required.

## Snap Surveys Software for Health and Safety

Snap Surveys has worked with the UK's national regulator for work-related health, safety and illness – the Health and Safety Executive (HSE) – to create a tool that could measure safety within organisations.

The HSE Safety Climate Tool provides a customisable questionnaire that can be tailored to different organisations. Once the survey is completed, the organisation will have access to personalised reports that provide a comprehensive assessment of attitudes towards safety. The automated reports include identification of high/low performing areas, recommendations for improvements, benchmarks against industry standards, plus analysis of additional user defined questions.

Snap Surveys software is an effective data collection tool that can be used to gather, analyse and secure data from audits and assessments, as well as keeping records, to meet Health and Safety regulations..

## Benefits of Collecting Data

Regardless of the field, data collection offers heaps of benefits. To help you become attuned to these

advantages, we've listed some of the most notable ones below:

Collecting good data is extremely helpful when it comes to identifying and verifying various problems, perceptions, theories, and other factors that can impact your business.

It allows you to focus your time and attention on the most important aspects of your business.

It helps you understand your customers better. Collecting data allows your company to truly understand what your consumers expect from you, the unique products or services they desire, and how they want to connect with your brand as a whole.

Collecting data allows you to study and analyze trends better.

Data collection enables you to make more effective decisions and come up with solutions to common industry problems.

It allows you to resolve problems and improve your products or services based on data collected.

Accurate data collection can help build trust, establish productive and professional discussions, and win the support of important decision-makers and investors.

When engaging with key decision-makers, collecting, monitoring, and assessing data on a regular basis may offer businesses reliable, relevant information.

Collecting relevant data can positively influence your marketing campaigns, which can help you develop new strategies in the future.

Data collection enables you to satisfy customer expectations for personalized messages and recommendations.

These are just a few of the many benefits of data collection in general. In fact, there are still a lot of advantages when it comes to collecting consumer data that you can benefit from.

## Crash Data Introduction:

Crash data are information that comes from a reportable crash. A reportable crash according to Title 75, Pennsylvania Consolidated Statutes, Section 3746(a) is: an incident that occurs on a highway or traffic way that is open to the public by right or custom and involved at least one motor vehicle in transport with:

- Injury to or death of any person, and/or
- Damage to any vehicle to the extent that it cannot be driven under its own power in its customary manner without further damage or hazard to the vehicle, other traffic elements, or the roadway, and therefore requires towing.

When reviewing data in the tables, keep in mind the following:

- Crash data does not include non-reportable crashes or near misses
- Crash data may not contain complete information, some elements may be unknown
- Crash data is dynamic:
  - The Department receives crash reports in paper and electronic formats; however, not in chronological order.
  - By law, police agencies may submit crash report forms up to 15 days after the crash event. However, this often takes longer.
  - The Department does not process reports in chronological order. For efficiency, data analysts may process reports by region or geographic area rather than date sequence.

## Defining Criteria:

When writing your query you will want to decide upon a few things before you begin:

- What exactly do I want to count or lookup?
- What tables contain the data I need?
- How do these tables relate to one another?
- Do I want any calculated fields?
- Do I want to limit my results with any specific criteria?
- How do I want to sort my records?

These questions may seem relatively basic, but it is very important to know exactly what you want and are able to extract it correctly as your decisions may be made on the basis of the results. The data in these tables was compiled mainly to make informed decisions to reduce the number and severity of crashes. It cannot analyze and interpret the data for you. Therefore you must analyze the data to determine its value in helping you make decisions with your own set of criteria. Before accepting the results of your queries try and verify its accuracy before making any decisions based upon the output. Things you may ask yourself:

- Does this data make sense?

- Are these results what I expected?
- Do the crash types match the roadway's geometry?

Additionally, you should:

- Compare data to older reports for the same location
- Compare data to other reports for similar locations
- Look for known incidents or specific crashes (i.e., publicized fatal crashes, etc.)
- Use maps and other GIS tools to confirm locations
- Start with small pieces of a report and combine them together to build a complex report.  
(For example, if you are looking for causations along an entire route look at one causation first, and then another. Alternatively, you can look at road segments rather than the entire road.)

## Crash Location Criteria:

**Intersection** versus **Mid-block** locations:

- *Mid-block Locations:* PennDOT will populate the database with one and only one roadway. Normally it will be numbered as roadway **number 3**.
- *Intersections:* PennDOT will populate the database with a minimum of two roadways. Generally the roads will be numbered as 3 and 4; however it could go up to roadway 9 depending on the configuration of the intersection.

### Categories of Roadways:

State Routes are PennDOT maintained roadways which include Interstates, US (Federal) Routes, and State Roads. These will contain:

- Two digit County
- Four digit State Route Number
- Four digit Segment (or 9999 for unknown)
- Four digit Offset (or 9999 for unknown)
- They May or may not have a Street Name and Street Ending

Local Roads include roads maintained by the County, Local Municipality, or privately maintained roadway open to the public. These will contain:

- Two digit County
- Route number (usually blank but might contain a 3 digit route number preceded by a letter, most commonly T for Township Routes or C for County Routes)
- Street Name
- Street Ending

### Defining location on a State Route:

Each State Route is separated into distinct but not necessarily contiguous segments. The segments commonly begin with segment 0010 and increment by 10 until the end of each route within each county. The segments and offset within the segments increase as you head either east or north. Upon reaching a county line, the segment will usually start again at 0010 (except for interstates).



Divided Highways are separated by a barrier, land, or a minimum of 4 feet of painted lines and are heading in opposing directions will have two separate segment designations, one for each direction. These are known as even/odd segment pairs. The odd segment corresponding to an even segment will always be one digit higher than the even segment. For example, US Route 15 in Adams County, starting at the Maryland state line, has 2 northbound lanes and 2 southbound lanes separated by a median. The northbound lanes are considered segment 0010 and the southbound lanes are considered segment 0011.

#### **Null Segments:**

There are numerous examples of State Routes that are disjoint. The point from which the first section of a state route ends to the point where the next section of the same state route picks up again within any given county is referred to as a null segment. This can occur where either a roadway is shared by multiple state routes (example 22/322 north of Harrisburg) or where a section of state route has been turned back to a local municipality (example Route 72 in the City of Lebanon)



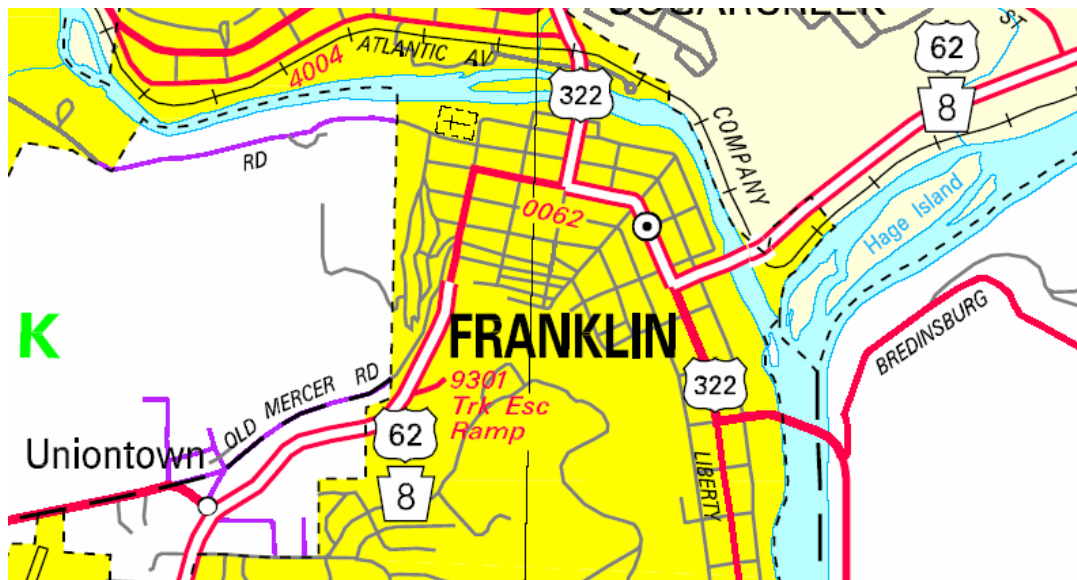
In Tionesta Borough, Forest County, US Route 62 heads north into Tionesta Station, crosses the Allegheny River then heads north towards Warren. Route 36 heads north into Tionesta, crosses the river and then heads north towards Titusville.

- Any crashes that would occur on the bridge but not at an intersection on either side would be coded as County 27 Route 0062.

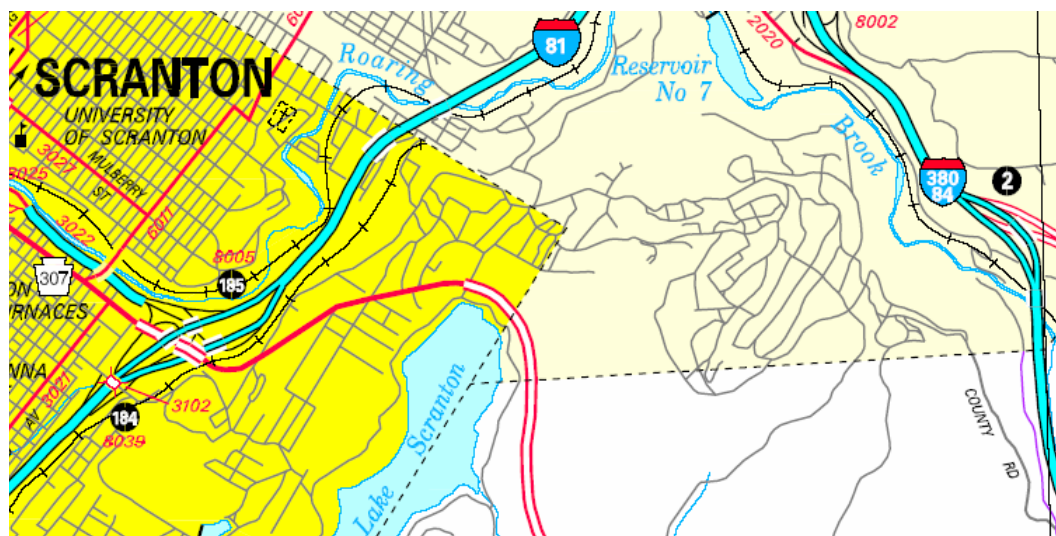
- If the crash were to happen at an intersection at either end of the bridge, then both roadways would be included.
- Between the two intersections, a **null segment** would exist for route 36, and no crashes would be coded against that null segment.

When a roadway has multiple route designations, the way to determine which will be the null segment is based on 2 factors. The first factor is route designation. Interstates always take priority, followed by US Routes, and finally State Highways. If there are multiple routes that are in the same category then the lowest number prevails.

For Example:



For US Route 62/US Route 322/Route 8 in the city of Franklin. SR0062 and SR0322 are US highways and SR0008 is a state highway. That section of roadway is considered SR0062 and would be a **null segment** for both SR0008 and SR0322.

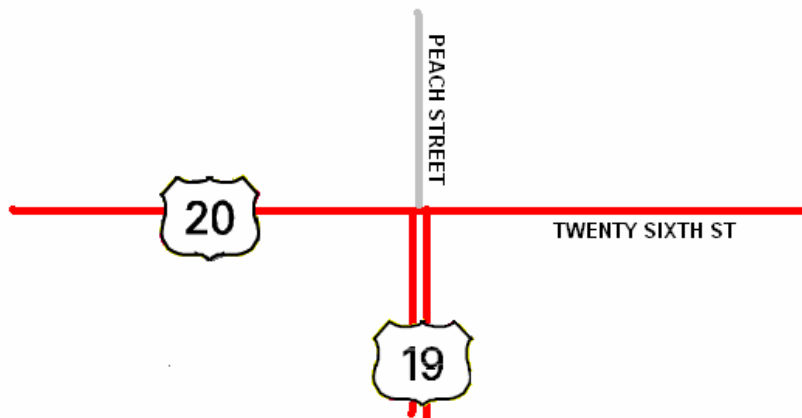


Interstate 380/84 in Lackawanna County would be coded as SR0084 and would be a **null segment** for Interstate 380 (SR0380).

### Roadway Data at Intersections:

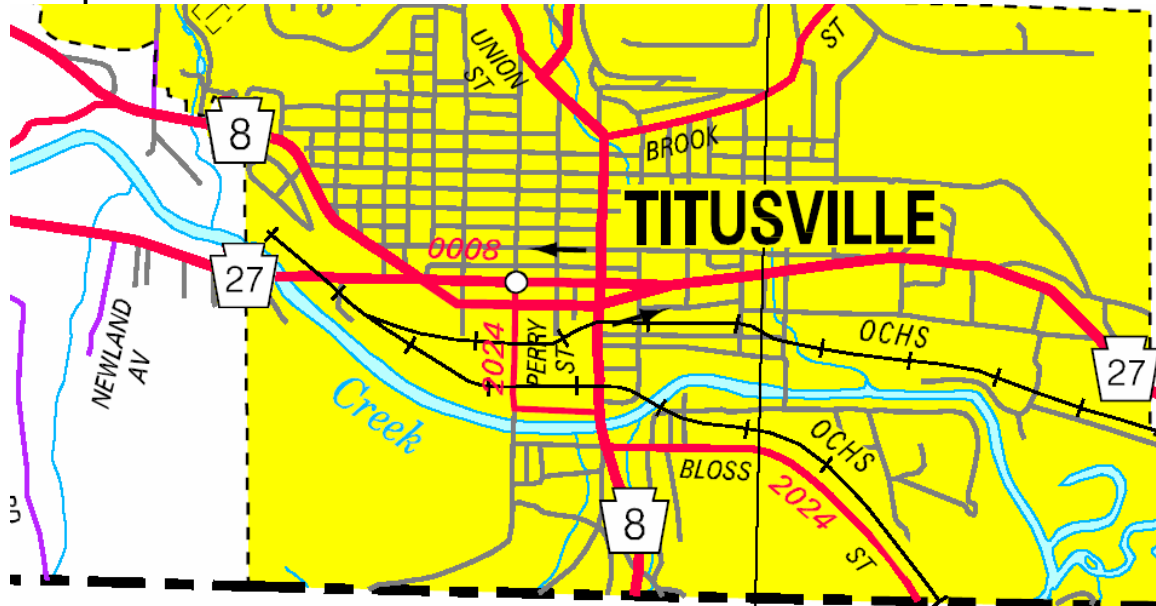
When a crash is located at an intersection with a divided highway, both the even and odd segment will be included with the roadway data. The exception would be when the divided highway is made up of two separate named roadways, usually within a city or borough.

#### Example #1



In the City of Erie, US Route 19 ends at US Route 20 at the corner of 26<sup>th</sup> and Peach. US Route 19 is a divided highway and US Route 20 is a non-divided highway. Peach Street becomes a local one-way street north of US20. The 4 roadways that will be included with this location are the even and odd segments of the divided highway (SR0019, segments 0410 and 0411), the non-divided highway (SR0020, segment 0580) and the local road (Peach Street).

#### Example #2:



In the City of Titusville, Route 8 splits and becomes two separate one way streets, one carrying north bound traffic (Central Avenue) and the other carrying south bound traffic (Spring Street).

- The intersection of Perry Street (SR2024) and Spring Street (SR0008) would have only 2 roadways listed. SR2024 segment 0010 offset 0231 and SR0008 segment 0031 offset 0896.
- The intersection of Perry Street (SR2024) and Center Avenue would have 3 roadways listed. SR2024 segment 0010 offset 0000, SR0008 segment 0030 offset 0896, and the local portion of Perry Street.

### **Non-typical Roadway data:**

- Local Roads:

Local roads do not follow the same conventions as State Routes in that they do not get stored with a numeric route, segment and offset. They also do not have corresponding latitude and longitude coordinates. Compiling data on local roads cannot be done with as much accuracy in regard to location as with state roads. Finding an intersection between 2 local roads can be achieved by finding all crashes that happen on each road separately and combining the subset. Be sure to narrow down your search to only a specific municipality (see municipal code table).

Finding crashes for a portion of a local road cannot be determined since there is no systematic method used for determining the distinct crash location. Definitively finding all crashes that happened on Maple Street between Front Street and Pennsylvania Avenue is simply not possible. The only way this might be achieved is to determine that no crashes happened on Maple Street, or if there were crashes on Maple Street, to determine the location of each one, crash by crash, and determine if they are within the location range. If any of those crashes were midblock crashes... all bets are off.

Another problem is that street names are not always consistent. Though the majority of streets are easily kept consistent (no one ever misspells OAK STREET) there are cases where streets are referred to by multiple names, commonly misspelled, have a space or hyphen in the name that aren't used consistently, or are referred to by both a local name and township/county route number.

- Interchanges and Ramps

Ramps at interchanges are a separate category of state roads and are normally designated with a state route designation between 8001 and 8999. These route numbers are distinct for each interchange within each county (virtually every county has a state route 8001). Each of the ramps within one interchange has the same SR number, but each ramp will have a different segment number. The segments are generally assigned in a clock wise manner.

Crashes that occur at interchanges that involve a ramp will either be a midblock crash on the ramp or an intersection between the ramp and another roadway.

### **Determining location ranges:**

When PennDOT is asked to produce a crash history for a specific location we generally follow certain guidelines.

- For intersections, we include all crashes that occur within 100 feet of the intersection.
- For interchanges, we include all crashes on all ramps and on the state route within 100 feet of those ramps.
- Point A to point B requests are done for each route separately when multiple routes are involved (common where null segments exist, or when a named local street has multiple state route designations).
- For those that involve interchanges (such as Interstate X from Exit 10 to Exit 15) the report is typically run to include 100 feet beyond all entrance and exit ramps. For multiple sections (i.e. Interstate X

from Exit 10 to Exit 11 and Exit 11 to Exit 12), the delineation between the two requests is where the main roads cross each other.

- When a request spans a county line, each county is run separately.

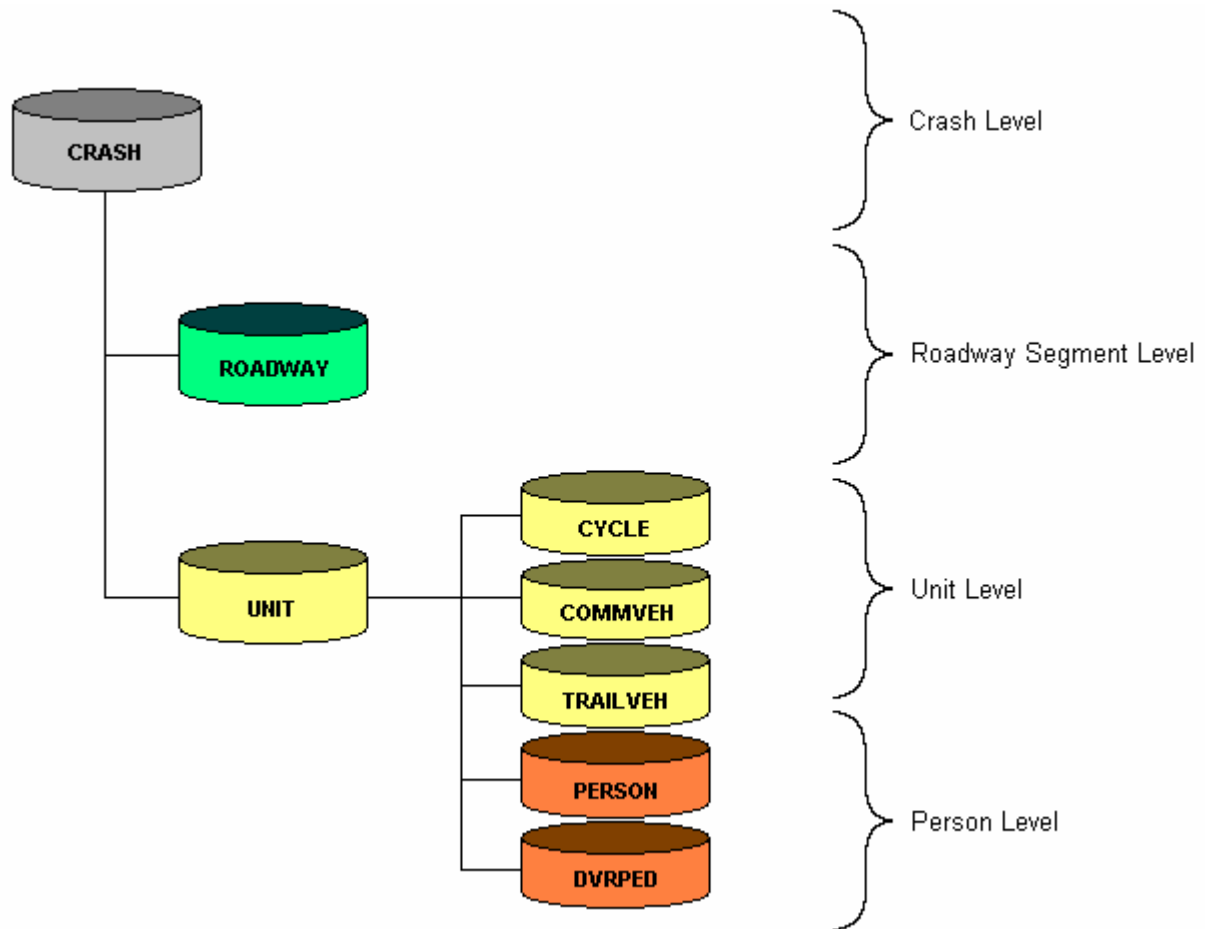
### The Database:

The data that has been sent is in MSAccess XP/2002. Whether you keep the data and work with it in MSAccess or export it to another database you will want to extract your data based on specific criteria by using SQL. You can use Structured Query Language (SQL) to query, update, and manage relational data. Packages such as MSAccess or Crystal Reports (reporting software) also have query builders that aid in the query building process. Before you begin writing your queries it is important to familiarize yourself with the data elements so you can better define your criteria so that the results you desire are accurate.

The tables that have been sent to you are shown here with a general description about the data elements contained within.

Table Name	Description
CRASH	Information about the crash such as:  <b>Where:</b> Latitude, Longitude, County, Municipality, Work zone <b>When:</b> Date, Time, Day of Week, Hour of Day, Month of Year <b>Item Counts:</b> People, Vehicles, Unbelted, Fatal, etc.
ROADWAY	Information about all the roadways involved in the crash such as: Route number or name, Segment, Offset, Type of Roadway, Rating, and many other Roadway defining elements.
UNIT	Information about all vehicles involved in the crash such as: Body Type, Most Harmful events and all Harmful Events, Movement, Position, Unit number in the crash And other vehicle related information.
CYCLE	Information that pertains to motorcycle/pedal cycles, such as helmet usage and appropriate attire and other accessories such as side bags
COMMVEH	Information about commercial vehicles, such as carrier information, the cargo body type, Hazmat information, and official agency registration numbers.
TRAILVEH	Information about all the roadways involved in the crash such as: Route number or name, Segment, Offset, Type of Roadway, Rating, and many other Roadway defining elements.
PERSON	Information about all people from all units related to the crash such as: Age, Sex, Where they sat and in which vehicle, Were they ejected from the vehicle? etc.
DVRPED	Information about drivers and pedestrians from all units related to the crash such as: Drug and alcohol results, Actions in the crash, Driver history information.

The next visual will illustrate the level of the information and a general understanding of how the tables relate to one another. When you remain within the CRASH table you will normally be counting crashes. As you move down through the table structure you will very often be counting other attributes involved in the crash.



You should familiarize yourself with the data dictionary and the column code or constraints criteria for specific fields and the tables in which they occur. The data dictionary and constraint tables were included as DataDictionary.doc.

The constraints or fields that have a Column Code were intended to limit you to only valid values on an application level. Since you will be working directly with the raw data you will want to be careful and only apply valid criteria as your filter to a field.

The Bureau of Highway Safety and Traffic Engineering would like to wish you well on the use of the data, and thanks you for your cooperation.

Most data requests are relatively straightforward. Others may take a bit of time to get sorted out before writing your query. If you encounter a problem such as a location range that is unusually complicated, we would be more than willing to assist you with your request. You can contact us at (717) 787-2855 or email us at [penndotcrashhelp@state.pa.us](mailto:penndotcrashhelp@state.pa.us)