Safety Performance Function (SPF) Clearinghouse

**Concept of Operations**

**(ConOps V1.0)**

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Prepared By:

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# List of Abbreviations and Acronyms

| **Abbreviation** | **Term** |
| --- | --- |
| AADT | Annual Average Daily Traffic |
| AASHTO | American Association of State Highway and Transportation Officials |
| CMF | Crash Modification Factor |
| ConOps | Concept of Operations |
| FHWA | Federal Highway Administration |
| HSM | Highway Safety Manual |
| PFS | Pooled Fund Study |
| SOW | Statement of Work |
| SPF | Safety Performance Function |
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# Scope

## Purpose of Document

The purpose of this Safety Performance Function (SPF) Clearinghouse Concept of Operations (ConOps) document is to convey the next steps as they relate to the Federal Highway Administration’s (FHWA) Office of Safety’s, along with Pooled Fund States, expressed interest in developing an SPF Clearinghouse.

This document will:

* identify the primary stakeholders;
* provide a description and rationale of the expected operations of the system;
* describe high-level functional requirements for the system, and;
* recognize anticipated management controls to manage the project.

The intent of this document is to elicit stakeholder discussion and consensus that ensures support in the development of an operationally feasible SPF Clearinghouse.

## Scope of Project

This SPF Clearinghouse project consists of the development, testing, and implementation of web-based application for the purpose of providing transportation professionals easy access to safety performance functions. The clearinghouse will give users the ability to search for, share, and provide feedback on SPFs; will provide users the capacity to contribute SPFs for potential inclusion in the Clearinghouse; and give authorized administrators the ability to review, manage, and rate SPFs. The project also includes the development of an outreach plan for raising the awareness of the availability and purpose of the Clearinghouse, promoting its use, and encouraging the submissions of SPFs by states, universities, and other entities. This document, the SPF ConOps, describes the application’s capabilities from the viewpoint of key Clearinghouse users.

## Overarching Goal for the System

The overarching goal of the Clearinghouse is to improve roadway safety by increasing the number of agencies that use SPFs to identify high-priority locations for potential safety improvement. Additional goals include providing a platform upon which knowledge transfer about the development of SPFs can take place and serving as a portal for obtaining SPF resources, including links to training. A final goal is to include communication and social media tools in the Clearinghouse that can be used to strategically engage with submitters and users.

# Existing Systems and Processes

At this time, there is no single access point to obtaining CMFs. There is no online repository and no structured way for States to share SPFs.

# Capability Need

## Statement of Need

Many States are finding it challenging to develop and implement SPFs. This could be due to various components, and the lack of accurate, reliable analytics and data may be among one such components. Currently there are existing tools to support the implementation of SPFs, such as the Highway Safety Manual (HSM)[[1]](#footnote-1) and the Crash Modification Factor (CMF) Clearinghouse.[[2]](#footnote-2) The intention of the SPF Clearinghouse is to provide an additional level of statistical and policy support to state and local safety professionals beyond what is already available in the HSM and CMF Clearinghouse.

The FHWA Office of Safety has pointed to the CMF Clearinghouse website as a prototype for the SPF Clearinghouse. The CMF Clearinghouse, funded by FHWA and hosted and maintained by the University of North Carolina is available at: [http://www.cmfClearinghouse.org/](http://www.cmfclearinghouse.org/). This site provides a variety of resources for safety professionals. In particular, it contains a few of the following key elements:

* A large database of specific CMFs for a wide variety of road types, countermeasures, and settings (rain, wet roads, day, fog, etc.)
* Guidance on the proper use of CMFs
* Ratings on the CMFs , included in the database, used to judge the statistical accuracy and adherence

The SPF Clearinghouse will adhere to many features and characteristics that are indicative to the CMF website. However, there is one main component in how they differ. The CMF computes the expected number of crashes after implementing a given countermeasure at a specific site, whereas the SPF is an equation used to predict the average number of crashes in a given year at a specific location. SPFs do not address countermeasures, but rather calculate crashes for segments that do not currently exist.

## Justification of Changes

As mentioned earlier, State DOTS are finding it challenging to work with SPFs. Given the importance of the HSM to FHWA’s overall roadway safety mission, and the integral role SPFs play in the successful implementation of the HSM, it is critical that a widely-accessible tool for transferring knowledge about SPFs is made available to transportation professionals. The Clearinghouse will offer professionals a platform for obtaining information and resources about SPFs. In addition to providing states a straightforward means of identifying relevant SPFs, the Clearinghouse will provide transportation professionals with information about developing SPFs, inks to noteworthy practices and technical assistance, and information about how to obtain training.

# System Concept

## Operational Concept

The SPF Clearinghouse will be a publically-accessible, web-based application that will give users the ability to search for and obtain SPFs, which they can then use to improve roadway safety conditions within their jurisdiction. The Clearinghouse will also serve as a learning tool that will offer users guidance on best approaches for developing SPFs. The Clearinghouse will be a federal system and will reside on the U.S. Department of Transportation (U.S. DOT) network.

***The SPF Clearinghouse will be:***

* Located in the .gov domain, on a U.S. DOT server, and on the DOT network.
* A publically-accessible web application, supported by a database that holds no personally identifiable information (PII).
* Able to accept and store data submitted from the public across the DOT firewall.
* Developed by the Volpe National Transportation System Center in MS SQL Server and the .net framework.
* Maintained by the Volpe Center under oversight of Federal Highway Administration Office of Safety staff.

***The SPF Clearinghouse development process will consist of the:***

* Development of Concept of Operations (the system from the perspective of users).
* Development of functional requirements (what the system must do).
* Development of a design document (how the system will do what it must do).
* A test plan.
* Launch plan.
* Official launch of the Clearinghouse.

All of the above steps will be informed by and completed in conjunction with the FHWA Office of Safety and the participating states of the Transportation Pooled Fund.

***The SPF Clearinghouse will provide transportation professionals (the public) with:***

* An interface for uploading an SPF for potential inclusion in the Clearinghouse **(no user name or password required).**
* An interface for searching for an SPF by key word or phrase, roadway segment or intersection type, State, and Author, or application to the HSM.
* A tool for submitting feedback about an individual SPF or about the Clearinghouse in general.
* Instruction and guidance on how to develop and build a SPF.
* Educational information on the proper application of SPFs.
* Resources to obtain SPF-related trainings and publications, and other various informational resources on cost-benefit analysis.

***The SPF Clearinghouse will provide Clearinghouse administrators with:***

* Notifications when new SPFs are submitted.
* A tool for validating SPF metadata and rating an SPF development approach.
* An administrative portal for viewing and sorting SPFs in the Clearinghouse.
* An administrative tool for managing an individual SPF.
* Web analytics for quantifying the number of visits to the Clearinghouse and individual SPFs.

## System Components

The Clearinghouse consists of the following components:

1. Public, web-based interface
   1. Search interface
   2. Document upload function
   3. Categorization Form (a web form the Submitter uses to add **metadata** to the SPF). Database (see 4.2.1)
2. SPF
   1. The **Report** (the document, spreadsheet, or PDF that describes the approach used to develop the PDF)
   2. The statistical model (i.e. the actual SPF)
3. Administrative interfaces
   1. Validation (interface used to confirms metadata are accurate) (see 4.2.2)
   2. Rating (interface used to rate the integrity of the SPF development approach) (see 4.2.2)
4. Database server
5. Web server

### Metadata

Metadata about the SPF accompanies every submission to the Clearinghouse. These data describe the roadway segment, intersection, and other characteristics to which the submitted SPF is applicable. The database uses these metadata fields to categorize the SPF, allowing both administrators and public users to manage and locate relevant SPFs. The metadata collected by the Categorization Form at the time the Submitter submits the SPF to the Clearinghouse are:

* + 1. Average Daily Traffic (ADT)
    2. Roadway segment type
    3. Intersection type
    4. Segment length
    5. State(s)
    6. Author(s)
    7. Submitter Name
    8. Submitter Email

### Validating and Rating

***Validating*** and ***Rating*** are two key tasks undertaken by the Reviewer after the Submitter uploads the SPF.

1. *Validating* applies to the accuracy of the metadata. The Reviewer confirms that the metadata submitted on the Categorization Form accurately reflect the metadata in the **Report.** If the data are not accurate, the Reviewer takes steps to correct them.
2. *Rating* applies to assigning a quality level to the development approach taken by the Submitter to develop the SPF. The approach will be evaluated against the following **rating criteria:**
   1. Data used (temporal, geographic)
   2. Crash report and road segment data
   3. Summary statistics about the data
   4. Process for choosing variables to put in the model
   5. Models that were run but that are not part of the final model
   6. Declared gaps in the data or known issues

The Clearinghouse will provide a password-protected interface and mechanism through which the Reviewer can validate metadata and rate the integrity of the approach used to develop the SPF. The approach will be rated against these criteria:

# Operations and Support Description

## Users

Users of the SPF Clearinghouses consist of the following:

* Internal Users
  + Program Manager (Federal Highway Administration)
  + Reviewer (Volpe National Transportation Systems Center)
  + Locator (Volpe)
  + Outreach Coordinator (TBD)
  + System/Database Administrator (Volpe)
  + Web Programmer (Volpe)
  + Host (Volpe)
* External Users:[[3]](#footnote-3)
  + Submitter
  + Applier
  + Learner

## Functional Roles and Responsibilities

|  |  |
| --- | --- |
| Role | Authority |
| Program Manager | * Set business rules for the Clearinghouse * Approve SPFs before they are added to Clearinghouse |
| Reviewer | * Validate required SPF metadata * Rate SPF development approach |
| Locator | * Identify new SPFs for possible inclusion in the Clearinghouse |
| Outreach Coordinator | * Identify opportunities and mechanisms to increase awareness of the SPF, promote its use, and obtain user feedback |
| Database Administrator | * Maintain proper functioning of the SPF database and web interfaces |
| Web Programmer | * Program a 508-compliant version of SPF |
| Submitter | * Submit an SPF |
| Applier | * Search for SPFs * Provide feedback on SPFs |
| Learner | * Obtain knowledge from Clearinghouse on how to develop an SPF |

## Selected Key System Functions

The following use cases demonstrate how users will interact with the Clearinghouse in order to complete key system functions.

|  |  |
| --- | --- |
| **Name** | **Event 1: Submit an SPF** |
| Summary | As a Submitter, I need to add **one** new SPF to the Clearinghouse. |
| Users | Submitter |
| Preconditions | The **Submitter** has read the Clearinghouse FAQs and understands that the Clearinghouse will require him to categorize the SPF before he uploads the document. |
| Basic Course of Events | **Bold = required field**   1. The Submitter navigates to the section of the Clearinghouse where the upload function is located. 2. The Submitter opens the *Categorization Form* and enters: **ADT**, R**oadway Segment Length, Roadway Segment (or Intersection Type)**, **Title of Paper,** Subtitle of Paper, **State**, **Author(s)**, **Submitter Name**, **Submitter Email**, Unique Operational or Geometric Characteristics, and Comments. *(See Appendix A for complete list of data fields on the Categorization Form.)* 3. The Submitter uploads the document. 4. The Submitter clicks <Submit>. If all fields are present, the SPF is accepted. 5. If any of the fields are missing, the system issues an error message. 6. The Submitter supplies the missing data and clicks <Submit>. |
| Post-conditions | The SPF is in the system and will be in a pending status (not available in the database) until it is validated and rated by Volpe, and approved by FHWA. |
| Alternate Course of Event 1 | Steps 1 from Basic Course of Events.  In Step 2 – the user clicks <Cancel>. |
| AC 1 Outcome | No SPF is uploaded. |

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| --- | --- |
| **Name** | **Event 2: Submit Multiple SPF (in one upload)** |
| Summary | As a **Submitter**, I need to add **multiple** new SPFs to the Clearinghouse. |
| Users | Reviewer |
| Preconditions | The **Submitter** has read the Clearinghouse FAQs and understands that the Clearinghouse will require him to categorize the SPF before he uploads the document. |
| Basic Course of Events | **Bold = required field**   1. The Submitter navigates to the section of the Clearinghouse where the upload function is located. 2. The Submitter opens the *Categorization Form* and enters: **ADT**, R**oadway Segment Length, Roadway Segment (or Intersection Type)**, **Title of Paper,** Subtitle of Paper, **State**, **Author(s)**, **Submitter Name**, **Submitter Email**, Unique Operational or Geometric Characteristics, and Comments. *(See Appendix A for complete list of data fields on the Categorization Form.)* 3. The Submitter uploads the document. 4. The Submitter clicks <Submit>. If all fields are present, the SPF is accepted. 5. If any of the fields are missing, the system issues an error message. 6. The Submitter supplies the missing data and clicks <Submit>. 7. The Submitter clicks “Add Another.” He completes another Categorization Form. 8. The Submitter clicks <Submit>. If all fields are present, the SPF is accepted. 9. Submitter repeats 2-7 until there are no more SPFs to upload. |
| Post-conditions | The database recognizes that metadata associated with the SPF are correct. |
| Alternate Course of Event 2 | Steps 1 from Basic Course of Events.  In Step 2 – the user clicks <Cancel>. |
| AC 2 Outcome | No SPF is uploaded. |

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| **Name** | **Event 3: Validate Metadata** |
| Summary | As a **Reviewer**, I need to validate the metadata associated with a new SPF submitted to the Clearinghouse. |
| Users | Reviewer |
| Preconditions | The Reviewer has received an email from the Clearinghouse, informing her that a new SPF was just submitted. |
| Basic Course of Events | 1. The Reviewer opens the notification email and clicks on the link to the submitted content in the Clearinghouse. 2. He reviews the Report and confirms that the SPF metadata are correct. 3. Using TBD functionality on the interface, he indicates that the metadata are correct. |
| Post-conditions | The database recognizes that metadata associated with the SPF are correct. |
| Alternate Course of Event 3 | Step 1 from Basic Course of Events.  In Step 2 – the Reviewer determines that the metadata are not accurately described. |
| AC 3 Outcome | Metadata are assigned “On Hold” status. |

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| **Name** | **Event 3a: Validate “On Hold” Metadata** |
| Summary | As a **Reviewer**, I need to validate the metadata associated with a new SPF submitted to the Clearinghouse that is On Hold. |
| Users | Reviewer |
| Preconditions | The Reviewer has already reviewed the metadata and assigned an On Hold status. |
| Basic Course of Events | 1. The Reviewer locates the submitted metadata from the Clearinghouse administrative portal. 2. Outside the system, the Reviewer compiles proposed changes/questions for the submitter. 3. She contacts the Submitter to discuss proposed changes. 4. Post conversation, using TBD functionality on the interface, she updates the metadata, which are now correct. |
| Post-conditions | The database recognizes that metadata associated with the SPF are correct. |
| Alternate Course of Event 3a | The metadata cannot be validated. |
| AC 3a Outcome | Outcome: TBD |

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| **Name** | **Event 4: Rate SPF Development Approach** |
| Summary | As a **Reviewer**, I need to rate the development approach of a new SPF submitted to the Clearinghouse. |
| Users | Reviewer |
| Preconditions | The Reviewer has received an email from the Clearinghouse, informing her that a new SPF was just submitted. |
| Basic Course of Events | **Bold = required field**   1. The Reviewer opens the notification email and clicks on the link to the submitted content in the Clearinghouse. 2. He reviews the Report, reviews the approach used to development the SPF, and evaluates the approach against the rating criteria. 3. Post conversation, using TBD functionality on the interface, she rates the process. |
| Post-conditions | The database recognizes that a rating has been assigned to the SPF development approach. |
| Alternate Course of Event 4 | Step 1 from Basic Course of Events.  In Step 2 – the Reviewer determines that the SPF development approach is not described sufficiently, which prevents her from assigning a rating. |
| AC 4 Outcome | SPF is assigned a “hold” status. |

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| **Name** | **Event 4a: Rate “On Hold” SPF Development Approach** |
| Summary | As a **Reviewer**, I need to validate the development approach associated with a new SPF submitted to the Clearinghouse that is On Hold. |
| Users | Reviewer |
| Preconditions | The Reviewer has already reviewed the development approach and assigned an On Hold status. |
| Basic Course of Events | 1. The Reviewer locates the submitted Report from the Clearinghouse administrative portal. 2. Outside the system, the Reviewer composes an email that compiles proposed changes/questions for the submitter. 3. She contacts the Submitter to discuss proposed changes. 4. Using TBD functionality on the interface, she updates the metadata, which are now correct. |
| Post-conditions | The database recognizes that a rating has been assigned to the SPF development approach. |
| Alternate Course of Event 4a | The development approach cannot be rated. |
| AC 4a Outcome | Outcome: TBD |

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| --- | --- |
| **Name** | **Event 5: Learn About SPF Development** |
| Summary | As a **Learner**, I need to understand how to develop an SPF. |
| Users | Learner |
| Preconditions | The Learner has read the FAQs and understands that an SPF rating is tied to the integrity of the approach used to develop the SPF. |
| Basic Course of Events | **Bold = required field**   1. The Learner navigates to the SPF homepage. |
| Post-conditions |  |
| Alternate Course of Event 1A |  |
| AC 1A Outcome |  |

## Use Cases

A use case describes a typical scenario for how a user will interact with the Clearinghouse. These various interactions reveal, on a high level, the functional requirements of the Clearinghouse. A table showing a list of high-level functional requirements contained in the use cases is displayed after the final use case.

**Use Case 1: A State DOT Submits a SPF**

Tom, the senior traffic engineer at State DOT asks Marcia, a Professor of Civil Engineering at State University, to develop an SPF for unsignalized intersections on rural roads. Tom also asks Marcia to submit the SPF to the SPF Clearinghouse and because of this, he encourages Marcia to visit the Clearinghouse website to learn about upload requirements.

When Marcia finishes the SPF, she submits it to Tom, who reviews it and deems it complete. Marcia is ready to upload the SPF to the Clearinghouse. Marcia opens her web browser, navigates to the SPF Clearinghouse website, and clicks the prominent “Upload Your SPF” button on the homepage. On the next page, she follows the step-by-step instructions on the SPF upload tool. There, she completes the Categorization Form that collects metadata about the SPF and the clicks Submit. Next, she then uploads the PDF of the research report that describes the approach used to develop the SPF and the mathematical equation (i.e. the SPF). The system accepts the PDF (the file) and displays a confirmation message, confirming the upload is successful. The Clearinghouse gives Marcia the option to notify individuals by email that she uploaded the SPF. She enters Tom’s email address. Within seconds, she receives an email from the Clearinghouse, confirming her submission. The email explains next steps, including the review process that occurs before the SPF is added to the Clearinghouse. Esther at Federal Highways and Lee at Volpe, two Clearinghouse administrators, also receive emails from the Clearinghouse, informing them that a new SPF has been submitted.

**Functions Embedded in Use Case:**

Ability to:

* Provide clear instructions for submitting an SPF.
* Upload PDFs, zipped files, other file formats.
* Send confirmation email to Submitter and other designated emails after successful upload of SPF.
* Send notification email to the Program Manager and Reviewer.

***Use Case 1 Alternate:***

*Marcia is only required initially to upload a PDF of the SPF, understanding that if the SPF is accepted by Clearinghouse administrators, she will need to submit it in HTML format before the SPF is added to the Clearinghouse.*

**Use Case 2: A Reviewer Validates Metadata**

Lee, an economist at the Volpe National Transportation System Center, opens an email he just received from the Clearinghouse. In it, he reads that Marcia from State University submitted an SPF on behalf of State DOT. Lee logs into the Clearinghouse with his user name and password, clicks on the checkbox next to the SPF to indicate that he has initiated review of the SPF, and then evaluates the SPF within the parameters set by the system used to assign a quality rating to each SPF. Several weeks later, Lea finishes his review, assigns the rating, and categorizes the PDF. Along with the PDF, he forwards the HTML file to the web programmer, who puts the HTML code into the SPF style sheet, and uploads it to the SPF database. At that point, the SPF – in both 508-compliant HTML and printer-friendly PDF – is available in the SPF and appears in Clearinghouse searches. At this point, Marcia (the submitter) and Elsa (the FHWA Program Manager) and Kara (FHWA Communications Manager) receive an email from the Clearinghouse, informing them of the availability of a new SPF.

**Functions Embedded in Use Case:**

Ability to:

* Assign a rating to an SPF.
* Set a timeline for reviewing an SPF.
* Categorize a SPF (add tags that improve searching, such as tags that link an SPF to other similar ones based on TBD roadway characteristics).
* Notify users when an SPF is added to the Clearinghouse.

***Use Case 2 Alternate:***

*Lea receives the emails from the Clearinghouse but does not act on it. He does not log-in to the Clearinghouse within the allotted 10 business days to indicate that he has initiated his review of the SPF. On the 11th business day, the Clearinghouse sends Lea and Elsa a reminder that a SPF is pending review.*

**Use Case 3: A Transportation Professional Searches for a SPF**

Mike, from Western State DOT, is a transportation planner who has been asked by his supervisor to evaluate the safety performance of single-lane, four-leg roundabouts. Mike read about the SPF Clearinghouse in the recent edition of *Public Roads* so his supervisor’s request was timely. Mike clicks on the link in the article and begins his search on the SPF homepage. (He noticed the “Recently Added SPFs” highlighted on the homepage but then noticed that none of them focused on roundabouts.) He enters the key word “roundabouts” in the search field and reviews the search results. He narrows his search by selecting SPFs submitted by neighboring states. His search returns six CMFs that meet his search criteria. He selects one of the six to download. Along with downloading the SPF, he notices the Clearinghouse gives him other options: He selects “Yes” and “12 weeks” check-off boxes next to the question “May a Clearinghouse representative contact you to discuss your use of this SPF?” He also selects the “Notify Me” checkbox next to the question “Do you want to be notified when the Clearinghouse adds new SPFs?”

**Functions Embedded in Use Case:**

Ability to:

* Search for an SPF by key word or phrase.
* Search for an SPF by roadway characteristic.
* Search for SPF by State.
* Identify SPF users who will provide feedback on the effectiveness of an SPF.
* Notify users when an SPF is added to the Clearinghouse (either all new SPFs or within a certain category).

## Summary of Functional Requirements (from Use Cases)

The Clearinghouse shall perform the following functions:

* Upload SPFs in PDF, zipped files, other file formats.
* Send confirmation email to submitter and submitter’s designee(s) after successful upload of SPF.
* Send notification email to FHWA Program Manager and Raters when a new SPF is submitted.
* Assign a rating to an SPF.
* Establish a timeframe within which a Rater reviews and rates an SPF.
* Categorize a SPF (add tags that improve searching, such as tags that link an SPF to other similar ones based on TBD roadway characteristics).
* Notify FHWA Program Manager, Rater, and Submitter when an SPF is added to the Clearinghouse.
* Search for an SPF by key word or phrase.
* Search for an SPF by roadway characteristic.
* Search for SPF by State.
* Identify SPF users who will provide feedback on the effectiveness of an SPF.
* Notify users when an SPF is added to the Clearinghouse (either all new SPFs or within a certain category).

# System Overview

## Support Environment

The SPF Clearinghouse will be hosted at the Volpe National Transportation Systems Center and will adhere to all security requirements mandated by the Office of the Secretary. The following roles will support and maintain the Clearinghouse post launch:

* Reviewer – Will validate and rate SPFs (metadata and development approach respectively).
* Locator – Will identify new, potential SPFs.
* Database Administrator (DBA) – In concert with the Web Programmer, will ensure that the Clearinghouse web application is properly maintained:
  + DBA will install and upgrade the database server and application tools, modify the database structure, as necessary, based on updated requirements, maintain archived data, back-up and restore database files, as well as other duties typically performed by a DBA.
  + Web Programmer will ensure compliance with Section 508 and update the Clearinghouse interface based on updated requirements.
* Host – Will ensure that the facility where the database resides (on web and database servers) is physically secured and hardened against cyber threats.

# Appendix A

**SPF Metadata (or Data Fields on Categorization Form)**

1. **Title**
2. **ADT**
3. **Roadway Segment Length**
4. **Roadway Segment**
   1. Rural two-lane highways
   2. Rural multilane undivided highways
   3. Rural multilane divided highways
   4. Rural freeways – four lanes
   5. Rural freeways – six-plus lanes
   6. Urban two-lane arterials
   7. Urban multilane undivided arterials
   8. Urban multilane divided arterials
   9. Urban one-way arterials
   10. Urban freeways – four lanes
   11. Urban freeways – six lanes
   12. Urban freeways – eight-plus lanes
5. **Intersection**
   1. Rural minor-road STOP control
   2. Rural all-way STOP control
   3. Rural signal control
   4. Rural undetermined
   5. Urban minor-road STOP control
   6. Urban all-way STOP control
   7. Urban signalized
   8. Urban undetermined
6. **Unique Characteristic (of Location or Design)**
7. **State(s)**
8. **Author(s)**

# Appendix B

**SPF Development Approach – Rating Criteria**

1. Data used (temporal, geographic)
2. Crash report and road segment data
3. Summary statistics about the data
4. Process for choosing variables to put in the model
5. Models that were run but that are not part of the final model
6. Declared gaps in the data or known issues

# Appendix C Relevant Documents

Relevant documents include:

* Concept of Operations Standard Outlines are ANSI/AIAA G-043-1992 (supports new systems developments) and IEEE Standard 1362 (supports system upgrades).
* American Association of State Highway and Transportation Officials (AASHTO). *Highway Safety Manual*, 1st Edition, k Washington, DC, 2010.
* American Association of State Highway Transportation Officials (AASHTO’s) Highway Safety Manual (HSM) webpage at: highwaysafetymanual.org.
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1. For more information, see the American Association of State Highway Transportation Officials (AASHTO’s) Highway Safety Manual (HSM) webpage at: [highwaysafetymanual.org](http://highwaysafetymanual.org). [↑](#footnote-ref-1)
2. For more information, see the Crash Modification Factor Clearinghouse, funded by FHWA and hosted by the University of North Carolina Highway Safety Research Center at: [http://www.cmfClearinghouse.org/](http://www.cmfclearinghouse.org/). [↑](#footnote-ref-2)
3. External users will come mainly from the job roles: Highway safety engineers, Traffic engineers, Highway designers, Transportation planners, Transportation researchers, Managers and administrators, Academicians [↑](#footnote-ref-3)