April 2013
Colorado Department of Transportation
Intelligent Transportation Systems Branch
<table>
<thead>
<tr>
<th>ACRONYMS</th>
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<tr>
<td>CDOT</td>
<td>Colorado Department of Transportation</td>
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<td>DOT</td>
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<td>DRCOG</td>
<td>Denver Regional Council of Governments</td>
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<td>ITS</td>
<td>Intelligent Transportation Systems</td>
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<td>FHWA</td>
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<td>MOE</td>
<td>Measures of Effectiveness</td>
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Executive Summary

ES 1 FHWA Rule

On December 23, 2010 FHWA adopted the Real –Time System Management Information Program “the Rule” (Title 23 Part 511 Subpart C) that requires State DOTs, also referred to as States, to make available certain information on Interstate highways and on designated non-Interstate highways, which are defined as Routes of Significance within the respective Metropolitan Statistical Area (MSA), by the dates specified in the Rule.

Figure ES 1, Denver-Aurora-Broomfield Metropolitan Statistical Area, shows the MSA and also shows the Denver Regional Council of Governments (DRCOG) boundary. The MSA and DRCOG boundaries are somewhat contiguous; however, the MSA includes Park and Elbert Counties, which are not part of DRCOG, but does not include Boulder County, which is part of DRCOG, or a portion of Weld County, which is part of the DRCOG Metropolitan Planning Organization (MPO) boundary. Therefore, because Boulder County in DRCOG and the portion of Weld County in the DRCOG MPO are very much part of the greater Denver metropolitan-regional area, and the transportation network is interconnected and integrated to serve the concentrated transportation needs in the area, the Working Group (more information regarding the Working Group is provided in Section ES.2) decided to include Boulder County and the portion of Weld County within the MSA.

Figure ES 1: Denver-Aurora-Broomfield Metropolitan Statistical Area
The Rule is both complex and extensive. The following summary identifies the salient points of the Rule regarding criteria, reporting elements, categories of routes and reporting timeframes and items associated with designating the Routes of Significance:

- Certain factors (criteria) to be considered in evaluating the routes such as: crash rate, routes affected by environmental events, routes used for evacuations, economic productivity, severity and frequency of congestion and utility of the highway to serve as a diversion route for congestion locations
- Four elements that States must report specifically related to three categories of routes
  - **Four elements**
    - Construction and maintenance activities
    - Roadway or lane blocking incidents
    - Roadway weather observations
    - Travel time information
  - **Three categories of routes**
    - Interstate highways outside of the MSA
    - Interstate highways within the MSA
    - Routes of Significance (by definition within the MSA)
- Required data parameters regarding accuracy, availability, quality, timeliness and validity
- Required reporting timeframe pertaining to the three categories of routes.
  - November 8, 2014 – Interstate highways outside and within the MSA
  - November 8, 2016 – Routes of Significance
- Designating the Routes of Significance
  - Use a collaborative process with local or regional agencies
  - Within the MSA
  - All public roadways (shall be considered) including arterial highways, toll facilities and other facilities that apply end user pricing mechanisms
  - Report element information by reporting timeframe
  - Develop methods to ensure data quality
  - Evaluate Regional ITS Architecture to determine if real-time highway and transit information needs are addressed and, if necessary, update the Architecture

**ES 2 Process to Identify the Routes of Significance**
To perform the Routes of Significance Project “the Project” the Colorado Department of Transportation (CDOT) Intelligent Transportation Systems Branch (ITS) first assessed the requirements of the Rule to ensure a clear understanding regarding the details related to the Rule and to determine the corresponding level of work and best approach to perform the Project. The ITS Branch then tasked a consultant for assistance and discussed strategy and preferred approach regarding the Project. The ITS Branch and the consultant “the Project Team” developed a project workflow diagram to reflect the Project approach, direct the work related activities and guide the sequence of those activities within the Project.

To facilitate the Project, the Project Team decided to use the existing DRCOG Regional Transportation Operations (RTO) Working Group as the core working group due to the Group’s intimate knowledge of, and experience with, transportation issues in the region. The DRCOG RTO Working Group is comprised of federal, state and local transportation engineers and planners and meets on a monthly basis to discuss, address and coordinate transportation related issues within the DRCOG area. The DRCOG RTO
Working Group also developed other related planning documents such as; the DRCOG ITS Strategic Plan, DRCOG Regional ITS Architecture and the Denver Regional Integrated Traveler information Display Map Guidelines “the Arterial Route Guidelines”. To perform this Project the DRCOG RTO Working Group was expanded to include law enforcement, emergency responders, toll operators and North Central evacuation planning specialist, and is referred to as “the Working Group” as it pertains to the Project. The Project Team, working with the Working Group, conducted three Workshops over the period from May 2012 through November 2012.

In preparation to conduct the first Workshop, the Project Team identified all public roadways, i.e., state highways including Interstate and non-Interstate principal arterials and above within the MSA, which accounted for 274 roadways totaling 2,416 miles. Due to both the number and miles of roadways in the MSA, it was not feasible or practical to begin route evaluation from this as a starting point to designate the Routes of Significance. Therefore, the Project Team decided to focus on the Major Regional Arterials (MRA) as identified in the DRCOG 2035 Metro Vision Regional Transportation Plan - Emphasis Corridors for Operational Improvements, which accounted for 15 roadway corridors totaling 224 miles.

Next, the Project Team assessed the required four reporting elements to determine the extent to which this traffic and travel condition information was currently being reported on the three categories of routes. CDOT currently provides all traffic and travel condition information on all Interstate highways, as well as on numerous other state highways, statewide as required by the Rule via the CDOT traveler information web site at www.cotrip.org, the CDOT 511 Automated Phone System and the CDOT App. Therefore, the reporting requirements and associated timeframes with respect to Interstate highways are satisfied. With regard to the MRA routes, CDOT currently provides certain traffic and travel condition information, albeit a very small amount, on certain portions of the MRA routes including:

- Travel time (including speed) information on portions of four MRA routes
- Roadway weather observations information on portions of three of those same MRA routes and portions of two other MRA routes
- Construction and maintenance activities information and roadway or lane blocking incidents information on all MRA routes; however, the information may not be as comprehensive or extensive in scope as required by the Rule.

The Project Team reviewed the Arterial Route Guidelines, which established the implementation framework for the Routes of Significance, regarding specific data items and associated data parameters that were identified for the four traffic and travel condition reporting elements. The Arterial Route Guidelines also identified operational processes and procedures to be considered in conjunction with route implementation in order to ensure jurisdictional coordination and technological integration, identified measures of effectiveness (MOE) for each traffic and travel condition element and their applicability and usefulness to operators and the traveling public/others, and included the timeframe associated with each traffic and travel condition element as required by the Rule.

As part of the Next Steps, the Arterial Route Guidelines identified the following several remaining items that need to be addressed to foster seamless, coordinated and integrated operations, and to meet the reporting requirements pertaining to the Routes of Significance as required by the Rule, within the greater Denver metropolitan-regional area.

- Jurisdiction commitment and resources
- Modifying certain field equipment to meet Guidelines
• Programming changes to Colorado Transportation Management System platform and cotrip website
• Architecture related to data sharing, storage, archiving and reporting
• Software licensing regarding ITS Branch COGNOS reporting tool
• Configuration management process/responsibility pertaining to the Guidelines
• Feasibility of including traveler information for transit and other modes

Finally, the Project Team assessed the factors (criteria) to gauge relevance, determine applicability and data availability and identified data and sources with respect to the factors recommended in the Rule. The Project Team also identified additional criteria to apply as part of the evaluation process and defined the criteria in terms of: data source, value to the project goals and how to apply each criterion and developed the initial list of criteria.

The following provides a very brief summary of each Workshop. More detailed information regarding the Workshops and associated activities to ensure compliance with the Rule is provided in Section 3.

**ES 2.1 Workshop #1 – May 22, 2012**
The Project Team presented the Project to the Working Group and summarized and explained the requirements of the Rule, MSA and DRCOG boundaries, purpose of the Project, relationship of the Project to other CDOT and DRCOG/local operations and planning projects. The Project Team reiterated that although the primary intent of the Rule from FHWA perspective was to provide traffic and travel condition information, the primary goal of the Project from CDOT’s perspective was to improve operational efficiency and provide performance measures monitoring on the designated Routes of Significance. The Project Team stated there were 274 corridors totaling 2,416 miles in the MSA that could be considered as potential Routes of Significance and provided the initial list of criteria to the Working Group.

The Working Group suggested top-fifteen corridors should be designated with consideration given to procuring data from Internet Service Providers (ISP) in lieu of installing infrastructure, use a test corridor to better understand implementation,jurisdictional and resource related issues. The Working Group stated that construction and incident information are institutional, travel time and weather are technology dependent and travel time is most important, that the Project should focus on the MRA and not put emphasis on evacuation routes, use the DRCOG Congestion Mobility Program (CMP) grade for crash rates, severity and frequency of congestion and that CDOT regional ranking of the corridors was very important.

**ES 2.2 Workshop #2 – September 25, 2012**
The Project Team recapped the requirements of the Rule, MSA and DRCOG boundaries, purpose of the Project, relationship of the Project to other CDOT and DRCOG/local operations and planning projects and reemphasized the goal of the Project from CDOT’s perspective was to improve operational efficiency and provide performance measures monitoring on the designated routes of significance. The Project Team presented the MRA corridors prioritized using the criteria and explained the rationale used to select and apply data in each criterion area and to determine and apply the associated point values in each criterion area. Attached as Appendix C are: Routes of Significance – Evaluation of MRAs in the DRCOG Region (Workshop #2 – September 25, 2012) showing the MRA ranking based on the criteria that
were selected in Workshop #1 and *MRA Corridor Ranking Map* illustrating MRA corridor ranking and the Interstate highways and freeways.

The Working Group recommended renaming certain criterion, changes to associated point values and higher and lower weighting for certain criterion. The Working Group also recommended that MRA corridors be broken into segments based on signal timing projects and three non-MRA routes should be included and evaluated within the process.

**ES 2.3 Workshop #3 – November 28, 2012**

The Project Team discussed certain items that the Working Group agreed to with regard to MRAs, segmentation and addition and evaluation of several non-MRA corridors, revised selected criteria and changes in applying points, and summarized the changes to the criteria as recommended by the Working Group in the previous Workshop and comments that were received following the previous Workshop. The Project Team presented the priority ranking based on the segmentation of each MRA corridor and informed the Working Group CDOT was in the process of hiring an Operations Director and reorganizing to form a Division of Operations and intended to develop a CDOT Statewide Systems Operations Plan to be incorporated into, and used as part of, the upcoming 2040 Statewide Transportation Improvement Plan update scheduled for 2013. Attached as Appendix D is: *Routes of Significance – Evaluation and Ranking of MRAs in the DRCOG Region (Workshop #3 – November 28, 2012)* showing the MRA ranking based on MRA segmentation and revised criteria that were identified in Workshop #2.

The Working Group recommended certain changes to certain criterion areas and that CDOT should wait to designate the Routes of Significance based on forthcoming CDOT actions and to provide time for CDOT and local jurisdictions to coordinate regarding implementation items.

**ES 3  CDOT and Related DRCOG and Local Agency Projects**

CDOT as well as other transportation agencies are convinced there are substantial operational efficiencies that can now be obtained by utilizing ITS applications on the transportation network to leverage and coordinate the deployment of operational activities and measures. CDOT has committed to place a much higher emphasis on improving the operations of the transportation network and to that extent recently established and filled a Director of Operations position. As a first step in the reorganization process, CDOT also created a Division of Operations and transferred the ITS Branch into the newly formed Division of Operations, and is planning to transfer other business groups into the Division of Operations to coordinate and deliver statewide corridor operations more efficiently and effectively. Furthermore, CDOT intends to develop a CDOT Statewide Systems Operations Plan that will be an integral component and used within the 2040 Statewide Transportation Plan update process, which is scheduled to begin in the spring of 2013.

In March 2012 the ITS Branch in working in conjunction with DRCOG convened a broad-based regional stakeholder group and developed the *Denver Regional Integrated Traveler information Display Map Guidelines* “the Arterial Route Guidelines”. The Arterial Route Guidelines address traveler information protocols, methodologies, data parameters and other related items on the arterial routes to ensure uniform and consistent delivery of traveler information and display of the information on cotrip.org, including submitting, processing, archiving and storing the data. The Arterial Route Guidelines also
addresses and defines traveler information and map display requirements to ensure that travelers receive uniform and consistent information irrespective of jurisdictional boundaries.

DRCOG is working and co-sponsoring “proof-of-concept performance measures projects” with the City of Englewood, the City and County of Denver and the City of Lakewood. The purpose of the projects is to monitor and evaluate operational conditions and, if necessary, make changes to operational parameters to improve operations and measure and validate operational conditions and improvements by using certain prescribed performance measures. The projects are located on Hampden Avenue (Hampden Avenue Performance Measures Project, which has been implemented), Federal Boulevard and Wadsworth Boulevard (scheduled for implementation in 2013), respectively. More information regarding these local agency projects is provided in Section 3.8.

In July 2012 DRCOG developed the Regional Concept of Transportation Operations (RCTO), which describes a collaborative plan to improve regional operations performance by focusing on:

- Improving regional travel reliability by leveraging existing systems and success, and
- Reducing the impacts of traffic incidents.

The RCTO identifies three main goals, associated objectives and performance metrics, and also outlines four elements as part of a general approach to accomplish the goals.

Figure ES 3, Operations Plan’s Relationship, illustrates, at a very high level, the operations relationship between the CDOT Statewide Systems Operations Plan and the Arterial Route Guidelines, the Routes of Significance, the DRCOG/Local Agency Arterial Route Projects and the DRCOG RCTO.

Figure ES 3: Operations Plan’s Relationship

The reoccurring theme between and among these related projects is the emphasis on operating each corridor as effectively and efficiently as possible through systematic coordination, integration and
implementation of all related operations activities in order to optimize the available capacity and the utility of the corridor and the collective transportation system network.

**ES 4 Designating the Routes of Significance**

The Working Group recommended CDOT and the local agencies should focus on the top-ten segments as a reasonable number of routes that potentially could be implemented and thus designated by the effective date of the Rule and agreed that the MRA priority ranking provides CDOT and the local agencies with a road map regarding the order to systematically implement the Routes of Significance based on the methodology used. Table ES 4 shows the top-ten segments recommended for Routes of Significance designation.

**Table ES 4: Top-Ten Segments Recommended for Routes of Significance Designation**

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<tr>
<th>MRA Corridor</th>
<th>Segment Limits</th>
<th>Regional Ranking</th>
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<tbody>
<tr>
<td>SH 2 – Colorado Blvd</td>
<td>Alameda to 56th Avenue</td>
<td>1</td>
</tr>
<tr>
<td>US 40 – Colfax Avenue</td>
<td>I-25 to Logan Street</td>
<td>2</td>
</tr>
<tr>
<td>SH 2 – Colorado Blvd</td>
<td>Hampden to Alameda</td>
<td>3</td>
</tr>
<tr>
<td>US 40 – Colfax Avenue</td>
<td>Logan Street to Sable Blvd</td>
<td>4</td>
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<tr>
<td>SH 121 – Wadsworth Blvd</td>
<td>C 470 to Alameda</td>
<td>5</td>
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<tr>
<td>US 85 – Santa Fe Drive</td>
<td>I-25 to Highlands Ranch Pkwy</td>
<td>6</td>
</tr>
<tr>
<td>SH 88 – Arapahoe Road</td>
<td>Quebec Street to Buckley Road</td>
<td>7</td>
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<tr>
<td>US 287 – Federal Blvd</td>
<td>Alameda to I-76</td>
<td>7</td>
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<tr>
<td>SH 121 – Wadsworth Blvd</td>
<td>Alameda to 64th Avenue</td>
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<td>SH 285 – Hampden Avenue</td>
<td>Sheridan Blvd to Colorado Blvd</td>
<td>9</td>
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<tr>
<td>SH 119 – Longmont Diagonal</td>
<td>Iris Avenue to I-25</td>
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</tr>
<tr>
<td>SH 121 – Wadsworth Blvd</td>
<td>108th Avenue to Miramonte Blvd</td>
<td>10</td>
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However, the Working Group also recognized that between now and the time when the routes are actually designated conditions may change that affect CDOT and the local agencies ability to implement the routes by the effective date of the Rule. Therefore, CDOT as the agency charged with designating the Routes of Significance, working together with the local agencies, should only designate the number of routes commensurate with CDOT and local agencies ability to actually implement and report on the routes by the effective date of the Rule.

The Routes of Significance must be designated, with reporting beginning, by November 8, 2016. This provides CDOT with adequate time to complete the remaining items in the Arterial Route Guidelines, as identified in Section ES 2, including addressing not only technological but also institutional information issues related to maintenance, weather, incidents and construction, and to develop the CDOT Statewide Systems Operations Plan and update the 2040 Statewide Transportation Improvement Plan. These are essential inter-related project activities with the Routes of Significance that must be performed in order to ensure systematic and consistent operationally-based implementation on the statewide transportation system, the ability to monitor and evaluate operational conditions and measure and validate operational improvements by using performance measures, and to uniformly display and provide the information to the traveling public via CDOT traveler information media and other third-party information providers.

The cost to implement the Routes of Significance, as with implementation of any route, depends on numerous factors such as, but not limited to: type of technology, level of deployment, accessibility to
required communications and power, availability of other enabling infrastructure both on the roadway and technology capacity, capability and applications, including the cost to operate, maintain and replace the infrastructure that is implemented. CDOT and the local agencies will need to evaluate these, as well as other additional, factors to determine the most cost-effective manner to implement the Routes of Significance while ensuring that the operational and reporting requirements are addressed for each corridor.
1. Introduction/Background

1.1. FHWA Rule

On December 23, 2010 the Federal Highway Administration (FHWA) adopted a rule titled: Real–Time System Management Information Program “the Rule” (Title 23 Part 511 Subpart C) that requires State Departments of Transportation (DOTs), also referred to as States, to make available certain information on Interstate highways and on selected non-Interstate highways by the dates specified in the Rule. Non-Interstate highways are defined as the Routes of Significance. The Rule requires States to work with stakeholders in a collaborative process to identify and designate the Routes of Significance within their respective Metropolitan Statistical Areas (MSA). More specific information and detail regarding the Rule is provided in Section 2.

To meet the requirements of the Rule, the Colorado Department of Transportation (CDOT) Intelligent Transportation Systems Branch (ITS) initiated a project titled: Designation of Routes of Significance, which is referred to in this Report as “the Routes of Significance Project” or “the Project”, as applicable, and convened a broad-based regional stakeholder group “the Working Group” comprised of federal, state and local transportation engineers, planners and other transportation professionals, law enforcement, emergency responders, toll operators and North Central Area evacuation planning specialist. The ITS Branch conducted three Workshops over the period from May 2012 through November 2012, developed meeting agendas, workshop materials, related documents and presentations and provided explanation and clarification pertaining to the Rule and direction toward identification and designation of the Routes of Significance. The Working Group agreed upon and recommended that certain routes in the Denver-Aurora-Broomfield MSA be designated as Routes of Significance following completion of certain related activities in companion projects. More information regarding the Workshops is provided in Sections 3.4 through 3.7.

The primary purpose of the Rule focuses on the reporting of certain travel and road condition information to the traveling public. Although CDOT has not yet designated the Routes of Significance, CDOT currently provides the information required by the Rule, as well as other traveler information in some cases, on certain corridors within the state. As a matter of fact, CDOT has provided real-time traveler information for more than a decade via cotrip.org (CDOT traveler information web site) and 511 (CDOT automated traveler information phone system) and more recently on the CDOT App (CDOT traveler information smart phone application). Over that time period, and in response to an ever-increasing demand from the traveling public, CDOT has significantly expanded both the level and type of information and the corridors and routes on which the information is provided. The primary purpose for providing the information is to make travelers aware regarding travel and road conditions so they can make better informed choices that enhance and improve their choice of travel, mode, route and time, thereby resulting in a more productive, efficient and safe transportation experience. Studies further support and demonstrate that travelers that utilize traveler information can benefit by avoiding traffic problems, saving time by reducing delay and improving travel reliability, reducing travel frustration, reducing crash rates and reducing fuel consumption.

1.2. Denver Arterial Route Guidelines and Local Agency Arterial Route Projects

The Denver Regional Council of Governments (DRCOG) and the local jurisdictions also believe there is value in providing traveler information on local arterial routes. Over the past two to three years, several local jurisdictions within the Denver Metro area have either implemented arterial routes and provide
traveler information or are in the process of considering route implementation. As this arterial route implementation occurred, it became apparent that although traveler information could be provided in a number of different ways, e.g., type, level and extent of information, content and format, doing so would result in confusion, misunderstanding and ultimately mistrust and non-use of the information by the traveling public.

The ITS Branch in conjunction with DRCOG initiated a project and convened a broad-based regional stakeholder group to address these issues. The Arterial Route Guidelines were developed to address traveler information protocols, methodologies, data parameters and other related items on the arterial routes to ensure uniform and consistent delivery of traveler information and display of the information on cotrip.org, including submitting, processing, archiving and storing the data. The Arterial Route Guidelines addresses and defines traveler information and map display requirements to ensure that travelers receive uniform and consistent information irrespective of jurisdictional boundaries. The Arterial Route Guidelines also places an equally important, if not greater, emphasis on using the same ITS application to provide operators the ability to monitor the operational condition of the route, to modify, if necessary, certain operational parameters to improve conditions on the route and to evaluate and measure effectiveness of the change by using associated performance measures. More information regarding the Arterial Route Guidelines is provided in Section 3.2.D.

DRCOG is working and co-sponsoring “proof-of-concept performance measures projects” with the City of Englewood, the City and County of Denver and the City of Lakewood. The purpose of the projects is to monitor and evaluate operational conditions and, if necessary, make changes to operational parameters to improve operations and measure and validate operational conditions and improvements by using certain prescribed performance measures. The projects are located on Hampden Avenue (Hampden Avenue Performance Measures Project, which has been implemented), Federal Boulevard and Wadsworth Boulevard (scheduled for implementation in 2013), respectively. More information regarding these local agency projects is provided in Section 3.8.

In July 2012 DRCOG developed the Regional Concept of Transportation Operations (RCTO), which describes a collaborative plan to improve regional operations performance by focusing on:

- Improving regional travel reliability by leveraging existing systems and success, and
- Reducing the impacts of traffic incidents.

The RCTO identifies three main goals, associated objectives and performance metrics, and also outlines four elements as part of a general approach to accomplish the goals.

### 1.3. CDOT Operations

Concurrently, over the past several years, Intelligent Transportation Systems (ITS) technology has tremendously improved, the applicability of ITS to transportation related applications both has broadened and been integrated between and among the ITS applications, and ITS has been expanded to cover a larger portion of the transportation system network. Due to this, CDOT as well as other transportation agencies are convinced there are substantial operational efficiencies that can now be obtained by utilizing ITS applications on the transportation network to leverage and coordinate the deployment of operational activities and measures. This is very timely as the possibility for expanding the physical capacity of the transportation system to meet increasing traffic volume is becoming more and more challenging due to ever-increasing material and labor cost, physical constraints, impacts to the
traveling public and other related items. Transportation funding is also stagnating, and in some cases is even declining, which further affects CDOT’s ability to construct large capacity improvement projects.

Conscientiously and intentionally applying and using ITS as a systematic coordinated strategy to improve operations of the transportation system is a very economical, efficient and effective way to maximize the available capacity of the corridor thereby resulting in quantifiable benefits both to the department and transportation users. CDOT has committed to place a much higher emphasis on improving the operations of the transportation network and to that extent recently established and filled a Director of Operations position. As a first step in the reorganization process, CDOT also created a Division of Operations and transferred the ITS Branch into the newly formed Division of Operations, and is planning to transfer other business groups into the Division of Operations to coordinate and deliver statewide corridor operations more efficiently and effectively. Furthermore, CDOT intends to develop a CDOT Statewide Systems Operations Plan that will be an integral component and used within the 2040 Statewide Transportation Plan update process, which is scheduled to begin in the spring of 2013.

Figure 1, Operations Plan’s Relationship, illustrates, at a very high level, the operations relationship between the CDOT Statewide Systems Operations Plan and the Arterial Route Guidelines, the Routes of Significance, the DRCOG/Local Agency Arterial Route Projects and the DRCOG RCTO.

In summary, as mentioned above, the Rule requires CDOT to designate the Routes of Significance and make available certain information on those routes by the date specified in the Rule. The ITS Branch initiated the Routes of Significance Project and established a Working Group and conducted three Workshops resulting in consensus regarding identification and future designation of the Routes of Significance. CDOT already provides this information on certain corridors, local jurisdictions have begun to implement local arterial routes and the ITS Branch, DRCOG and local jurisdictions developed the Arterial Route Guidelines to guide implementation of, and reporting on, the routes and to define

![Figure 1: Operations Plan’s Relationship](image-url)
operational parameters and related performance measures. DRCOG is co-sponsoring three local jurisdiction performance measures projects to evaluate operational data and related performance measures. CDOT recently hired a Director of Operations, created a Division of Operations and intends to develop a CDOT Statewide Systems Operations Plan. The reoccurring theme between and among these related projects is the emphasis on operating each corridor as effectively and efficiently as possible through systematic coordination, integration and implementation of all related operations activities in order to optimize the available capacity and the utility of the corridor and the collective transportation system network.
2. Summary of the FHWA Rule

2.1. Metropolitan Statistical Area
As stated in Section 1.1 on December 23, 2010 FHWA adopted the Real–Time System Management Information Program “the Rule” (Title 23 Part 511 Subpart C) that requires State DOTs, also referred to as States, to make available certain information on Interstate highways and on selected non-Interstate highways by the dates specified in the Rule. The Rule requires States to work with stakeholders in a collaborative process to identify and designate the Routes of Significance, which are defined as non-Interstate highways, within their respective MSA.

The MSA is defined as the area designated by the Office of Management and Budget in the Office of the President with a population exceeding 1,000,000 inhabitants. The MSA and DRCOG boundaries are somewhat contiguous; however, the MSA includes Park and Elbert Counties, which are not part of DRCOG, but does not include Boulder County, which is part of DRCOG, or a portion of Weld County, which is part of the DRCOG Metropolitan Planning Organization (MPO) boundary. Figure 2, Denver-Aurora-Broomfield Metropolitan Statistical Area, shows the MSA and also shows the DRCOG boundary.

Figure 2: Denver-Aurora-Broomfield Metropolitan Statistical Area

The Rule requires that States designate Routes of Significance within the MSA, which is the prescribed minimum area; however, the Rule does not preclude that States designate Routes of Significance in an area that exceeds the limits of the MSA. Therefore, because Boulder County in DRCOG and the portion of Weld County in the DRCOG MPO are very much part of the greater Denver metropolitan-regional area, and the transportation network is interconnected and integrated to serve the concentrated...
transportation needs in the area, the Working Group decided to include Boulder County and the portion of Weld County within the MSA.

2.2. Evaluation Factors
With respect to the Routes of Significance designation process, the Rule identifies certain factors to be considered in evaluating the routes such as: crash rate, routes affected by environmental events, routes used for evacuations, economic productivity, severity and frequency of congestion and utility of the highway to serve as a diversion route for congestions locations. The Rule also states that all public roadways including arterial highways, toll facilities and other facilities that apply end user pricing shall be considered, and that States shall apply collaborative practices in designating the Routes of Significance.

2.3. Traffic and Travel Condition Information
The Rule identifies four elements within an area called traffic and travel conditions that States must make available, i.e., report, specifically related to three categories of routes in accordance with certain required data parameters and by certain required dates, and based on other prescribed terms and conditions identified in the Rule, and further requires that States collaborate with local or regional agencies and designate Routes of Significance within the MSA.

The four elements within the traffic and travel conditions area are:
- Construction and maintenance activities
- Roadway or lane blocking incidents
- Roadway weather observations
- Travel time information

The three categories of routes are:
- Interstate highways outside of the MSA
- Interstate highways within the MSA
- Routes of Significance (by definition within the MSA)

With respect to reporting the traffic and travel conditions information, the Rule charges States with the responsibility to report such information. The Rule also acknowledges and allows that States determine the best and most effective manner in which to provide the information, in order to satisfy the provisions for traffic and travel time conditions reporting as stated in the Rule, whether that reporting means:
- The State
- The State including cooperative activities engaging multiple state agencies
- A State partnership with commercial providers of value-added information products
- Other effective means that enable the State to satisfy the provisions

2.4. Reporting Timeframe
The Rule identifies the timeframe, referred to as Availability and Timeliness of the data, by which the traffic and travel condition elements must be reported following an event that warrants reporting associated with each traffic and travel condition element on the categories of routes, identifies the
applicability of the traffic and travel condition elements to the categories of routes and identifies the date that reporting must begin. The following describes how this applies for each category of routes:

- **Interstate highways outside of the MSA.** By November 8, 2014 all traffic and travel condition elements, except for Travel time information which is not required, must be reported within 20 minutes or less from the time an event warrants reporting of the related traffic and travel condition element.

- **Interstate highways within the MSA.** By November 8, 2014 all traffic and travel condition elements must be reported within 10 minutes or less from the time an event warrants reporting of the related traffic and travel condition element, except for Roadway weather observations, which must be reported within 20 minutes or less from the time an event warrants reporting.

- **Routes of Significance.** By November 8, 2016 all traffic and travel condition elements must be reported within 10 minutes or less from the time an event warrants reporting of the related traffic and travel condition element, except for Roadway weather observations, which must be reported within 20 minutes or less from the time an event warrants reporting.

### 2.5. Data Parameters

With respect to the data, the Rule defines the following data parameters and also identifies metrics for Accuracy and Availability:

- **Accuracy.** Means the measure or degree of agreement between a data value or set of values and a source assumed to be correct. *(Metric: The designed accuracy shall be 85 percent accurate at a minimum, or have a maximum error rate of 15 percent.)*

- **Availability.** Means the degree to which data values are present in the attributes (e.g., speed and travel time are attributes of traffic) that require them. Availability is typically described in terms of percentages or number of data values. *(Metric: The designed availability shall be 90 percent available at a minimum.)*

- **Quality.** Means the fitness of data for all purposes that require such data.

- **Timeliness.** Means the degree to which data values or a set of values are provided at the time required or specified.

- **Validity.** Means the degree to which data values fall within the respective domain of acceptable values.

### 2.6. Data and Regional ITS Architecture

The Rule requires States, in conjunction with the associated reporting dates, to perform certain tasks pertaining to the following areas:

- **Data Quality.** States shall develop methods by which data quality can be ensured and receive FHWA’s concurrence that the selected methods provide reasonable checks of the quality of the data. States shall develop the criteria for defining the validity of the traffic and travel conditions.

- **Update Regional ITS Architecture.** States shall evaluate pertinent Regional ITS Architectures to determine whether the Regional ITS Architecture explicitly address real-time highway and transit information needs and the methods needed to meet such needs while considering traffic and travel conditions monitoring needs for all Interstate highways, and if necessary, update the Regional ITS Architectures to address the requirements.
2.7. Federal Funding Eligibility

Finally, the Rule confirms that to advance the goals of the Rule certain federal program funds, in accordance with the federal matching share based on Interstate or non-Interstate implementation, known as: NHS, CMAQ and STP are eligible to be used for activities relating to the planning, deployment and operation, including preventative maintenance while SPC funds are only eligible for activities relating to development and implementation.

Table 2, Real-Time System Management Information Program, provides a summary overview regarding the salient points of the Rule. Also, for more information the FHWA Rule is attached as Appendix A.
<table>
<thead>
<tr>
<th>Table 2: Real-Time System Management Information Program</th>
<th>FHWA Rule Title 23 Part 511 Subpart C – Federal Register Volume 75 Number 215 pages 68427-68429 Effective December 23, 2010</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>Implementation Date</th>
<th>Interstate highways outside Metropolitan Statistical Area</th>
<th>Interstate highways within Metropolitan Statistical Area</th>
<th>Metropolitan Statistical Area roadways – Routes of Significance (1)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Traffic and Travel Conditions</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Construction &amp; maintenance activities</td>
<td>Reported within 20 minutes or less from the time of the closure or reopening of roadway. (2)</td>
<td>Reported within 10 minutes or less from the time of the closure or reopening of roadway. (2)</td>
<td>Reported within 10 minutes or less from the time of the closure or reopening of roadway. (2)</td>
</tr>
<tr>
<td>Roadway or lane blocking</td>
<td>Reported within 20 minutes or less from the time the incident is verified.</td>
<td>Reported within 10 minutes or less from the time the incident is verified.</td>
<td>Reported within 10 minutes or less from the time the incident is verified.</td>
</tr>
<tr>
<td>Roadway weather observations</td>
<td>Reported about hazardous driving conditions and roadway or lane closures or blockages because of adverse weather conditions within 20 minutes from the time hazardous conditions, blockage or closure is observed.</td>
<td>Reported about hazardous driving conditions and roadway or lane closures or blockages because of adverse weather conditions within 20 minutes from the time hazardous conditions, blockage or closure is observed.</td>
<td>Reported about hazardous driving conditions and roadway or lane closures or blockages because of adverse weather conditions within 20 minutes from the time hazardous conditions, blockage or closure is observed.</td>
</tr>
<tr>
<td>Travel time or speed information</td>
<td>Not required</td>
<td>Reported on limited access roadways that experience recurring congestion within 10 minutes from the time that the travel time or speed calculation is completed.</td>
<td>Reported on limited access roadways that experience recurring congestion within 10 minutes from the time that the travel time or speed calculation is completed.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Data Quality Parameters (3)</th>
<th>Interstate highways outside Metropolitan Statistical Area</th>
<th>Interstate highways within Metropolitan Statistical Area</th>
<th>Metropolitan Statistical Area roadways – Routes of Significance (1)</th>
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</thead>
<tbody>
<tr>
<td>Accuracy</td>
<td>Shall be 85% accurate at a minimum, or have a maximum</td>
<td>Shall be 85% accurate at a minimum, or have a maximum</td>
<td>Shall be 85% accurate at a minimum, or have a maximum error rate of 15%.</td>
</tr>
<tr>
<td>Availability</td>
<td>Interstate highways outside Metropolitan Statistical Area</td>
<td>Interstate highways within Metropolitan Statistical Area</td>
<td>Metropolitan Statistical Area roadways – Routes of Significance (1)</td>
</tr>
<tr>
<td>-------------------------</td>
<td>-----------------------------------------------------------</td>
<td>---------------------------------------------------------</td>
<td>-------------------------------------------------------------------</td>
</tr>
<tr>
<td></td>
<td>error rate of 15%</td>
<td>error rate of 15%</td>
<td>Shall be 90% available at a minimum.</td>
</tr>
<tr>
<td>Timeliness</td>
<td>Shall be 90% available at a minimum.</td>
<td>Values must be provided at the time required or specified.</td>
<td>Values must be provided at the time required or specified.</td>
</tr>
<tr>
<td>Regional ITS Architecture (4)</td>
<td>Evaluate Architecture to determine whether Architecture explicitly addresses real-time highway and transit information needs and methods to meet such needs. Traffic and travel conditions monitoring needs for all Interstate system highways shall be considered. If necessary, Architecture shall be updated and shall feature the components and functionality of the real-time information program.</td>
<td>Evaluate Architecture to determine whether Architecture explicitly addresses real-time highway and transit information needs and methods to meet such needs. Traffic and travel conditions monitoring needs for all Interstate system highways shall be considered. If necessary, Architecture shall be updated and shall feature the components and functionality of the real-time information program.</td>
<td>Evaluate Architecture to determine whether Architecture explicitly addresses real-time highway and transit information needs and methods to meet such needs. Traffic and travel conditions monitoring needs for all Interstate system highways shall be considered. If necessary, Architecture shall be updated and shall feature the components and functionality of the real-time information program.</td>
</tr>
</tbody>
</table>

1. The MSA is identified as the Denver-Aurora-Broomfield, and consists of the following ten counties: Denver, Arapahoe, Jefferson, Adams, Douglas, Broomfield, Elbert, Park, Clear Creek and Gilpin. Routes of significance are defined as non-Interstate roadways in the MSA that are designated by the State as meriting collection and provision of information related to traffic and travel conditions. Factors to be considered include: crash rates, environmental events, evacuation/diversion routes, severity and frequency of congestion, and economic activity. All public roadways including arterials, toll facilities and other facilities that apply end user pricing mechanism shall be considered when designating routes of significance. In identifying these routes, States shall apply collaborative practices and procedures.

2. Short term or intermittent lane closures of limited duration that are less than the required reporting times are not included as a minimum requirement.
3. State shall develop the methods by which data quality can be ensured. The criteria for defining the validity of traffic and travel conditions made from real-time informant programs shall be established by the State in collaboration with their partners for establishing the programs. State shall receive FHWA concurrence that the selected methods provide reasonable checks of the quality of the information made available by the real-time information program. In requesting FHWA’s concurrence, the State shall demonstrate to FHWA how the selected methods gauge the accuracy and availability of the real-time information and the remedial actions if the information quality falls below the levels described.

4. Although no date is provided as to when the Regional ITS Architecture must be updated, if applicable, it is assumed that it is the implementation date of the Rule. Although the Rule only identifies that traffic and travel conditions shall be considered for all Interstate highways, it is logical to assume that the update would also include MSA Routes of Significance, if applicable.
3. Process to Identify the Routes of Significance

3.1. Process and Approach
To perform the Routes of Significance Project the ITS Branch first assessed the requirements of the Rule to ensure a clear understanding regarding the details related to the Rule and to determine the corresponding level of work and best approach to perform the Project. The ITS Branch then tasked a consultant for assistance and discussed strategy and preferred approach regarding the Project. The ITS Branch and the consultant “the Project Team” developed a project workflow diagram to reflect the Project approach, direct the work related activities and guide the sequence of those activities within the Project. Figure 3, Process to Designate the Routes of Significance, illustrates the project process, methodology and workflow diagram.

![Figure 3: Process to Designate the Routes of Significance](image)

The Project Team also identified existing related documents and projects, convened the Working Group, prepared meeting agendas, workshop materials and documents, presentations and meeting minutes, conducted the workshops, received comments and updated materials and developed this Routes of Significance Report.

3.2. Requirements of the Rule
Within the context of designating the Routes of Significance, the Rule identifies both requirements, which are summarized directly below, and recommendations, which are summarized in Section 3.3.
- Designate Routes of Significance, which are defined as non-Interstate roadways in metropolitan areas that are designated by the State as meriting the collection and provision of information related to traffic and travel conditions in conjunction with the following:
  - Use a collaborative process with local or regional agencies
Within the MSA

All public roadways (shall be considered) including arterial highways, toll facilities and other facilities that apply end user pricing mechanisms

Report certain traffic and travel condition information on Routes of Significance and on Interstate Highways by certain dates

- Develop methods to ensure data quality
- Evaluate Regional ITS Architecture to determine if real-time highway and transit information needs are addressed and, if necessary, update the Architecture

Following explains work processes, activities, tasks that the Project Team and Working Group performed to ensure compliance with each area identified above in Requirements of the Rule.

3.2.A. **Use a collaborative process with local or regional agencies**

To facilitate the Project and meet the requirement to use a collaborative process, the Project Team decided to use the existing DRCOG Regional Transportation Operations (RTO) Working Group as the core working group due to the Group’s intimate knowledge of, and experience with, transportation issues in the region. The DRCOG RTO Working Group is comprised of federal, state and local transportation engineers and planners and meets on a monthly basis to discuss, address and coordinate transportation related issues within the DRCOG area. The DRCOG RTO Working Group also developed the DRCOG ITS Strategic Plan, DRCOG Regional ITS Architecture and the Arterial Routes Guidelines. To perform this Project the DRCOG RTO Working Group was expanded to include law enforcement, emergency responders, toll operators and North Central evacuation planning specialist and is referred to as the Working Group. The Project Team, working with the Working Group, conducted three Workshops over the period from May 2012 through November 2012.

3.2.B. **Within the MSA**

The Project Team reviewed the MSA and determined that the ten counties included in the MSA facilitate most of the regional travel within the greater Denver metropolitan-regional area; however, a notable exception was very apparent. Boulder County and the southwest portion of Weld County are very much part of, and integral to regional travel, in the greater Denver metropolitan-regional area. Therefore, the Project Team decided to include Boulder County and the portion of Weld County within the MSA.

3.2.C. **All public roadways (shall be considered) including arterial highways, toll facilities other facilities that apply end user pricing mechanisms**

The Project Team identified all public roadways, i.e., state highways including Interstate and non-Interstate principal arterials and above within the MSA. There are 274 roadways totaling 2,416 miles. Obviously, due to both the number and miles of roadways in the MSA, it was not feasible or practical to begin route evaluation from this as a starting point to designate the Routes of Significance. Figure 3.1, DRCOG 2035 Metro Vision Emphasis Corridors, shows the roadways categorized into three areas classified as follows: Freeways, Major Regional Arterials and Principal Arterials. Freeways include Interstate highways and freeways/expressways. The Rule requires the State report on Interstate highways within the MSA, which are classified as Freeways. The Rule further defines Routes of Significance as non-Interstate highways, which are classified as Major Regional Arterials and Principal Arterials. Major Regional Arterials (MRA) account for 15 roadway corridors, total 224 miles and are defined as follows:
Divided and undivided roadways that provide for high traffic volumes by minimizing left turns, side access, and cross streets. They permit at-grade access and crossings, but some intersections with other major facilities might be grade-separated. They form the backbone of the regional roadway system along with freeways.

Figure 3.1: DRCOG 2035 Metro Vision Emphasis Corridors

Principal Arterials are defined as major streets primarily serving regional through-traffic, with at-grade intersections and side access permitted but not regulated. Because MRA are higher functionally operating corridors and are more closely integrated and aligned with Interstate highways and the freeway system than are the Principal Arterials, the Project Team, working closely in conjunction with DRCOG, decided to recommend to the Working Group that MRA be evaluated for Routes of Significance. This was presented to the Working Group at the first Workshop as an option, and the Working Group concurred with the recommendation. Later on in the process, the Working Group decided to segment the corridors due to several long corridor lengths ranging from 20 miles to 53.5 miles. The Working Group also decided to add three non-MRA corridors due to the operational nature and utility of the corridors. More detailed information regarding this is provided in Section 3.6.
3.2.D. Report certain traffic and travel condition information on Routes of Significance and on Interstate Highways by certain dates

As mentioned in Section 1.1, CDOT currently provides all traffic and travel condition information on all Interstate highways, as well as on numerous other state highways, statewide as required by the Rule via the CDOT traveler information web site at www.cotrip.org, the CDOT 511 Automated Phone System and the CDOT App. Therefore, the reporting requirements and associated timeframes with respect to Interstate highways are satisfied. With regard to the MRA routes, CDOT currently provides certain traffic and travel condition information, albeit a very small amount, on certain portions of the MRA routes. For example, travel time (including speed) information is provided on portions of four MRA routes, while roadway weather observations information is provided on portions of three of those same MRA routes and portions of two other MRA routes. Construction and maintenance activities information and roadway or lane blocking incidents information are provided on all MRA routes; however, the information may not be as comprehensive or extensive in scope as required by the Rule.

As mentioned above, the ITS Branch, in conjunction with the DRCOG RTO Working Group, developed the Arterial Route Guidelines in March 2012. The Arterial Route Guidelines established traveler information protocols, methodologies, data parameters and other related items on the arterial routes to ensure uniform and consistent delivery of traveler information and display of the information on cotrip.org, including submitting, processing, archiving and storing the data. The Arterial Route Guidelines identified specific data items and associated parameters to be reported within each of the four traffic and travel condition elements. Following provides an example of some data items and their associated data parameters within each traffic and travel condition element:

- **Construction activities** - construction and maintenance operations to be classified as bridge, road, signal installation, paving or roadway maintenance, use the cone symbol to display and include planned or ongoing, location, direction, road/lane closures type, hours/day, completion data, description, delays, update time and reporting source information.

- **Roadway or lane blocking incidents** – incidents and lane blocking to be classified as accident (primary or secondary), stalled vehicle, spill load (non Hazmat), Hazmat or other, use a red triangle symbol to indicate closure and green circle with a check to indicate open and include location, direction, type, roadway or lane closure, potential duration and reporting source information.

- **Roadway weather observations** – roadway weather observation to be classified as and use the associated colors of: icy spots (light blue), snow (sky blue), wet/rain (green), poor visibility/fog (dark gray) and adverse (black) and include segment, road condition, roadway or lane blockages, update time and reporting source information.

- **Travel time information** – travel time index to be reported in two-minute intervals within ranges and using associated colors and legends of: 1.2 (green/light or no congestion), 1.21 – 1.5 (yellow/moderate congestion), 1.51 – 1.8 (red/heavy congestion), >1.81 (black/severe congestion) and no data (gray/no data).

The Arterial Route Guidelines also identified operational processes and procedures to be considered in conjunction with route implementation in order to ensure jurisdictional coordination and technological integration, identified measures of effectiveness (MOE) for each traffic and travel condition element and their applicability and usefulness to operators and the traveling public/others, and included the timeframe associated with each traffic and travel condition element as required by the Rule.
In summary, CDOT is already reporting traffic and travel condition information on all Interstate highways. Also, CDOT is reporting traffic and travel condition information on some MRA routes, from which the Routes of Significance will be identified, selected and designated. The Arterial Route Guidelines is the foundational and fundamental framework that will be used to implement the Routes of Significance. It addresses each of the traffic and travel condition elements and includes their associated timeframes as required by the Rule.

The Arterial Route Guidelines (Chapter 4 – Conclusions and Next Steps) also identified the following several remaining items that need to be addressed to foster seamless, coordinated and integrated operations, and to meet the reporting requirements pertaining to the Routes of Significance as required by the Rule, within the greater Denver metropolitan-regional area.

- Jurisdiction commitment and resources
- Modifying certain field equipment to meet Guidelines
- Programming changes to Colorado Transportation Management System platform and cotrip website
- Architecture related to data sharing, storage, archiving and reporting
- Software licensing regarding ITS Branch COGNOS reporting tool
- Configuration management process/responsibility pertaining to the Guidelines
- Feasibility of including traveler information for transit and other modes

It is anticipated that the ITS Branch will initiate a project in the very near future and reconvene the Working Group to address and resolve these issues in preparation to designate, implement, operate and report on the Routes of Significance by the timeframe as required by the Rule, and to facilitate operational improvements as identified in the yet-to-be developed CDOT Statewide Systems Operations Plan. The Arterial Route Guidelines can be accessed at [http://cotrip.org/its/arch](http://cotrip.org/its/arch).

### 3.2.E. Develop methods to ensure data quality

The ITS Branch has already developed methodologies and use-case functional requirements for each traffic and travel condition element, in conjunction with reporting traffic and travel condition information on Interstate highways and on other highways including several portions of MRA routes, that ensure data quality and validity conditions meet, and data parameters regarding accuracy, availability and timeliness exceed, the requirement as prescribed by the Rule. The methodologies and use-case functional requirements regarding each traffic and travel condition element will be submitted to FHWA, for review and concurrence, prior to the required reporting date for Interstate highways, which is November 8, 2014, and prior to the required reporting date for Routes of Significance, and in conjunction with official CDOT designation of the Routes of Significance, which is November 8, 2016.

### 3.2.F. Evaluate Regional ITS Architecture to determine if real-time highway and transit information needs are addressed and, if necessary, update the Architecture

DRCOG is the responsible agency regarding the pertinent Regional ITS Architecture. DRCOG has initiated the review and update the Regional ITS Architecture. The ITS Branch believes that the Regional ITS Architecture already addresses real-time highway and transit information needs, but the review will confirm and, if necessary, update this. DRCOG will work with the DRCOG RTO Working Group to conduct the Architecture update.
### 3.3. Recommendations of the Rule

The Rule identifies the following factors (criteria) to be considered in designating Routes of Significance:

- Roadway safety – crash rate and routes affected by environmental events
- Public safety – routes used for evacuations
- Economic productivity
- Severity and frequency of congestion
- Utility of the highway to serve as a diversion routes for congestions locations

Following explains work processes, activities, tasks that the Project Team and Working Group performed to address the factors (criteria) in designating Routes of Significance identified above in Recommendations of the Rule.

The Project Team assessed the factors to gauge relevance, determine applicability and data availability. Most of the factors seemed to make sense and be relevant; however, a couple of the factors seemed very abstract and somewhat difficult to understand how the factor would be applied, and if applied what would be the relevance. For example, “routes affected by environmental events” is a very broad term and could mean many different things, but would seem to imply something related to weather events. Although the MSA is a large geographical area, for the most part the geography is similar and weather is substantially the same over the entire area unlike weather over a much larger area such as the state with varying geographic conditions that greatly impact weather. Economic productivity was very difficult to understand as to what exactly was meant and how it would be applied. Did it mean revenues generated by businesses located directly on the corridor, or to travelers using the corridor to access a business whether or not it was located directly on the corridor or some combination thereof?

The Project Team determined that even if such data were available, collecting it would take much more time than the value of the factor contributed to the designation process. During the Workshop process the Project Team crafted criteria that it believed addressed the concepts and ideas set forth in the factors pertaining to routes affected by environmental events and economic productivity. More information regarding this is provided in Sections 3.5 through 3.7.

The Project Team identified data and sources with respect to the factors recommended in the Rule, identified additional criteria to apply as part of the evaluation process and developed the initial list of criteria. The Project Team also defined the criteria in terms of: data source, value to the project goals and how to apply (the criterion), and presented it at the first Workshop, along with other project related materials, to the Working Group for their consideration and for discussion. Table 3, Criteria to Designate Routes of Significance, shows a compilation of the initial criteria, definitions and relationship to the factors recommended in the Rule.

<table>
<thead>
<tr>
<th>Criteria</th>
<th>Data Source</th>
<th>Value to Project Goals</th>
<th>How to Apply</th>
<th>Relationship to Factor</th>
</tr>
</thead>
<tbody>
<tr>
<td>Crash rates</td>
<td>CDOT, DRCOG and local agencies</td>
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<td>Higher crash rate get more points</td>
<td>Roadway safety – crash rate</td>
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<td>Unsure</td>
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<td>Criteria</td>
<td>Data Source</td>
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<td>How to Apply</td>
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<tr>
<td>Routes</td>
<td>and North Central Plan</td>
<td>get more points</td>
<td>routes used for evacuations</td>
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<tr>
<td>Severity and frequency of congestion</td>
<td>DRCOG Model</td>
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<td>Severity and frequency of congestion</td>
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<td>Economic productivity</td>
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<td>Corridors with higher CMP rank higher</td>
<td>Roadway safety – crash rate and Severity and frequency of congestion</td>
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<td>Corridors with fiber score higher</td>
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<tr>
<td>Presence of ITS Infrastructure</td>
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<tr>
<td>Return on Investment</td>
<td>DRCOG</td>
<td>High</td>
<td>Unsure</td>
<td>N/A</td>
</tr>
<tr>
<td>Parallel Routes</td>
<td>DRCOG</td>
<td>Medium</td>
<td>Corridors with parallel routes score higher</td>
<td>N/A</td>
</tr>
</tbody>
</table>

The Working Group discussed the initial Criteria to Designate Routes of Significance, as well as the other project related materials, and recommended certain revisions to reprioritize the criteria, refine the points associated with the data values and realign the data parameters related to specific criterion. This information, as well as other information regarding the Project, is documented in Sections 3.5 through 3.7.

3.4. **Overview of the Routes of Significance Workshops**
The following provides a summary overview of each of the three Workshops that were conducted by the Project Team to facilitate the Project including the main topics that were discussed and recommendations given by the Working Group. The Workshop Agenda, Presentation, Workshop
Materials (if applicable) and Meeting Minutes for each Workshop are attached as Appendix B, C and D, respectively, for additional information and as reference materials.

3.5. Workshop #1 – May 22, 2012
The Project Team presented the Project to the Working Group and summarized and explained the requirements of the Rule, MSA and DRCOG boundaries, purpose of the Project, relationship of the Project to other CDOT and DRCOG/local operations and planning projects. The Project Team reiterated that although the primary intent of the Rule from FHWA perspective was to provide traffic and travel condition information, the primary goal of the Project from CDOT’s perspective was to improve operational efficiency and provide performance measures monitoring on the designated Routes of Significance. The Project Team also identified several benefits that could be realized from improved corridor operations and associated performance measures. The Project Team pointed out that in the MSA there were 274 roadways totaling 2,416 miles that could be considered as potential corridors. The Project Team identified and discussed implementation considerations and expectations, requested direction regarding narrowing down the potential corridors to a logical subset and presented several options to achieve this for the Working Group’s consideration. The Project Team then presented the initial list of criteria, as shown above in Table 3, to be considered in evaluating the potential corridors.

The Working Group suggested that following corridor identification the corridors should be prioritized and the top-fifteen corridors should be designated and that consideration should be given to procuring certain data from Internet Service Providers (ISP) in lieu of installing infrastructure. The Working Group suggested using a test corridor to better understand requirements and resources and asked how segment implementation might be affected by jurisdictional boundaries, and other related jurisdictional resource issues, that occur within the segment. The Working Group stated that construction and incident information are more institutional in nature whereas travel time and weather information are more technology dependent and that travel time is most important. The Working Group stated that the criteria should be applied to each potential corridor, that the Project should focus on the MRA and not put too much emphasis on evacuation routes and that the DRCOG Congestion Mobility Program (CMP) grade, which is attached as part of Appendix B, should be used for crash rates and severity and frequency of congestion. The Working Group agreed that CDOT regional priority ranking of the corridors was very important, suggested that consideration be given to including other evacuation routes for less catastrophe reasons such as wild fire and to adding other routes that have limited egress opportunities. The Working asked if the 2008 data were the latest available for the DRCOG CMP grade. DRCOG stated they would check internally. The Project Team stated they would apply the selected criteria to the MRA and have it available for the next workshop.

3.6. Workshop #2 – September 25, 2012
The Project Team recapped the requirements of the Rule, MSA and DRCOG boundaries, purpose of the Project, relationship of the Project to other CDOT and DRCOG/local operations and planning projects and reemphasized the goal of the Project from CDOT’s perspective was to improve operational efficiency and provide performance measures monitoring on the designated routes of significance. The Project Team confirmed that the Working Group decided to focus on the MRA, which account for 15 roadway corridors totaling 224 miles within the MSA. The Project Team presented the MRA corridors, and a companion document titled: Routes of Significance – Evaluation of MRAs in the DRCOG Region (Workshop #2 – September 25, 2012) showing the MRA ranking based on the criteria that were selected.
in Workshop #1 and a Map titled: MRA Corridor Ranking Map illustrating MRA corridor ranking and the Interstate highways and freeways, which are attached as part of Appendix C. The Project Team discussed rationale used to select and apply data in each criterion area and to determine and apply the associated point values in each criterion area as follows:

- **Environmental Events** – used the highest traffic volume for the MRA and assigned points in relation to the volume, i.e., higher volume receives more points.
- **Evacuation Diversion Routes** – used the draft North Central Region Evacuation Plan. MRA, or portion of MRA, assigned as evacuation route received points.
- **Economic Activity** – identified shopping malls, events centers and major employment centers directly located on the MRA and assigned points accordingly.
- **Corridor CMP Value** – calculated a weighted-average segment CMP Value using DRCOG Congestion Mobility Grade Calculation for each sub-segment within the segment.
- **Connection to Freeways** – identified freeways that directly connected to MRA and applied one point for each freeway connection.
- **Synergies** - identified ITS infrastructure, signal system, fiber and other ITS projects on the MRA and assigned one point for each category existing on the corridor.
- **CDOT Region Ranking** – identified CDOT MRA corridor ranking (in discussions with CDOT Regions and from ITS Implementation Plans) and assigned points based on CDOT priority.
- **Accidents not Occurring in Dry Weather** – calculated accidents that occurred during non-dry weather conditions, i.e., snow, ice, rain/wet, etc. and assigned points relative to accidents per mile.

The Project Team then presented two potential options regarding designating the Routes of Significance and identified pros and cons associated with each option. Finally, with respect to the comment pertaining to ISP at the previous Workshop, the Project Team posed several questions for the Working Group to consider.

The Working Group recommended that Environmental Events be renamed to Traffic Volumes because accidents during non-dry conditions are evaluated in a separate criterion and that Economic Activity should be renamed to Major Traffic Generators. The Working Group also suggested that each shopping mall, event center and major employment center should receive individual points instead of only points for the entire category, and that points should be given for each ITS project within the Synergies criterion. The Working Group identified an additional employment center on a MRA, suggested that consideration be given to routes that connect to tourist areas outside of the DRCOG boundary, identified an additional freeway connection for two MRA corridors, proposed missing accident data for local roadways should be obtained from the local jurisdictions, and recommended placing higher weighting for CDOT Region Ranking and current ITS projects on the MRA and a lower weighting for Evacuation Diversion Routes. The Working Group agreed that it was important to designate the Routes of Significance sooner rather than later to allow agencies to work towards incorporating the routes into the future CDOT Statewide Systems Operations Plan and to seek and leverage funding. The Working Group recommended that the MRA corridors should be broken into segments based on signal timing projects, that three non-MRA routes should be included and evaluated at a high-level analysis and only included in the final ranking if they ranked within the top ten, and that a concept-of-operations needed to be developed for this Project. The Project Team stated they would revise the criteria, identify accident data needed from local jurisdictions, segment the MRA corridors and add and evaluate the proposed non-MRA corridors and have it available for the next workshop.
3.7. Workshop #3 - November 28, 2012

The Project Team recapped the requirements of the Rule, purpose of the Project, reemphasized the goal of the Project from CDOT’s perspective was to improve operational efficiency and provide performance measures monitoring on the designated routes of significance, and reiterated certain items that the Working Group agreed to with regard to MRAs, segmentation and addition and evaluation of several non-MRA corridors, revised selected criteria and changes in applying points. The Project Team presented a companion document titled: Routes of Significance – Evaluation and Ranking of MRAs in the DRCOG Region (Workshop #3 – November 28, 2012) showing the MRA ranking based on MRA segmentation and revised criteria that were identified in Workshop #2, which is attached as part of Appendix D. The Project Team summarized the changes to the criteria as recommended by the Working Group in the previous Workshop and comments that were received following the previous Workshop:

- Traffic Volumes – renamed from Environmental Events, averaged traffic volume over the segment to normalize and updated with local data that was provided.
- Evacuation Diversion Routes – incorporated Primary and non-Primary evacuation route pertaining to the MRA, revised point assignment and applied 50% less weighting for Primary.
- Major Traffic Generator – renamed from Economic Activity, expanded centers to include hospitals, airports, universities, colleges and high schools, defined traffic impacts associated with each center and added centers based on comments received.
- Corridor CMP Value – informed prior to Workshop that 2010 data was available.
- Connection to Freeways – applied one point for each freeway connection.
- Synergies – applied one point for each individual application, except for traveler information and transit signal priority that were assigned ten points and five points and applied 50% greater weighting.
- CDOT Region Ranking – assigned points based on CDOT priority of short term, medium term and long term and applied 50% greater weighting.
- Accidents Occurring During Non-Dry Weather Conditions – renamed from Accidents not Occurring in Dry Weather to more accurately reflect criterion and used CDOT 2007-2011 traffic accident data for MRA that are state highways.

The Project Team then discussed the priority ranking based on the segmentation of each MRA corridor and provided the Working Group with some information to consider that might impact the designation decision from the previous Workshop, that being CDOT was in the process of hiring an Operations Director and reorganizing to form a Division of Operations and intended to develop a CDOT Statewide Systems Operations Plan to be incorporated into, and used as part of, the upcoming 2040 Statewide Transportation Improvement Plan update scheduled for 2013.

The Working Group recommended that additional traffic generators be included on segments 12, 3 and 6, respectively. The Working Group stated that DRCOG CMP grade 2010 data were available, that a freeway connection should be added to segment 9. The Working Group questioned if within Synergies, ITS Projects/Transit Signal projects should receive ten points and five points, respectively, which could due to the high number of points for these items result in inflating the segment value, when if in fact the purpose of the Project was to implement corridors that, although have enabling infrastructure such as fiber, were not already implemented with ITS Projects/Transit Signal projects. The Project Team performed a cursory analysis at the Workshop and determined that removing the points attributed to ITS Projects/Transit Signal projects would change the priority order within the top-ten segments; however, not significantly and only one segment (prioritized as number 10) would be removed from the top ten while four segments (prioritized 11 through 13) would move into the top ten as numbers 7, 8
and 9. Although there is merit in considering whether these items warrant the high number of points, the Working Group also pointed out that existing ITS Projects/Transit Signal projects reflect an obvious priority and provide the ability to utilize and potentially leverage on the existing application. The Working Group agreed that it made sense to wait to designate the Routes of Significance based on forthcoming CDOT actions and to provide time for CDOT and local jurisdictions to coordinate regarding implementation items. The Working Group stated that with respect to maintenance, weather, incidents and construction a larger group of stakeholders should be involved. The Project Team stated they would update the Routes of Significance – Evaluation and Ranking of MRAs in the DRCOG Region (Workshop #3 – November 28, 2012) based on the DRCOG CMP grade 2010 data and other minor comments received at the Workshop and provide it to the Working Group. It was anticipated that the DRCOG CMP grade 2010 data would not have any significant impact on the segment ranking. The Project Team also stated the draft Routes of Significance Report should be provided to the Working Group for review and comment no later than February 15.

3.8. DRCOG/Local Agency Arterial Route Projects

As mentioned in Section 1.2 DRCOG is working and co-sponsoring “proof-of-concept performance measures projects” with the City of Englewood, the City and County of Denver and the City of Lakewood. The purpose of the projects is to monitor and evaluate operational conditions and, if necessary, make changes to operational parameters to improve operations and measure and validate operational conditions and improvements by using certain prescribed performance measures. The corridors on which the projects will be implemented are MRA. The projects are located on:

- Hampden Avenue (Hampden Avenue Performance Measures Project, which has been implemented), from Federal Boulevard to University Boulevard,
- Federal Boulevard (scheduled for implementation in 2013) from Alameda Avenue to I-70, and
- Wadsworth Boulevard (scheduled for implementation in 2013) from Mansfield to 26th Avenue.

The projects will be implemented in accordance with the Arterial Route Guidelines and will focus on Travel Time information using the following performance measures to monitor, evaluate, measure and validate operational conditions and operational parameters on the corridor.

- Average Travel Time
- Average Travel Speed
- Average Travel Time Index
- Congestion Duration
- Planning Time Index
- Traffic Volume
- Congestion Duration by V/C Ratio

Also, all three projects are ranked within the top-ten corridor segments that would potentially be designated as Routes of Significance although none of the projects implement the entire segment. Table 3.1, DRCOG/Local Agency Arterial Route Projects – Regional Ranking, shows the projects in conjunction with MRA Corridor, Segment Limits and Regional Ranking from the Regional Ranking (Workshop #3 - November 28, 2012).
Table 3.1: DRCOG/Local Agency Arterial Route Projects – Regional Ranking

<table>
<thead>
<tr>
<th>Project</th>
<th>MRA Corridor</th>
<th>Segment Limits</th>
<th>Regional Ranking</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hampden Avenue</td>
<td>SH 285 (Hampden Ave)</td>
<td>Sheridan Blvd to Colorado Blvd</td>
<td>9</td>
</tr>
<tr>
<td>Federal Boulevard</td>
<td>Federal Boulevard</td>
<td>Alameda to I-76</td>
<td>7</td>
</tr>
<tr>
<td>Wadsworth Boulevard</td>
<td>SH-121/US-287</td>
<td>C-470 to Alameda</td>
<td>5</td>
</tr>
<tr>
<td>Wadsworth Boulevard</td>
<td>SH-121/US-287</td>
<td>Alameda to 64th Avenue</td>
<td>8</td>
</tr>
</tbody>
</table>
4. Designating the Routes of Significance

4.1. Recommended Route Selection

Following Workshop #3 the Project Team updated the Routes of Significance – Evaluation and Ranking of MRAs in the DRCOG Region (Workshop #3 – November 28, 2012) spreadsheet with the DRCOG CMP grade 2010 data and a couple of other minor changes in the areas of Primary Evacuation Diversion Routes Ranking and Major Traffic Generators Ranking that were identified by the Working Group at Workshop #3. As anticipated by the Project Team there were no significant changes in the priority ranking regarding the top-ten segments based on the updated DRCOG CMP grade data and other minor changes. There was, however, a minor shift in the priority order within the top-ten segments, segment number 3 was removed (was priority 10 updated priority 11) and segment number 6 was added (was priority 16 updated priority 9). Table 4.1 shows the top-ten segments recommended for Routes of Significance designation.

<table>
<thead>
<tr>
<th>MRA Corridor</th>
<th>Segment Limits</th>
<th>Regional Ranking</th>
</tr>
</thead>
<tbody>
<tr>
<td>SH 2 – Colorado Blvd</td>
<td>Alameda to 56th Avenue</td>
<td>1</td>
</tr>
<tr>
<td>US 40 – Colfax Avenue</td>
<td>I-25 to Logan Street</td>
<td>2</td>
</tr>
<tr>
<td>SH 2 – Colorado Blvd</td>
<td>Hampden to Alameda</td>
<td>3</td>
</tr>
<tr>
<td>US 40 – Colfax Avenue</td>
<td>Logan Street to Sable Blvd</td>
<td>4</td>
</tr>
<tr>
<td>SH 121 – Wadsworth Blvd</td>
<td>C 470 to Alameda</td>
<td>5</td>
</tr>
<tr>
<td>US 85 – Santa Fe Drive</td>
<td>I-25 to Highlands Ranch Pkwy</td>
<td>6</td>
</tr>
<tr>
<td>SH 88 – Arapahoe Road</td>
<td>Quebec Street to Buckley Road</td>
<td>7</td>
</tr>
<tr>
<td>US 287 – Federal Blvd</td>
<td>Alameda to I-76</td>
<td>7</td>
</tr>
<tr>
<td>SH 121 – Wadsworth Blvd</td>
<td>Alameda to 64th Avenue</td>
<td>8</td>
</tr>
<tr>
<td>SH 285 – Hampden Avenue</td>
<td>Sheridan Blvd to Colorado Blvd</td>
<td>9</td>
</tr>
<tr>
<td>SH 119 – Longmont Diagonal</td>
<td>Iris Avenue to I-25</td>
<td>9</td>
</tr>
<tr>
<td>SH 121 – Wadsworth Blvd</td>
<td>108th Avenue to Miramonte Blvd</td>
<td>10</td>
</tr>
</tbody>
</table>

The updated document titled: Routes of Significance – Final Evaluation and Ranking of MRAs in the DRCOG Region is attached as Appendix E. Also, for additional information, attached is a spreadsheet titled: Final MRA Ranking Compared to Workshop #3 that shows the final ranking of the segments compared to the Workshop #3 ranking of the segments. The MRA priority ranking provides CDOT and the local agencies with a road map regarding the order to systematically implement the Routes of Significance based on the methodology used. The Working Group recommended CDOT and the local agencies should focus on the top-ten segments as a reasonable number of routes that potentially could be implemented and thus designated by the effective date of the Rule. However, the Working Group also recognized that between now and the time when the routes are actually designated conditions may change that affect CDOT and the local agencies ability to implement the routes by the effective date of the Rule. Therefore, CDOT as the agency charged with designating the Routes of Significance, working together with the local agencies, should only designate the number routes commensurate with CDOT and local agencies ability to actually implement and report on the routes by the effective date of the Rule.
4.2. Routes of Significance Designation/Reporting Date
As required by the Rule, Routes of Significance must be designated, with reporting beginning, by November 8, 2016. This provides CDOT with adequate time to complete the remaining items in the Arterial Route Guidelines, as identified in Section 3.2.D, including addressing not only technological but also institutional information issues related to maintenance, weather, incidents and construction, and to develop the CDOT Statewide Systems Operations Plan and update the 2040 Statewide Transportation Improvement Plan. These are essential inter-related project activities with the Routes of Significance that must be performed in order to ensure systematic and consistent operationally-based implementation on the statewide transportation system, the ability to monitor and evaluate operational conditions and measure and validate operational improvements by using performance measures, and to uniformly display and provide the information to the traveling public via CDOT traveler information media and other third-party information providers. Therefore, based on this, and in accordance with the Working Group’s recommendation, the ITS Branch should perform and complete these project related activities prior to designating the Routes of Significance. Also, in conjunction with designation of the Routes of Significance, the ITS Branch should submit data quality documentation to FHWA and verify that real-time highway and transit information needs are addressed in the pertinent Regional ITS Architectures as required by the Rule.

4.3. Interstate Highways Reporting Date
With respect to Interstate highways reporting must begin by November 8, 2014 as required by the Rule. Interstate highways are broken into two categories; outside of the MSA and within the MSA. Required reporting of traffic and travel condition information, with the exception of travel time information that is not required to be reported on Interstate highways outside of the MSA, is the same for both. The timeframe (see Section 2.4) for reporting roadway weather observations is the same for both categories, but the timeframes (see Section 2.4) for construction and maintenance activities and roadway or lane blocking incidents are not the same for both categories. As stated in Section 3.2.D, CDOT already reports and provides all traffic and travel condition information on all Interstate highways, thus CDOT is in compliance with the requirements of the Rule pertaining to Interstate highways. Nonetheless, as the project related activities, as identified above, are performed CDOT will have an opportunity to verify and validate, and refine accordingly if necessary, that traffic and travel condition information is being reported in accordance with the provisions identified in the Rule regarding the traffic and travel conditions information elements, timeframe and within the data parameters. Also, prior to the effective date of the Rule, the ITS Branch should submit data quality documentation to FHWA and verify that real-time highway and transit information needs are addressed in the pertinent Regional ITS Architectures as required by the Rule.

4.4. Cost to Implement the Routes of Significance
The cost to implement the Routes of Significance, as with implementation of any route, depends on numerous factors such as, but not limited to: type of technology, level of deployment, accessibility to required communications and power, availability of other enabling infrastructure both on the roadway and technology capacity, capability and applications, including the cost to operate, maintain and replace the infrastructure that is implemented. CDOT and the local agencies will need to evaluate these, as well as other additional, factors to determine the most cost-effective manner to implement the Routes of Significance while ensuring that the operational and reporting requirements are addressed for each corridor.
Cost related information will be available from the DRCOG/Local Agency Arterial Routes Projects, which will be useful as agencies prepare to implement the designated Routes of Significance. The local agencies are using different technologies to implement their Projects, which will undoubtedly result in much different implementation costs. The City of Englewood is using toll-tag readers and radar units to collect travel time and traffic volume data, while both the City and County of Denver and the City of Lakewood are using Bluetooth reader technology. Additionally, as mentioned in Section 3.5, the ITS Branch has been exploring the possibility of procuring such data from ISP providers. While toll tag readers and radar provide proven, verifiable source and high-confidence level data, other types of technology such as Bluetooth reader technology and procuring data from ISP providers still need to be rigorously tested and evaluated to ensure that the data meet the requirements in the Arterial Route Guidelines as well as other requirements pertaining to use and distribution of the data.

4.5. Configuration Management Process/Responsibility Pertaining to the Routes of Significance

Configuration management process and responsibility was identified as one of the remaining items to be addressed pertaining to the Arterial Route Guidelines. This also needs to be addressed regarding the Routes of Significance. Due to the intrinsic relationship between the Arterial Route Guidelines and the Routes of Significance, it seems logical to incorporate the Routes of Significance within the Arterial Route Guidelines configuration management process. This will ensure proper administrative oversight and agency responsibility, regularly scheduled meetings to discuss status, progress and address changes and issues related to operations, technology, implementation and/or other issues.