U.S. Department of Transportation Federal Highway Administration Arizona Division		**Standard Operating Procedure (SOP)** Issued: 9/27/2011 (date) Updated: 1/29/2015 (date) Review Cycle: 5 Years Next Review: 1/29/2020
Subject:	**New or Revised Access Points on the Interstate System (Change of Access Requests)**	Approved: ____________ (signature) Karla S. Petty, Division Administrator

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II. REFERENCES

23 U.S.C. 111, Agreements relating to use of and access to rights-of-way - Interstate System

23 CFR 1.23, Rights-of-way

23 CFR 710 Subpart D, Real Property Management

23 CFR 771, Environmental Impact and Related Procedures

23 CFR 625, Non-regulatory Supplement, 03/01/2005

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23 CFR 630C, Non-Regulatory Supplement, June 17, 1998

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III. PURPOSE

The purpose of this Standard Operating Procedure (SOP) is to establish Federal Highway Administration (FHWA) review and approval procedures for new or revised Interstate access points in accordance with the August 27, 2009, Interstate Access Policy and related FHWA policies and guidance. This Interstate Access Policy is applicable to new or revised access to existing Interstate facilities regardless of the funding of the original construction or regardless of the funding for the new or revised access points. This includes routes incorporated into the Interstate System under the provisions of 23 U.S.C. 103(c)(4)(A) or other legislation.

FHWA has retained all approval rights for the control of access to the Interstate System. This is necessary to protect the integrity of the Interstate System and the extensive investment associated with it. The Arizona Department of Transportation (ADOT) must submit all requests for new or revised access (permanent and temporary) to the Interstate System to the FHWA Arizona Division Office regardless of who is initiating the request. The request should be reviewed by ADOT prior to submittal to FHWA and contain its recommendation(s).

IV. DEFINITIONS

Access Point – Each break in the control of access to the Interstate System right-of-way is considered to be an access point. For the purpose of applying this policy, each entrance or exit point, including "locked gate" access, is considered to be an access point. For example, a diamond interchange configuration has four access points. Ramps providing access to rest areas, information centers, and weigh stations within the Interstate controlled access are not considered access points for the purpose of applying the Interstate Access Policy.

AASHTO – American Association of State Highway and Transportation Officials

ADOT – Arizona Department of Transportation

Change of Access – Terminology commonly used in Arizona and by ADOT for new or revised access to the Interstate System.

Change of Access Report – Terminology commonly use in Arizona and by ADOT to denote a report prepared to describe the scope (configuration) and justification for new or revised access to the Interstate System. A Change of Access Report is normally submitted as support for a Change of Access Request for new or revised access to the Interstate System.

Change of Access Request – Terminology commonly used in Arizona and by ADOT for requests for new or revised access to the Interstate System.

CFR – Code of Federal Regulations

DA – FHWA Arizona Division Administrator

Determination of Engineering and Operational Acceptability – An FHWA determination that a proposed new or revised access point is acceptable from an engineering and operational perspective prior to the completion of the National Environmental Policy Act (NEPA) process. A Determination of Engineering and Operational Acceptability affords the Arizona Department of Transportation an opportunity to determine if a proposal is acceptable for inclusion as an alternative in the environmental review and public involvement processes.

FHWA – Federal Highway Administration

Freeway – A high-speed multi-lane divided highway with full control of access. Access to or from freeways is always by ramps at interchanges. All Interstate Highways are freeways.

FTA – Federal Transit Administration

HCM – Highway Capacity Manual

HCS – Highway Capacity Software

HOV – High Occupancy Vehicle (Carpools, Van Pools, Buses, etc.)

HQ – FHWA Headquarters in Washington, DC

IJR – Interstate Justification Report (alternative name for a Change of Access Report – IJR has not been used in Arizona)

ITS – Intelligent Transportation Systems

LRTP – Long Range Transportation Plan

MPO – Metropolitan Planning Organization

NEPA – National Environmental Policy Act

Service Interchange – An interchange on the Interstate System (or any freeway) that provides access to a street or highway that does not have full control of access, and thus provides access to land and land uses (residences, businesses, farms, parks, etc).

SOP – Standard Operating Procedure

SPDI – Single Point Diamond Interchange

STIP – Statewide Transportation Improvement Program

System Interchange – An interchange on the Interstate System (or any freeway) that provides access to another Interstate Highway or to a non-Interstate freeway.

TIP – Transportation Improvement Program (for an urban area or other subdivision of the State)

TSM – Traffic Systems Management

Temporary Change of Access – A short term access to or from the Interstate System granted to facilitate a special short term need for access. The most common Temporary Changes of Access requests involve access to or from material sources where access through the nearest interchange and/or by other public roads is long and circuitous or is likely to damage the local road system. Other Temporary Changes of Access have been granted to facilitate movement of special equipment (large mining equipment), for utility installations or when normal access to land by adjacent interchanges is cut off by natural or man-made events. Short term can be as short as a single day (or even a few hours) or it may extend out to more than a year. However, Temporary Changes of Access lasting longer than one year should be reviewed very carefully.

Traffic Interchange (TI) – Terminology commonly used in Arizona to describe an interchange on an Interstate Highway or any freeway

Transportation Management Area (TMA) – An urbanized area with a current population of more than 200,000 as determined by the latest census, or other area when the TMA designation is requested by the Governor and the MPO, and officially designated by the Administrators of the FHWA and FTA.

U.S.C. – United States Code

V. SCOPE

The intent of this SOP is to provide guidance and procedures for all FHWA Arizona Division Office personnel who may become involved in reviewing and approving new or modified access points on the Interstate Highway System.

VI. PROCEDURES

In Arizona, most requests for new or revised access to the Interstate System are generated (initiated) for one of six reasons, as follows:

1. A need for new freeways to connect to existing Interstate Highways.
2. A need for existing Interstate Highways and other freeways and their system interchanges to be widened and/or otherwise upgraded to better accommodate growing traffic demands.
3. A need for existing service interchanges along the Interstate System to be expanded and/or reconfigured to better accommodate growing traffic demands.
4. A need and/or desire by local public agencies to have new arterial streets, particularly in developing parts of their communities, connect to the Interstate System.
5. A desire by landowners and/or development interests to create new interchanges on the Interstate System to serve or better serve their land holdings and/or developments.
6. A need and/or desire to provide access to lands and land uses in remote areas where no other roads exist except for the Interstate Highway – either on a temporary or permanent basis.

In most cases in Arizona, the proponents for new or revised access to the Interstate System first approach ADOT regarding their need or desire; and ADOT then contacts the FHWA Arizona Division Office. Occasionally, private developers, landowners, local public agencies and other Federal agencies contact FHWA first regarding their needs or desires for new or revised access to the Interstate System. In those cases, the Arizona Division staff member contacted should immediately encourage the potential applicant to contact ADOT, specifically the State Engineer and the appropriate District Engineer. In addition, the Arizona Division staff member contract should advise the appropriate Area Engineer of the desire or need for a new or revised access to the Interstate System.

As a matter of long-standing practice, the FHWA Arizona Division desires the earliest possible involvement in proposals for new or revised access to the Interstate System and encourages ADOT to contact the FHWA Arizona Division Office soon after it becomes aware of the need or desire for a Change in Access – to seek and initiate FHWA involvement. This starts a process and procedure outlined below and further delineated in a flow chart (see Section VIII – FLOWCHART).

<u>Step 1—Initial Request Meeting</u>
ADOT initiates a meeting with the appropriate Area Engineer and the Senior Engineering Manager for Operations from the Arizona Division Office to discuss the need and/or desire for a new or revised access on the Interstate System. Normally, this meeting includes the proponent(s) of the new or revised access (land owners, developers, local public agency staff and officials, and any consulting firms already involved). The primary purpose of this meeting is threefold:

a. To assess the reasonableness of the proposed new or revised access;
b. To provide FHWA guidance (see Appendix A) on how to proceed to prepare a Change of Access Report and formally request a Change of Access Approval; and,
c. To determine if the Change of Access Request is sufficiently complicated to require extensive traffic engineering analysis and warrant the preparation of a Methods and Assumptions Document, and to facilitate agreement on analysis programs, procedures, and assumptions needed to perform these analysis and procedures.

Step 2 – Response to Initial Request for Change of Access

If the initial request for a Change of Access appears to be unreasonable, a response should be provided in writing. If the initial request appears to be reasonable, written guidance should be provided to ADOT and to the requestors to proceed according to the following steps.

Step 2A – Unreasonable Request

If the proposed new or revised access does not appear reasonable, violates FHWA policies regarding access control on the Interstate, or has other obvious fatal flaws, the Area Engineer and the Senior Engineering Manager for Operations should attempt to discourage further development of the proposal. If necessary, upon a written request for a preliminary assessment, FHWA would provide a formal response articulating the negative assessment of the proposal. This assessment, normally conveyed in the form of a letter, should be prepared by the Area Engineer for the signature of the Division Administrator. This letter (assessment) should be reviewed by the Senior Engineering Manager for Operations prior to submittal to the Division Administrator for signature. See Appendix A and C for Guidance and Checklists for factors when considering Change of Access Requests.

Step 2B – Reasonable Request

If the proposal appears to be reasonable pending further study and evaluation, the Area Engineer and the Senior Engineering Manager for Operations should provide appropriate guidance and offer to stay involved as necessary as ADOT and/or the proponents work through the process of preparing the Change of Access Report, initiating the necessary environmental studies, and conducting the appropriate public involvement. In particular, the Area Engineer and the Senior Engineering Manager for Operations should stress the need for a NEPA approval before final formal approval can be obtained, provide guidance on the use of a Determination of Engineering and Operational Acceptability (see Step 6) as an additional alternative step, and indicate if FHWA HQ Office of Infrastructure (HQ) approval will be necessary. In addition, the scope and methods for the necessary traffic studies should be discussed. Further guidance for traffic analysis can be found in the July, 2009, FHWA Arizona Division Traffic Analysis in Change of Access Reports and Evaluations program review report (see Appendix F) and the FHWA Traffic Analysis Toolbox Volume II: Decision Support Methodology for Selecting Traffic Analysis Tools, available at http://ops.fhwa.dot.gov/trafficanalysistools/tat_vol2/.

Step 2C – If the Change of Access appears to be sufficiently complex to warrant a Methods and Assumption Document to guide the analysis, review and approve a Methods and Assumptions Document prepared by ADOT, the applicant and/or their consulting engineer. This Methods and Assumptions Document would be included in the Change of Access Report, most likely as an appendix. See Appendix E for further guidance on the preparation and review of Methods and Assumptions Documents.

Step 3 – Monitor Progress

The Area Engineer monitors the progress of the necessary studies and keeps other Division Office staff, including the Senior Engineering Manager for Operations, the appropriate Transportation Planner, and the Environmental Coordinator, informed. If FHWA HQ Office approval will be needed (see Appendix B for Delegation of Authority), the Area Engineer should make contact with the HQ Office as necessary in order to address issues and concerns. In addition, if special or complex traffic analysis is needed, the Area Engineer should contact others within the Division Office and in the FHWA Resource Center to obtain assistance.

Step 4 – Draft Change of Access Report
If ADOT desires, it may submit a draft of the Change of Access Report for review, comments and further guidance. The Area Engineer is primarily responsible for this review, but may enlist the assistance of others as needed. The review period for draft Change of Access Reports by FHWA Arizona Division Office staff should be no longer than one month.

Step 5 – One-Step Determination
If ADOT desires and it can reasonably complete the necessary environmental document (NEPA document) for the proposed new or revised access prior to or simultaneous with the Change of Access Report, the FHWA Arizona Division Office will review and act on the formal request for a Change of Access approval. This will not require the additional alternative process of considering a Determination of Engineering and Operational Acceptability (see Step 6). This one step process is normally appropriate only for simple and straightforward requests for new or revised access, such as isolated interchanges or other types of access points in rural and remote locations.

Step 5A – Review of Final Change of Access Report without Headquarters Review
Upon receipt of the final Change of Access Report and formal Change of Access Request at the FHWA Arizona Division Office, the Area Engineer will review the final document. If acceptable and if the necessary NEPA approval has been made, the Area Engineer will prepare a letter for the Division Administrator signature approving the requested Change of Access. This letter should be reviewed by the Senior Engineering Manager for Operations prior to submittal to the Division Administrator for signature.

Step 5B – Transmitting to Headquarters
Upon receipt of the final Change of Access Report and formal Change of Access Request at FHWA, the Area Engineer will review the final document. If the final Change of Access Report and Request requires review and approval by the FHWA HQ Office, the Area Engineer will prepare a Memorandum for the Division Administrator signature forwarding the Change of Access Report and the formal Change of Access Request to the HQ Office for action. The Memorandum should articulate an appropriate recommendation based on the Arizona Division Office review of the Change of Access Report and Request. In addition, it should indicate that a NEPA document has been approved for the Change of Access Request. This memorandum should be reviewed by the Senior Engineering Manager for Operations prior to submittal to the Division Administrator for signature.

Step 5C – Response from Headquarters
If the Change of Access Report and Request are sent to the HQ Office for action (see Appendix B for Delegation of Authority), when that response is received back in the Arizona Division Office, the Area Engineer should prepare a letter for the Division

Administrator signature advising ADOT of the action (approval, rejection, or returned for more analysis). This letter should be reviewed by the Senior Engineering Manager for Operations prior to submittal to the Division Administrator for signature.

Step 6 – Determination of Engineering and Operational Acceptability

Most Change of Access Requests are complex, particularly if they involve urban areas, multiple interchanges or system interchanges. These more complex Change of Access Requests require an additional step of obtaining a Determination of Engineering and Operational Acceptability in order to proceed with the completion of the environmental review process and obtain a NEPA approval. The *Determination of Engineering and Operational Acceptability* is prepared using the prompt lists in Appendices A and C, and information from publications in the References.

Step 6A – Review of Final Change of Access Report without Headquarters Review

Upon receipt of a final Change of Access Report and a formal request for a Determination of Engineering and Operational Acceptability, the Area Engineer will review the final document. If it is acceptable and if the requested new or revised access can be approved by the Division Administrator, the Area Engineer will prepare a letter for the Division Administrator signature approving the requested Determination of Engineering and Operational Acceptability. This letter should be reviewed by the Senior Engineering Manager for Operations prior to submittal to the Division Administrator for signature.

Step 6B – Transmitting to Headquarters

Upon receipt of a final Change of Access Report and a formal request for a Determination of Engineering and Operational Acceptability, the Area Engineer will review the final document. If it is acceptable and if the requested new or revised access requires approval by the FHWA HQ Office, the Area Engineer will prepare a memorandum for the Division Administrator signature forwarding the requested Determination of Engineering and Operational Acceptability to the HQ Office for review and action. The memorandum should articulate an appropriate recommendation based on the Arizona Division Office review. This memorandum should be reviewed by the Senior Engineering Manager for Operations prior to submittal to the Division Administrator for signature.

Step 6C – Response from Headquarters

If the Change of Access Report and Request for a Determination of Engineering and Operational Acceptability are sent to the HQ Office for action (see Appendix B for Delegation of Authority), when that response is received back in the Division Office, the Area Engineer should prepare a letter for the Division Administrator signature advising ADOT of the action (approval, rejection, or returned for more analysis). This letter should be reviewed by the Senior Engineering Manager for Operations prior to submittal to the Division Administrator for signature.

Step 7 – Monitor Progress
If the HQ Office approved the Determination of Engineering and Operational Acceptability, the Area Engineer should monitor the progress of the project development and the environmental review process.

Step 8 – NEPA Approval
When the NEPA document covering the implementation of the requested Change of Access is approved, the Area Engineer should prepare a letter for the Division Administrator signature approving the Change of Access Request.

Step 9 – Filing
Following FHWA approval of a Change of Access Request, a copy of the final Change of Access Report and the approval letter should be placed in both the appropriate Federal-aid Project file and in the General File for the Interstate Route and Section where the approved Change of Access is located. This copy should be retained permanently for future reference. The Area Engineer should also update the Arizona Division database as appropriate.

Step 10 – Monitoring Project Development and Construction
Also following FHWA approval of a Change of Access Request, the Area Engineer should monitor further development and construction of the project to assure that the implementation of the new or revised access is consistent with the Change of Access Report and with FHWA approval of the Change of Access, including any additional conditions imposed as a part of FHWA approval of the Change of Access.

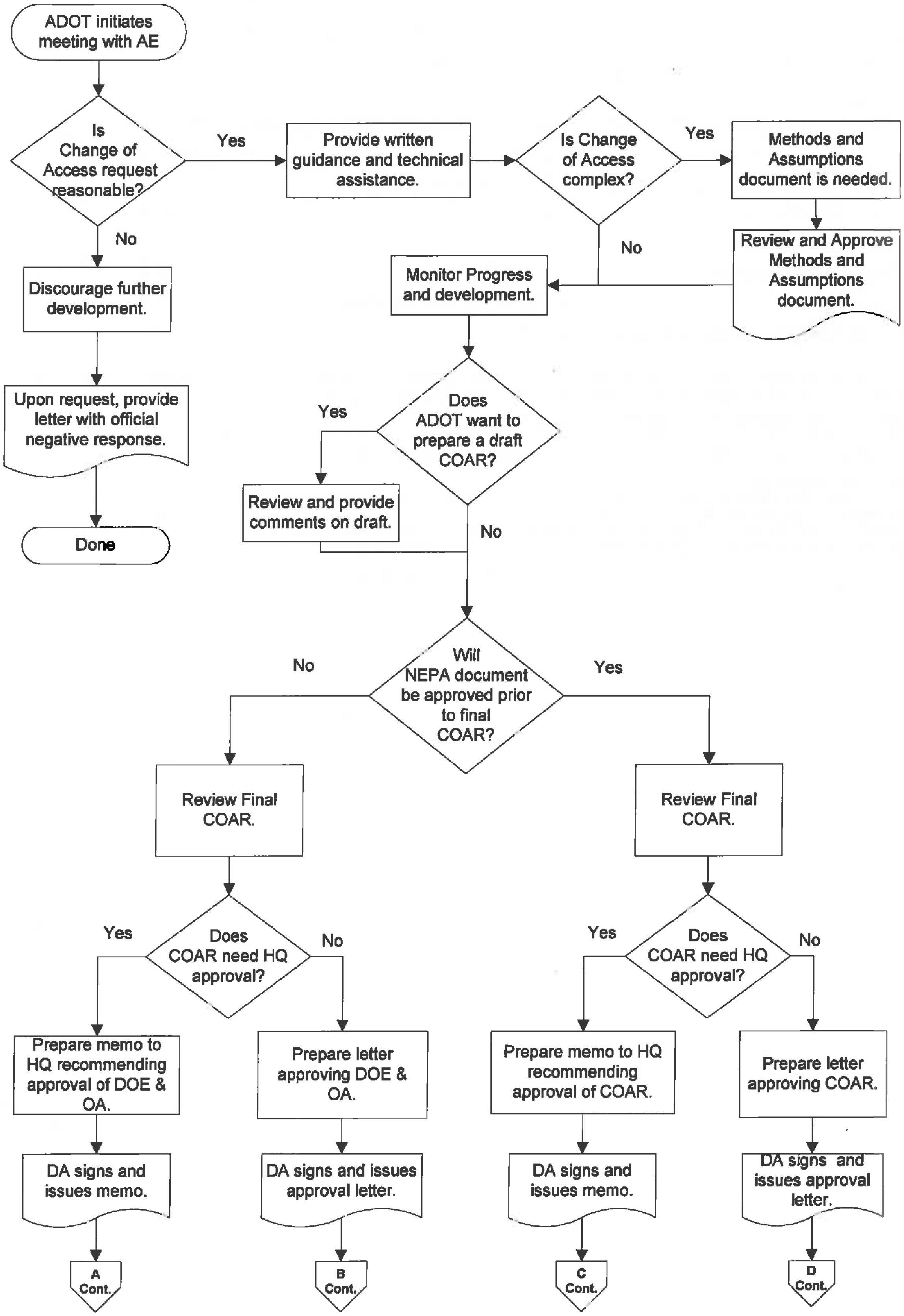
Re-Evaluations
If the design or operations of a project that was previously accepted is significantly changed (e.g., land use, traffic volumes, roadway configuration or design, environmental commitments), then a re-evaluation is required. If an accepted change in access has not progressed to construction within 8 years after receiving affirmative determination of the engineering and operational acceptability from FHWA, a re-evaluation is required. Note that the NEPA re-evaluation period is different from the Interstate System Access re-evaluation. The period for NEPA documents is 3 years (as per 23 CFR 771.129). See the FHWA Interstate System Access Informational Guide for additional information on re-evaluations.

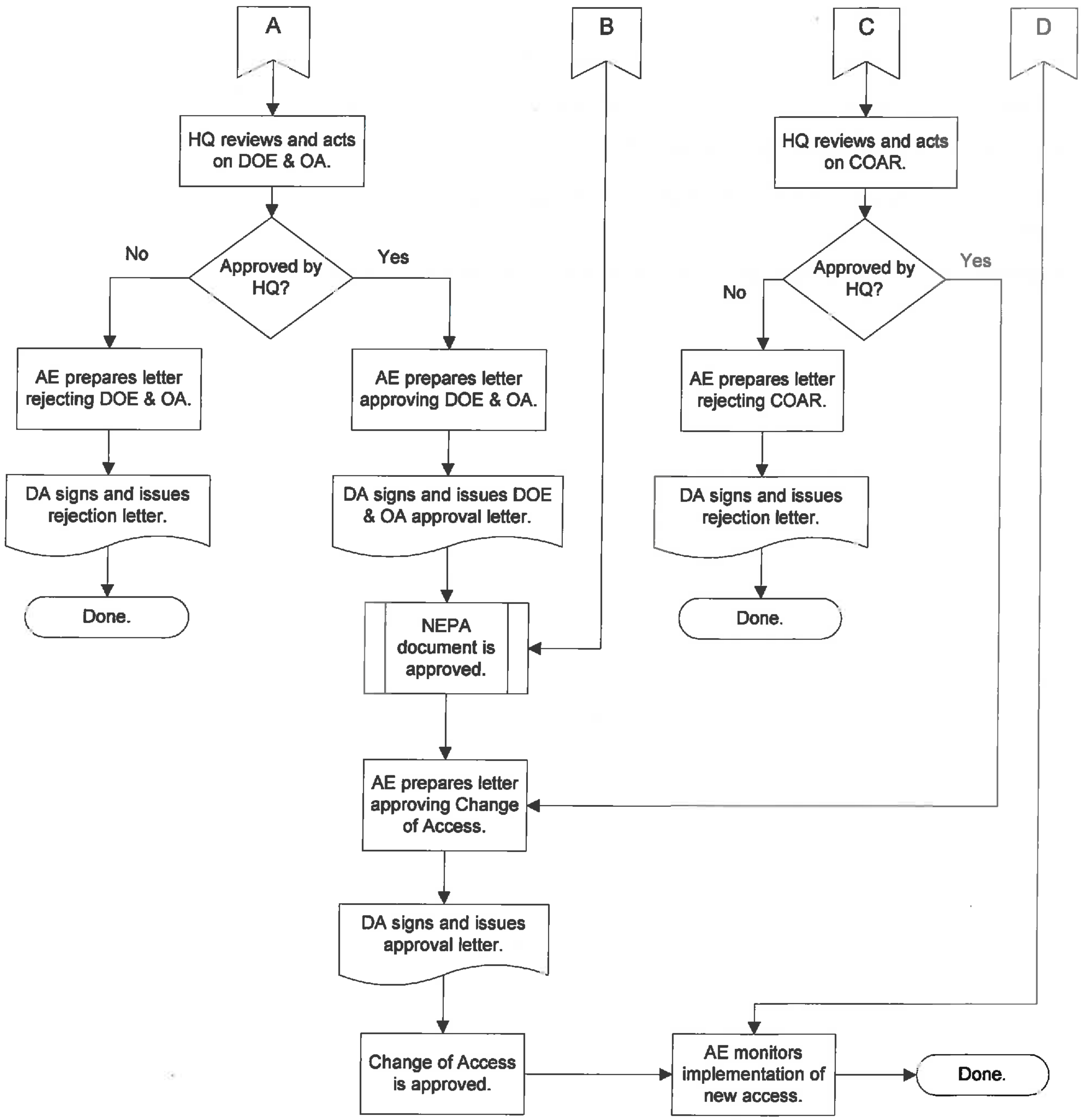
VII. CONTROLS

The following Arizona Division Office delegation of authority provides the necessary controls for approval of Change of Access Requests on the Interstate System:

<table>
<tr><th colspan="3">DELEGATION OF APPROVAL WITHIN ARIZONA DIVISION</th></tr>
<tr><th colspan="2">Type of Access Request</th><th>Delegated Authority</th></tr>
<tr><td colspan="2">New Freeway-to-Freeway Interchange (System Interchange)</td><td>*DA</td></tr>
<tr><td colspan="2">Major Modification of Freeway-to-Freeway Interchange (System Interchange)</td><td>*DA</td></tr>
<tr><td colspan="2">New Partial Interchange</td><td>*DA</td></tr>
<tr><td colspan="2">New Freeway-to-Crossroad Interchange (Service Interchange) within Transportation Management Area (TMA)</td><td>*DA</td></tr>
<tr><td colspan="2"></td><td></td></tr>
<tr><td colspan="2">New Freeway-to-Crossroad Interchange (Service Interchange outside Transportation Management Area (TMA)</td><td>DA</td></tr>
<tr><td colspan="2">Modification of Existing Freeway-to-Crossroad Interchange (Service Interchange)</td><td>DA</td></tr>
<tr><td colspan="2">Temporary Changes in Access Control</td><td>DA</td></tr>
<tr><td>* Requires prior approval from HQ</td><td>DA – Division Administrator</td><td></td></tr>
</table>

VIII. FLOWCHART




A
B
C
D
HQ reviews and acts on DOE & OA.
Approved by HQ?
No
Yes
AE prepares letter rejecting DOE & OA.
DA signs and issues rejection letter.
Done.
AE prepares letter approving DOE & OA.
DA signs and issues DOE & OA approval letter.
NEPA document is approved.
AE prepares letter approving Change of Access.
DA signs and issues approval letter.
Change of Access is approved.
HQ reviews and acts on COAR.
Approved by HQ?
No
Yes
AE prepares letter rejecting COAR.
DA signs and issues rejection letter.
Done.
AE monitors implementation of new access.
Done.

IX. APPENDICES

Appendix A – Prompt List for Review of Interstate System Access Change Requests

Appendix B – Delegation of Authority for Change of Access Approvals

Appendix C – Interchange Design Promptlist

Appendix D – Sample Outline for Interstate System Access Requests (Change of Access Reports)

Appendix E – FHWA Methods and Assumptions Document Procedures

Appendix A—Prompt List for Review of Interstate System Access Change Requests

Adequately Addressed? Yes	No	Prompt List for Review of Interstate System Access Change Requests FHWA Interstate Access Policy Points
		Policy Point 1: The need being addressed by the request cannot be adequately satisfied by existing interchanges to the Interstate, and/or local roads and streets in the corridor can neither provide the desired access, nor can they be reasonably improved (such as access control along surface streets, improving traffic control, modifying ramp terminals and intersections, adding turn bays or lengthening storage) to satisfactorily accommodate the design-year traffic demands (23 CFR 625.2(a)).
		Policy Point 2: The need being addressed by the request cannot be adequately satisfied by reasonable transportation system management (such as ramp metering, mass transit, and HOV facilities), geometric design, and alternative improvements to the Interstate without the proposed change(s) in access (23 CFR 625.2(a)).
		Policy Point 3: An operational and safety analysis has concluded that the proposed change in access does not have a significant adverse impact on the safety and operation of the Interstate facility (which includes mainline lanes, existing, new, or modified ramps, ramp intersections with crossroad) or on the local street network based on both the current and the planned future traffic projections. The analysis shall, particularly in urbanized areas, include at least the first adjacent existing or proposed interchange on either side of the proposed change in access (23 CFR 625.2(a), 655.603(d) and 771.111(f)). The crossroads and the local street network, to at least the first major intersection on either side of the proposed change in access, shall be included in this analysis to the extent necessary to fully evaluate the safety and operational impacts that the proposed change in access and other transportation improvements may have on the local street network (23 CFR 625.2(a) and 655.603(d)). Requests for a proposed change in access must include a description and assessment of the impacts and ability of the proposed changes to safely and efficiently collect, distribute and accommodate traffic on the Interstate facility, ramps, intersection of ramps with crossroad, and local street network (23 CFR 625.2(a) and 655.603(d)). Each request must also include a conceptual plan of the type and location of the signs proposed to support each design alternative (23 U.S.C. 109(d) and 23 CFR 655.603(d)).
		Policy Point 4: The proposed access connects to a public road only and will provide for all traffic movements. Less than ``full interchanges" may be considered on a case-by-case basis for applications requiring special access for managed lanes (e.g., transit, HOVs, HOT lanes) or park and ride lots. The proposed access will be designed to meet or exceed current standards (23 CFR 625.2(a), 625.4(a)(2), and 655.603(d)).
		Policy Point 5: The proposal considers and is consistent with local and regional land use and transportation plans. Prior to receiving final approval, all requests for new or revised access must be included in an adopted Metropolitan Transportation Plan, in the adopted Statewide or Metropolitan Transportation Improvement Program (STIP or TIP), and the Congestion Management Process within transportation management areas, as appropriate, and as specified in 23 CFR part 450, and the transportation conformity requirements of 40 CFR parts 51 and 93.

Prompt List for Review of Interstate System Access Change Requests		
Adequately Addressed?		**FHWA Interstate Access Policy Points**
		Policy Point 6: In corridors where the potential exists for future multiple interchange additions, a comprehensive corridor or network study must accompany all requests for new or revised access with recommendations that address all of the proposed and desired access changes within the context of a longer-range system or network plan (23 U.S.C. 109(d), 23 CFR 625.2(a), 655.603(d), and 771.111).
		Policy Point 7: When a new or revised access point is due to a new, expanded, or substantial change in current or planned future development or land use, requests must demonstrate appropriate coordination has occurred between the development and any proposed transportation system improvements (23 CFR 625.2(a) and 655.603(d)). The request must describe the commitments agreed upon to assure adequate collection and dispersion of the traffic resulting from the development with the adjoining local street network and Interstate access point (23 CFR 625.2(a) and 655.603(d)).
		Policy Point 8: The proposal can be expected to be included as an alternative in the required environmental evaluation, review and processing. The proposal should include supporting information and current status of the environmental processing (23 CFR 771.111).

FHWA Prompt List for Review of Interstate System Access Change Requests Available at:
www.fhwa.dot.gov/modiv/FHWA_Policy_Points_Promptlist.pdf

Policy Point 1: "The need being addressed by the request cannot be adequately satisfied by existing interchanges to the Interstate, and/or local roads and streets in the corridor can neither provide the desired access, nor can they be reasonably improved (such as access control along surface streets, improving traffic control, modifying ramp terminals and intersections, adding turn bays or lengthening storage) to satisfactorily accommodate the design-year traffic demands (23 CFR 625.2(a))."

Addressed Adequately? Y	N	N/A	Question	Reference Location
			Does the access request clearly describe the need and purpose of the proposal and identify project goals and objectives that are specific and measurable?	
			Is the proposal in the best interest of the public, or does it merely serve a narrow interest?	
			Is the proposal serving a regional transportation need, or is it merely compensating for deficiencies in the local network of arterials and collectors?	
			In lieu of granting new access, is there any reasonable alternative consisting of improvements to the existing roadway(s) or adjacent access points that could serve the need and purpose?	
			Has the evaluation of existing interchanges and the local road network taken into account all proposed improvements currently identified in the State and/or Regional Long Range Plan?	
			Will the proposed change in access result in needed upgrades or improvements to the cross road for a significant distance away from the interchange?	

Policy Point 2: "The need being addressed by the request cannot be adequately satisfied by reasonable transportation system management (such as ramp metering, mass transit, and HOV facilities), geometric design, and alternative improvements to the Interstate without the proposed change(s) in access (23 CFR 625.2(a))."

Addressed Adequately? Y	N	N/A	Question	Reference Location
			Was FHWA actively involved in preliminary studies and decisions? If not, then more detailed information may be required in support of proposed action.	
			Did the study area cover sufficient area to allow for an evaluation of all reasonable alternatives?	
			Was a No-Build Alternative evaluated?	
			Considering the context of the proposal, is this the best location for the proposed new interchange?	
			Were different interchange configurations (Tight diamond, SPDI, Parclo) considered?	AASHTO Green Book Chapter 10
			Were pedestrians and bicyclists considered in the alternative evaluation?	
			Was there an evaluation of different intersection configurations (stop control, signal, roundabout, free right turns, etc?)	
			Have Transportation Systems Management (i.e. HOV, ITS, Ramp Metering, Transit etc.) options been evaluated as an alternative to a new or modification to an existing interchange?	
			Did the report discuss how TSM alternatives were evaluated and eliminated from consideration?	
			Does the proposal consider any future planned TSM strategies and is the design consistent with the ability to implement the future TSM strategies?	

Policy Point 3: "An operational and safety analysis has concluded that the proposed change in access does not have a significant adverse impact on the safety and operation of the Interstate facility (which includes mainline lanes, existing, new, or modified ramps, ramp intersections with crossroad) or on the local street network based on both the current and the planned future traffic projections. The analysis shall, particularly in urbanized areas, include at least the first adjacent existing or proposed interchange on either side of the proposed change in access (23 CFR 625.2(a), 655.603(d) and 771.111(f)). The crossroads and the local street network, to at least the first major intersection on either side of the proposed change in access, shall be included in this analysis to the extent necessary to fully evaluate the safety and operational impacts that the proposed change in access and other transportation improvements may have on the local street network (23 CFR 625.2(a) and 655.603(d)). Requests for a proposed change in access must include a description and assessment of the impacts and ability of the proposed changes to safely and efficiently collect, distribute and accommodate traffic on the Interstate facility, ramps, intersection of ramps with crossroad, and local street network (23 CFR 625.2(a) and 655.603(d)). Each request must also include a conceptual plan of the type and location of the signs proposed to support each design alternative (23 U.S.C. 109(d) and 23 CFR 655.603(d))."

Addressed Adequately? Y	N	N/A	Question	Reference Location
			Does the report demonstrate that a proper traffic operational analysis was conducted? The analysis should include the applicable basic freeway segments, freeway weaving segments, freeway ramp segments, ramp junctions and crossroad intersections related to the proposed access point and at least the two adjacent interchanges.	
			Does the report include a **safety** analysis of the mainline, ramps and intersections of the proposed access point and the nearest adjacent interchange (provided they are near enough that it is reasonable to assume there may be impacts)?	
			Has the design traffic volume been validated?	
			Does the report include verification that the data used in the traffic analysis is consistent with the traffic and air quality models MPOs use to develop their current Transportation Plan (20-year) and Transportation Improvement Program (TIP)?	
			Does the report include a design period of 20 years commencing at the time of project approval (PS&E approval)?	
			Does the report include quantitative analyses and results to identify operational differences between alternatives that are heavily congested?	
			Has a conceptual signing plan been provided?	
			Is guidance signing (i.e., way-finding or trail blazing signs) clear and simple?	MUTCD Chapter 2E: Guide Signs – Freeways and Expressways
			Do the results of the operational analysis result in a significant adverse impact to existing or future conditions?	
			Will the proposed change in access result in needed upgrades or improvements to the cross road for a significant distance away from the interchange? If so, have impacts to the local network been disclosed and fully evaluated?"	

Policy Point 3: "An operational and safety analysis has concluded that the proposed change in access does not have a significant adverse impact on the safety and operation of the Interstate facility (which includes mainline lanes, existing, new, or modified ramps, ramp intersections with crossroad) or on the local street network based on both the current and the planned future traffic projections. The analysis shall, particularly in urbanized areas, include at least the first adjacent existing or proposed interchange on either side of the proposed change in access (23 CFR 625.2(a), 655.603(d) and 771.111(f)). The crossroads and the local street network, to at least the first major intersection on either side of the proposed change in access, shall be included in this analysis to the extent necessary to fully evaluate the safety and operational impacts that the proposed change in access and other transportation improvements may have on the local street network (23 CFR 625.2(a) and 655.603(d)). Requests for a proposed change in access must include a description and assessment of the impacts and ability of the proposed changes to safely and efficiently collect, distribute and accommodate traffic on the Interstate facility, ramps, intersection of ramps with crossroad, and local street network (23 CFR 625.2(a) and 655.603(d)). Each request must also include a conceptual plan of the type and location of the signs proposed to support each design alternative (23 U.S.C. 109(d) and 23 CFR 655.603(d))."

Addressed Adequately? Y	N	N/A	Question	Reference Location
			Are the cross roads or adjacent surface level roads and intersections affected by the proposed access point analyzed to the extent (length) where impacts caused or affecting the new proposed access point are disclosed to the appropriate managing jurisdiction?	
			Are pedestrian and/or bicycle facilities included (as appropriate) and do these facilities provide for reasonable accommodation?	
			Does the proposed access secure sufficient Limits of Access adjacent to the Interchange ramps?	AASHTO's "A Policy on Design Standards Interstate System, 2005" Pg. 2; NCHRP Synthesis 332
			Does the proximity of the nearest crossroad intersections to the ramps contribute to safety or operational problems? Can they be mitigated??	
			In addition to HCS, what analysis tools were employed and were they appropriate?	
			Has the proposal distinguished between nominal safety (i.e. adherence to design policies and standards) and substantive safety (actual and expected safety performance)?	
			Will any individual elements within the recommended alternative be degraded operationally as a result of this action? If yes, are reasons provided to accept them?	
			In evaluating whether the proposal has a "significant adverse impact" on safety, has the State Strategic Highway Safety Plan been used as a benchmark?	
			Are the proposed interchange design configurations able to satisfactorily accommodate the design year traffic volumes?	
			If the project is to be built in stages, has the traffic operational and safety analyses considered the interim stages of the proposal?	

Policy Point 4: "The proposed access connects to a public road only and will provide for all traffic movements. Less than "full interchanges" may be considered on a case-by-case basis for applications requiring special access for managed lanes (e.g., transit, HOVs, HOT lanes) or park and ride lots. The proposed access will be designed to meet or exceed current standards (23 CFR 625.2(a), 625.4(a)(2), and 655.603(d))."

Addressed Adequately? Y	N	N/A	Question	Reference Location
			Does the proposed access connect to a public road?	
			Are all traffic movements for full interchange access provided?	
			If not, is the proposed access for special purposes such as transit vehicles, HOVs, and/or a park and ride lot?	
			If a partial interchange is proposed, is there sufficient justification for providing only a partial interchange?	AASHTO Green Book 2004 Pg. 821-823
			If a partial interchange is proposed; was a full interchange evaluated as an alternative and is there sufficient justification to eliminate or discard it?	
			Is sufficient ROW available (or being acquired) to provide a full interchange at a future date (staged construction)?	
			Are you comfortable with how the missing movements will be accommodated on the surface streets and adjacent interchanges?	
			Does FHWA support the selection of design controls/criteria and desired operational goals?	
			Does the proposed access meet or exceed current design standards for the Interstate System?	AASHTO's Green Book and A Policy on Design Standards Interstate System, 2005
			If not, have anticipated design exceptions been identified and reviewed (at least conceptually)?	
			If expected design exceptions could have significant operational impacts on the Interstate and/or Crossroad system, are mitigation measures described?	
			Will the length of access control along the crossroad provide for acceptable operations and safety? (100-300' is a minimum. Additional access control is strongly encouraged when needed for safety and operational enhancement)	AASHTO "A Policy on Design Standards Interstate System" 2005
			Does FHWA support selection of opening and design years?	

<u>Policy Point 4:</u> "The proposed access connects to a public road only and will provide for all traffic movements. Less than "full interchanges" may be considered on a case-by-case basis for applications requiring special access for managed lanes (e.g., transit, HOVs, HOT lanes) or park and ride lots. The proposed access will be designed to meet or exceed current standards (23 CFR 625.2(a), 625.4(a)(2), and 655.603(d))."

Addressed Adequately? Y	N	N/A	**Question**	**Reference Location**
			Have all design criteria (including but not limited to the following) been adequately addressed?	
			a. Sight distance at ramp terminals (Don't overlook signal heads obscured by structures.)	AASHTO Green Book 2004 Pg. 841
			b. Sufficient storage on ramp to prevent queues from spilling on to the Interstate (based on current and/or future projected traffic demand)	
			c. Vertical clearance	AASHTO "A Policy on Design Standards Interstate System" 2005
			d. Pedestrian access through the interchange	AASHTO Green Book 2004 Pg. 864
			e. Length of accel/decel lanes	AASHTO Green Book 2004 Pg. 823, 847
			f. Length of tapers	AASHTO Green Book 2004 Pg. 849
			g. Spacing between ramps	Green Book pg 843 & Ex. 10-68 and operational analysis
			h. Lane continuity	AASHTO Green Book 2004 Pg. 810
			i. Lane balance	AASHTO Green Book 2004 Pg. 810 AASHTO Green Book 2004 Pg. 807
			j. Uniformity in interchange design and operational patterns (i.e. right-side ramps, exit design consistent w/adjacent interchanges)	
			Has each movement of the proposal been "tested" for ease of operation?	AASHTO Green Book 2004 Pg. 863

Policy Point 5: "The proposal considers and is consistent with local and regional land use and transportation plans. Prior to receiving final approval, all requests for new or revised access must be included in an adopted Metropolitan Transportation Plan, in the adopted Statewide or Metropolitan Transportation Improvement Program (STIP or TIP), and the Congestion Management Process within transportation management areas, as appropriate, and as specified in 23 CFR part 450, and the transportation conformity requirements of 40 CFR parts 51 and 93."

Addressed Adequately?				
Y	**N**	**N/A**	**Question**	**Reference Location**
			Does the IJR discuss or include (as appropriate) other project(s), studies or planned actions that may have an effect on the report analysis results?	
			Does the project conform to the local planning, MPO or other related plans?	
			Does the report include an endorsement of land use plans by the appropriate government entity before it is utilized for traffic generation purposes?	
			Is the access request located within a Transportation Management Areas? (TMAs are metropolitan areas of 200,000 or more in population)	http://hepgis.fhwa.dot.gov/hepgis_v2/Urbanboundaries/Map.aspx
			Is the access request located within a non-attainment area for air quality? (requests for access in a non-attainment or maintenance areas for air quality must be a part of a conforming transportation plan)	
			Is the project included in the TIP/STIP and LRTP?	
			Is the access point covered as a part of an Interstate corridor study or plan? *(especially important for areas where the potential exists for construction of future adjacent interchanges)*	

Policy Point 6: "In corridors where the potential exists for future multiple interchange additions, a comprehensive corridor or network study must accompany all requests for new or revised access with recommendations that address all of the proposed and desired access changes within the context of a longer-range system or network plan (23 U.S.C. 109(d), 23 CFR 625.2(a), 655.603(d), and 771.111)."

Addressed Adequately? Y	N	N/A	Question	Reference Location
			Is it possible that new interchange(s) not addressed in the IJR could be added within an area of influence to the proposed access point? (If so, could the proposal preclude or otherwise be affected by any future access points?)	
			Does the IJR report include the traffic volumes generated by any future additional interchanges within a vicinity of influence that are proposed?	
			Does the IJR report fail to include any other proposed interstate access points within a vicinity of influence that are being proposed or are in the current long range construction program?	

<u>Policy Point 7:</u> "When a new or revised access point is due to a new, expanded, or substantial change in current or planned future development or land use, requests must demonstrate appropriate coordination has occurred between the development and any proposed transportation system improvements (23 CFR 625.2(a) and 655.603(d)). The request must describe the commitments agreed upon to assure adequate collection and dispersion of the traffic resulting from the development with the adjoining local street network and Interstate access point (23 CFR 625.2(a) and 655.603(d))."

Addressed Adequately? Y	N	N/A	Question	Reference Location
			Does the access request adequately demonstrate that an appropriate effort of coordination has been made with appropriate proposed developments?	
			Are the proposed improvements compatible with the existing street network or are other improvements needed?	
			Are there any pre-condition contingencies required in regards to the timing of other improvements?	
			Have all commitments to improve the local transportation network been included in a TIP/STIP/LRTP prior to the Interstate access approval (final approval of NEPA document)?	
			If pre-condition contingencies are required, are pertinent parties in agreement with these contingencies and is this documented?	
			If the proposed improvements are founded on the need for providing access to new development, are appropriate commitments in place to ensure that the development will likely occur as planned?	
			If project is privately funded, are appropriate measures in place to ensure improvements will be completed if the developer is unable to meet financial obligations?	
			If the purpose and need to accommodate new development/traffic demands aren't fully known, is a worst case scenario used for future traffic?	
			Does the project require financial or infrastructure commitments from other agencies, organizations, or private entities?	

Policy Point 8: "The proposal can be expected to be included as an alternative in the required environmental evaluation, review and processing. The proposal should include supporting information and current status of the environmental processing (23 CFR 771.111)."				
Addressed Adequately?				
Y	**N**	**N/A**	**Question**	**Reference Location**
			Are there any known social or environmental issues that could affect the proposal?	
			Is the project consistent with the current TIP/STIP and LRTP and/or proposed amendments to the plan?	
			Although NEPA is a separate action, is an environmental overview for the proposed improvements included?	
			Is it appropriate to emphasize to the project stakeholders that the access approval will be handled as a two-step process? (i.e. Step 1: Engineering and Operational Acceptability and Step 2: Environmental Approvals)	
			Are all funding commitments included in a TIP/STIP/LRTP prior to the Interstate access approval (prior to final approval of the NEPA document)?	
			Are all commitments included in a TIP/STIP/LRTP prior to the Interstate access approval (prior to final approval of the NEPA document)?	

Appendix B – Delegation of Authority for Change of Access Approvals

Delegation of Authority for Access Approval			
Type of Access Change	Retained by Headquarters	Delegated to Division Office	N/A
New Freeway-to-Freeway Interchange (System Interchange)	X		
Major Modification of Freeway-to-Freeway Interchange (System Interchange)	X		
New Partial Interchange (System or Service Interchange)	X		
New Ramp(s) to/from Continuous Frontage Road (if resulting in partial interchange)	X		
New Freeway-to-Crossroad Interchange (Service Interchange) Within TMA*	X		
New Freeway-to-Crossroad Interchange (Service Interchange) Outside TMA*		X	
Major Modification of Existing Freeway-to-Crossroad Interchange (Service Interchange)		X	
Adding New Ramp(s) to an Existing Interchange (Service Interchange)		X	
Removing Ramp(s) from an Existing Interchange (Service Interchange)		X***	
Changing the Interchange Configuration (Service Interchange)		X	
Completion of Basic Movements At Partial Interchange (Service Interchange)		X	
Locked Gate Access		X	
Abandonment of Ramps or Interchanges		X***	
Temporary Changes in Access Control		X	
Adding Turn Lane or Through Lane on Cross Road at Ramp Termini			X**
Widening of Existing Ramp to Add Lane(s)			X**

Relocate Ramp Termini Along Cross Road			**X****
Relocating Existing Entrance/Exit Gore Point Along Freeway Mainline			**X****
Adding an Auxiliary Lane Between Two Adjacent Interchange Ramps			**X****
Signal or Channelization Improvements of Ramp Terminal Intersection with Cross Road			**X****

* Transportation Management Area as defined in 23 USC 134(i) and only includes urbanized portion as defined by Bureau of Census.
** These adjustments do not constitute changes in access control, as the degree of access control is not being changed.. They are and should be considered as traffic operational improvements.
*** If removal of ramps create partial interchanges, consultation with FHWA Washington Headquarters Office is necessary.

Appendix C—Interchange Design Promplist

FHWA Design Discipline Support Tool

Freeway Interchange Design

Prompt-List for Assessing Nominal Safety (Geometric Features) for Interstate System Access Requests

DRAFT – updated July 2010

The intent of this prompt list, and the supporting supplemental information, is to highlight key interchange design principles and objectives that should be considered in evaluating design alternatives in the planning, design and review of Interstate System Access Requests. The prompt list questions may also serve as an assessment of the expected safety performance of interchange design alternatives based on their geometric and operational characteristics. This prompt list and accompanying supplemental information was developed for use as a support tool by the FHWA Design Discipline Focus Area Team on *Freeway Design and Interstate Access*. Comments and suggestions for enhancing this support tool are greatly welcomed. Please send comments to the Focus Area Team co-chairs: Mark Doctor (mark.doctor@dot.gov) and Michael Matzke (michael.matzke@dot.gov).

INTRODUCTION

Many transportation agencies are planning, designing, or reconstructing existing freeways and interchanges or adding new interchanges to existing freeways. There are inherent design challenges in these types of projects since many are located in metropolitan areas with high traffic volumes, dense land development and competition over where to provide freeway access. It is vitally important that the safety and operational implications of proposed changes in freeway access are fully analyzed and understood before decisions are made. It is of particular importance to properly manage the location and design of access to the Interstate System. The Interstate System is the backbone of the nation's surface transportation network and provides the highest service in terms of moving people and goods.

Since the initial construction of the Interstate System, population growth, economic prosperity, and changes in land use have not only led to a steady increase in the number of vehicles using the highways, but also an increase in the demand for access to the system (i.e. new interchanges). Increased demand for new interchanges can pose challenges on the abilities to maintain the high quality of service of the Interstate System, both in urban and rural areas. Providing access to the Interstate System from the other portions of the highway network is crucial to the performance of the surface transportation system as a whole. However, having interchanges that are poorly designed or too closely spaced within a freeway segment can greatly diminish the traffic operations and safety of the freeway.

Properly managing Interstate access is about providing a balance between system mobility (i.e. maintaining the uninterrupted flow of freeway traffic) and reasonable accessibility to the other components of the transportation system. The desire to provide increased access to the Interstate System is often tied to goals for enhancing economic or social activity in a community. Sometimes these goals of greater accessibility can directly conflict with goals to improve or preserve mobility. This is especially true when poor practices for managing and controlling Interstate access contribute toward congestion and impede the ease and ability to travel in a reliable manner and with predictable travel times.

If designed and operated effectively, interchanges allow motorists to make connections between the freeway and other roadways in the network in a safe, convenient, and comfortable fashion with little or no delay or impact on traffic. However, if conditions are allowed to degrade to thresholds where ramps are too closely spaced, do not offer adequate acceleration or merge distances, or are simply overwhelmed by the increasing traffic volumes that use them, impacts may develop affecting the efficient and safe operation of traffic on the freeway and also the roadways to which they are connected. Sophisticated interchange design involves more than simply assembling the geometric dimensions of the typical sections and horizontal and vertical alignment. Appropriate design choices for an interchange project result from defining the desired level of operations and safety performance and balancing those considerations with the costs and the social and environmental impacts of the various alternatives.

The intent of this prompt list, and the supplemental information to support it, is to highlight some of the key interchange design objectives and issues that should be considered in evaluating design alternatives in the planning, design and review of Interstate System Access Requests. When using the prompt list questions for the first time, it is highly suggested that the companion supplemental information be reviewed along with it. The supplemental information is formatted to allow direct correlation with the prompt list questions.

This prompt list and accompanying supplemental information is intended to serve as a support tool for the FHWA Design Discipline. It was developed by the FHWA Design Discipline's *Freeway Design and Interstate Access* Design Focus Area Team. Comments and suggestions for enhancing this support tool are greatly welcomed. Please send comments to the Focus Area Team co-chairs: Mark Doctor (mark.doctor@dot.gov) and Michael Matzke (michael.matzke@dot.gov).

FHWA Design Discipline Support Tool

Interchange Design (New Construction and Reconstruction)
Prompt-List for Assessing Key Geometric Features

Project: ____

Location: ____

Description: ____

Assessment made by: ______________________ Date of Assessment __________

1.0 Design Standards

1.1 What design standards are applicable to the project?

_____ AASHTO publication "A Policy on Design Standards Interstate System" - applicable for all projects on the Interstate System

_____ AASHTO publication "A Policy on Geometric Design of Highways and Streets" (commonly called the Green Book) – applicable to all freeways on the NHS including the Interstate System

_____ Additional standards of State DOT for geometric design, standard drawings, and standard specifications that meet or exceed the FHWA's adopted standards

1.2 Are any design exceptions to the "13 controlling criteria" proposed? _________

2.0 Interchange and Ramp Spacing

2.1 Does the interchange spacing (based on crossroad to crossroad spacing) exceed 1 mi? _________

2.2 Does the spacing between successive entrances and exits meet or exceed AASHTO criteria? _________

3.0 Approach Alignment to Interchange

3.1 Is the grade of the freeway relatively flat through the interchange area? _________

3.2 Is the horizontal alignment of the freeway relatively straight through the interchange area? _________

3.3 Is adequate sight distance (desirably decision sight distance) provided in advance of each exit? _________

4.0 Interchange Configurations

4.1 Was an appropriate array of interchange configurations and variations evaluated in the design study phase?

4.2 Is the selected interchange configuration appropriate for the operational needs, fits the topography and potential site conditions and constraints, and is consistent in exit pattern with other nearby interchanges?

4.3 Are all directional traffic movements provided for? _________

4.4 Are all the exits and entrances on the right side of the freeway mainline? _________

4.5 Are any weaving sections created by the proposed design? ________
If YES, what is the distance between the physical merge and exit nose? __________

4.6 Is the interchange configured with the crossroad over the freeway? __________

4.7 Route Continuity - Is the interchange configured so that the priority route is the through facility? _________

5.0 Ramp Design

5.1 Is the design speed of the ramp proper at least 50 percent of the mainline design speed? _________

5.2 Is sufficient length for acceleration at entrance ramps provided? __________

5.3 Is sufficient length for deceleration at exit ramps provided? __________

5.4 Are the exits and entrances lane balanced? ________

6.0 Signing

6.1 Is the proposed signing in accordance with the MUTCD and suggested limits on message units? ________

6.2 Evaluate the proposed signing from a driver's point of view. Assess the risk of driver confusion and strategies to simplify the signing.

7.0 Crossroad Design

7.1 Are sidewalks and bicyclist facilities provided along the interchange crossroad? Pedestrians and bicyclists are particularly vulnerable to high speed approach vehicles turning at ramp terminals. Are the crossings at interchange ramps controlled or uncontrolled?

7.2 Is sufficient control of access along the crossroad beyond the interchange being provided to ensure its integrity? (The AASHTO standard of a minimum of 100 ft in urban areas and 300 ft in rural areas is usually insufficient where additional development is likely).

7.3 Are adequate land development and access management measures in place for the interchange area?

7.4 Ensure elements of the ramp/crossroad intersection are properly designed, especially with regard to:
- turning radii for design vehicle
- capacity
- traffic control
- channelization
- intersection sight distance

Interchange Design (New Construction and Reconstruction)
Supplemental Information to Prompt-List for Assessing Key Geometric Features

1.0 Design Standards

1.1 What design standards are applicable to the project?
_____ AASHTO publication "A Policy on Design Standards Interstate System" - applicable for all projects on the Interstate System
_____ AASHTO publication "A Policy on Geometric Design of Highways and Streets" (commonly called the Green Book) – applicable to all freeways on the NHS including the Interstate System
_____ Additional standards of State DOT for geometric design, standard drawings, and standard specifications that meet or exceed the FHWA adopted standards

Section 109(c) of Title 23 U.S.C. establishes standards for the design and construction of all projects on the National Highway System (NHS), including the Interstate System. These standards are applicable to any proposed improvement regardless of the funding source. Deviations from the standards must have approved design exceptions. FHWA has adopted the AASHTO publication "A Policy on Design Standards Interstate System" for all projects on the Interstate System, regardless of the funding for the proposed project. The Interstate Standards are not intended to be a "stand alone" document for all of the geometric design standards that are used in the development of projects on the Interstate System. Other publications, such as "A Policy on Geometric Design of Highways and Streets" (commonly called the Green Book) and the "Standard Specifications for Highway Bridges" are referenced in the Interstate Standards and used for all geometric design issues not specifically addressed in the Interstate Standards. Chapter 10 of the Green Book provides detailed information on the design concepts and standards that should be met as part of constructed new or improved interchanges. Many state DOTs have also developed additional standards for geometric design, standard drawings, and standard specifications that meet or exceed the FHWA adopted standards.

1.2 Are any design exceptions to the "13 controlling criteria" proposed? _________

The 23 CFR 625 provides that exceptions may be given on a project basis to designs which do not conform to the minimum criteria set forth in the standards, policies, and standard specifications for experimental features on projects and projects where conditions warrant that exceptions be made.

The FHWA has identified "*13 controlling criteria*" that require formal written approval if an exception from the standard is justified. These criteria are design speed, lane width, shoulder width, bridge width, horizontal alignment, superelevation, vertical alignment, grade, stopping sight distance, cross slope, vertical clearance, lateral offset to obstruction (formerly known as horizontal clearance), and structural capacity. A formal written design exception is required if design criteria on the NHS are not met for any of these 13 criteria. Divisions and States may supplement their design exception review procedures to include additional design elements and have exceptions to those additional elements handled by the same review and approval process, however, the 13 controlling criteria reflect the minimum FHWA requirements for formal written design exceptions on the NHS regardless of project funding.

1.2.1 Design Speed
Design speed is a selected value used to determine the various physical design elements and geometric features of the roadway. Design speed has a significant effect on the operation and safety of a highway because it is used to determine various individual design elements with specific dimensions such as stopping sight distance or horizontal curvature. The selected design speed should be a logical one with respect to the topography, anticipated operating speed, the adjacent land use, and the functional classification of the highway. The chosen design speed should equal or exceed the posted or regulatory speed in order to ensure that drivers operating at the legal speed limit can do so

without exceeding the safe design speed of the highway. A design exception to "design speed" is rare because it is really an exception to individual physical design elements and accordingly should be justified on that basis.

The design standards for the Interstate System state that a minimum design speed of 70 mph should be used for rural areas, and where terrain is mountainous a design speed from 50 to 60 mph may be used. In urban areas, the design speed shall be at least 50 mph. Design speed is also applicable to the ramps within an interchange.

1.2.2 Lane Width

The design standards for the Interstate System state that all traffic lanes shall be at least 12 feet wide. In addition to the primary through travel lanes, the criteria also apply to lane widths for auxiliary lanes such as climbing lanes. There are also widths for special-purpose lanes such as on interchange ramps.

Pavement markings which delineate lane lines on many highways may line up with longitudinal pavement joints, but do not always. For instance, the width of PC pavement is sometimes constructed wider than the lane widths to reduce stress at the pavement edge caused by heavy vehicles. However, the portion of the PC pavement outside of the painted lane line is considered part of the shoulder width, not the lane width. By definition, lane width is only the portion of the lane designed for use by vehicles traveling in the longitudinal direction and does not include shoulders, curbs, or on-street parking areas.

Lane width has an influence on the safety and comfort of the driver. As speed and volumes increase, adequate lane width is important to accommodate the variations in lateral placement of the vehicle within the lane. Adequate lane width is very important along horizontal curves where vehicles may tend to off-track and encroach into adjacent travel lanes. Lane width also has an impact on operations. When determining highway capacity, adjustments are made to reflect the effect of constricted cross sections on free-flow speeds. Lane widths less than 12 feet reduce travel speeds on high-speed roadways. Widths greater than 12 feet are not considered to increase speeds above the base level. The Highway Capacity Manual methodology for freeways and multi-lane highways reduces the estimated free flow speed for 11 or 10 foot wide lanes by 1.9 and 6.6 mph, respectively.

1.2.3 Shoulder Width

The design standards for the Interstate System state that the paved width of the right shoulder shall not be less than 10 feet and the paved width of the left shoulder shall be at least 4 feet on a four-lane section. On sections with six or more lanes, a 10 ft paved width for the left shoulder should be provided.

The adopted criteria for Interstates states that where truck traffic exceeds 250 DDHV, paved shoulder widths of 12 feet should be considered. A point of clarification is appropriate regarding the language "should be provided" and "should be considered" found in the AASHTO *Policy on Design Standards Interstate System.* All the shoulder widths mentioned become standards for the Interstate System by virtue of their adoption by FHWA and they are the minimum values for each condition described. Therefore, a project designed for the Interstate System which does not provide the applicable shoulder widths for the conditions mentioned in the AASHTO *Policy on Design Standards Interstate System* would require a design exception.

In situations where cross-sectional width is constrained, evaluating how that width can most effectively be distributed between the lane and shoulder should be evaluated. This evaluation is basically a consideration of trade-offs—taking some of the lane width to use for additional shoulder width or vice versa, depending on the location and the objectives. The optimal distribution will depend on site-specific characteristics. For example, on a rural two-lane roadway with no shoulders and a history of run-off-road crashes, an effective strategy may be to distribute some of the available width to accommodate a narrow paved shoulder and rumble strips, at the expense of narrower lanes. The objective would be to reduce the probability of run-off-road crashes. For a multilane highway with heavy truck volumes and a curvilinear alignment, maintaining full 12-foot lanes at the expense of some of the shoulder width may be a more optimal design. The objective would be minimizing truck off-tracking into adjacent lanes. The key is to look at the site specific characteristics such as highway type, traffic and truck volumes, geometry, crash history, and crash type. With this information various combinations of lane and shoulder width can be evaluated with the goal of optimizing safety and traffic operations at the design exception location.

Where shoulder width is limited, a possible mitigation strategy is to provide periodic "pull-off" areas in locations where additional space is available. Pull-off areas provide several advantages: 1) room to store disabled vehicles, particularly important for maintaining operations on high-volume freeways; and 2) they provide an area for law enforcement to pull over vehicles in areas with narrow shoulders. This increases safety for law enforcement personnel, the stopped driver, and passing motorists.

1.2.4 Bridge Width

Bridge width is the total width of all lanes and shoulders on the bridge, measured between the points on the bridge rail, curb, or other vertical elements that project the furthest onto the roadway. The design standards for the Interstate System state that the width of all bridges, measured between rails, parapets, or barriers shall equal the full paved width of the approach roadways. The approach roadway includes the width of paved shoulders. Long bridges (defined as having an overall length in excess of 200 ft) may have a lesser width and shall be analyzed individually. On long bridges, offsets to parapet, rail or barrier shall be at least 4 ft measured from the edge of the nearest traffic lane on both the left and the right.

1.2.5 Horizontal Alignment

The AASHTO *Policy on Design Standards Interstate System* states that curvature, stopping sight distance, superelevation, and allied features such as transition curves shall be correlated with the design speed in accordance with the current edition of AASHTO's *A Policy on Geometric Design of Highways and Streets*. In terms of the 13 controlling criteria, horizontal alignment refers only to the horizontal curvature of the roadway—the minimum radius for the selected design speed, which is determined from the maximum rate of superelevation and maximum allowable side friction factor. Other elements of horizontal alignment such as stopping sight distance and superelevation have separate criteria.

1.2.6 Superelevation

Maximum superelevation is affected by several variables such as climate, terrain, highway location (urban vs. rural), and frequency of very slow-moving vehicles. For example, northern states that experience ice and snow conditions may establish lower maximums for superelevation than states that do not experience these conditions. Due to these region specific variables that affect the rate of superelevation, State policy establishes maximum superelevation rates on the NHS within the ranges provided in the AASHTO Policy.

A point of clarification is that formal design exceptions are not required for superelevation transition lengths.

1.2.7 Vertical Alignment

In regard to the 13 controlling criteria, vertical alignment refers only to the vertical curvature of the roadway. Other elements of vertical alignment such as stopping sight distance and grade have separate criteria. In addition to stopping sight distance, vertical curvature is influenced by drainage, passenger comfort, and appearance.

1.2.8 Grade

The design standards for the Interstate System establish maximum grades as a function of the design speed and the type of terrain ranging from 3% to 6%. Grade affects vehicle speed and vehicle control, particularly for large trucks. A design exception is required if the maximum grade is exceeded. Minimum grades to achieve proper drainage are also provided and a design exception is required for highway segments that are flatter than the minimum grade.

1.2.9 Stopping Sight Distance

Stopping sight distance is required at all locations along the roadway, including horizontal and vertical curves. For horizontal curves this includes a sufficient horizontal sightline offset to an obstruction. For vertical stopping sight distance, this includes sight distance at crest vertical curves, headlight sight distance at sag vertical curves and sight distance at under crossings. On crest vertical curves the roadway itself limits the driver's sight distance. Sag vertical curves provide greater sight distance during daylight conditions, but severe sag vertical curves will limit the effective distance of the vehicle's headlights at night. Where lighting is provided on the roadway, a design to the driver comfort criteria may be adequate. The length of sag vertical curves to satisfy the comfort criteria over the typical design speed range results in minimum curve lengths about half of those based on headlight criteria.

Decision sight distance provides additional reaction time for more complex maneuvers that require speed, path or direction change, such as merging at a lane drop. It is desirable to provide decision sight distance at critical locations, but a formal design exception is not required for this criterion.

1.2.10 Cross Slope

Cross slope is an important design element because it drains water from the roadway laterally and helps prevent ponding of water on the pavement. Cross slopes that are too steep, however, can cause vehicles to drift, laterally skid when braking, and become unstable when crossing over the crown to change lanes. These conditions are exacerbated by icy, snowy, or windy conditions.

The design standards for the Interstate System states that on tangent sections the pavement cross slope shall be a minimum of 1.5 percent and desirably two percent. In areas of intense rainfall, the cross slope may be increased to 2.5 percent. Paved shoulders should have a cross slope in the range of two to six percent but not less than the cross slope of the adjacent pavement.

In addition to the cross slope of the lanes, the cross-slope break between the lane and shoulder on the high side of superelevated curves should not exceed 8%. A formal design exception is required when this condition cannot be met.

1.2.11 Vertical Clearance

The adopted standard for vertical clearance on all rural sections of the Interstate System is that the clear height of structures shall be not less than 16 ft over the entire roadway width, including the width of paved shoulder. In urban areas, 16 ft of clearance shall apply to at least a single interconnected interstate routing. On other interstate urban routes, the clear height shall be not less than 14 ft. An allowance should be made for future resurfacing to maintain the integrity of vertical clearance for national defense purposes. A design exception is required if this standard is not met. Exceptions for vertical clearance on the Interstate must also be coordinated with the Military Surface Development and Distribution Command Transportation Engineering Agency (SDDCTEA) of the Department of Defense.

1.2.12 Horizontal Clearance (Lateral Offset to Obstruction)

The lateral offset distance is defined from the edge of traveled way, shoulder, or other designated point to a vertical roadside element. Some examples of these elements include walls, barriers, bridge piers, sign and signal supports, trees, and utility poles. Lateral offset can be thought of as an operational offset—vertical roadside elements offset to the extent that they do not affect a driver's speed or lane position. Adequate clearance should be provided for mirrors on trucks and buses and for opening curbside doors where on-street parking is provided.

Lateral offset should not be confused with the clear zone—a clear recovery area, free of rigid obstacles and steep slopes, which allows vehicles that have run off the road to safely recover or come to a stop. While lateral offset can be thought of as an operational offset, the clear zone serves a safety function. Lateral offset to obstructions is one of the 13 controlling criteria that require a design exception. Clear zone is not. The AASHTO *Roadside Design Guide* provides ranges for clear zone based on speed, traffic, and roadside slopes. The Guide states that "the values suggest only the approximate center of a range to be considered and not a precise distance to be held as absolute." Designers need to exercise judgment in selecting an appropriate clear zone, taking into account the variables listed above as well as the location (urban vs. rural), the type of construction (new construction/reconstruction/3R), and the context. Chapter 10 of the *Roadside Design Guide* provides guidance on roadside safety in urban and restricted environments and emphasizes the need to look at each location and its particular site characteristics individually.

Even though clear zone is not one of the controlling criteria that requires a design exception if not met, its importance should still be recognized. Even though it is variable and dependent on many site specific issues, a clear zone should be established for projects or project segments. Once a clear zone has been established, decisions to deviate from it for particular roadside obstacles should be documented.

1.2.13 Structural Capacity

With regard to design exceptions, structural capacity refers to the load-carrying capacity of the bridge. Although identified as one of the controlling criteria, structural capacity is typically not thought of as an element of geometric design. The adopted standard for the Interstate System is that all new bridges have at least an MS 18 (HS 20) structural capacity.

The bridge rail (i.e. type or condition) is not part of the 13 controlling criteria. However, bridge rail is an important safety consideration and should be structurally sound and meet current crash test standards. Updating substandard barrier is an important safety improvement and should be included as part of a project if needed.

2.0 Interchange and Ramp Spacing

2.1 Does the interchange spacing (based on crossroad to crossroad spacing) exceed 1 mi? _________

Interchange and ramp spacing are related terms, but not synonymous. Interchange spacing is a distance measured along the freeway between the centerlines of the intersecting crossroads. Ramp spacing values are a byproduct of individual ramp design and operational requirements. Both are very important considerations in the planning and design of new or modified interchanges.

In urban areas, a rule-of-thumb is that there should be a one-mile minimum spacing between interchanges to allow for the ability to provide proper advance guide signing and to provide sufficient space for entrance and exit maneuvers. Closer spacing may be allowed, but might necessitate the use of collector-distributor roads or the "braiding" (grade-separation) of ramps to facilitate smooth traffic flow.

In rural undeveloped areas, the interchange spacing rule-of-thumb is spaced no closer than three miles apart. There is no specific guidance for areas between urban and rural contexts. These spacing guidelines are intended to minimize the disruption of entering and exiting traffic to the freeway and to prevent insufficient sign spacing. The risk is greatest with regard to urban spacing values of less than one-mile.

2.2 Does the spacing between successive entrances and exits meet or exceed AASHTO criteria? _________

For guidance on minimum spacing between individual ramps, most agencies utilize Exhibit 10-68 from the AASHTO *"Policy on Geometric Design of Highways and Streets"* (Green Book). An NCHRP research project will be completed in 2010 to provide supplemental guidance to Exhibit 10-68 and explain important considerations for determining appropriate ramp spacing. This supplemental guidance is very important since some design practitioners simply default to the stated minimum values in Exhibit 10-68 and fail to examine the key considerations of their specific project conditions. Such considerations include: ramp volumes, truck volumes, acceleration and deceleration length needs created by grade and ramp configuration. The spacing values in Exhibit 10-68 are also not indicative of the needs to accommodate two-lane entrance and exit ramps and the lengths needed to properly form auxiliary lanes for such ramps.

3.0 Approach Alignment to Interchange

3.1 Is the grade of the freeway relatively flat through the interchange area? _________

3.2 Is the horizontal alignment of the freeway relatively straight through the interchange area? _________

It is desirable to locate a proposed new interchange on a relatively flat gradient. Freeway gradients on approaches to interchanges should be limited to 3% in areas with a 70 mph design speed and up to 5% for a 50 mph design speed.

It is desirable to locate a proposed new interchange on a relatively straight alignment. The horizontal curve radius of the freeway approaching a proposed interchange should be limited to 2600 ft for a 70 mph design speed (1900 ft for 60 mph design speed).

3.3 Is adequate sight distance (desirably decision sight distance) provided in advance of each exit? _________

It is highly desirable to provide *decision sight distance* along the freeway mainline in advance of an exit. Decision sight distance is discussed in Chapter 3 of the AASHTO Green Book.
If full decision sight distance values cannot be provided, assess the risk of the deficiency. A deficiency of less than 10 mi/h is generally a low to moderate risk. Decision sight distance deficiencies greater than 10 mi/h represent higher risk and in such cases the following improvement alternatives should be considered:

- Revise the mainline geometry to provide adequate sight distance
- Relocate the exit ramp to lengthen available sight distance
- Incorporate enhanced advance signing strategies

4.0 Interchange Configurations

4.1 Was an appropriate array of interchange configurations and variations evaluated in the design study phase?

There are a variety of interchange configurations and variations available for the design of new and reconstructed facilities depending on the conditions encountered. The selection of an interchange configuration is influenced by factors such as topography, the number of intersecting legs, right-of-way availability, operational needs on the mainline and cross street, potential site impacts, and cost. Each interchange must be designed to fit individual site needs, conditions and constraints.

Interchanges are broadly classified into two functional categories – "service interchanges" and "system interchanges". The term "service interchange" applies to interchanges that connect a freeway to lesser facilities (non-freeways) such as arterials or collector roads. Most service interchange forms have at-grade intersections of the ramp terminals and the non-freeway cross-road. These intersections generally have some type of traffic control (stop signs, traffic signals, or yield conditions at roundabout intersections) that may require drivers to either stop or yield to other traffic or pedestrians. An interchange that connects two or more freeways is generally termed a "system interchange". Generally, the traffic movements within system interchanges are intended to be free-flowing without stopping (except in special cases where toll plazas or ramp metering may be present).

4.1.1 Diamond interchanges

Diamonds are the most common type of service interchange configuration and are applicable for a wide range of conditions. Diamond configurations have one-way diagonal ramps in each quadrant. As a result of the common usage of the diamond interchange, they have a high degree of driver familiarity. Traffic maneuvers at a diamond interchange are relatively uncomplicated. From a human factors perspective, an important desirable characteristic of the diamond interchange is that the turn movements from the crossroad and from the freeway exit ramps are "true" to the intended change in direction of travel. In other words, a driver makes a left turn at the interchange when desiring to make a left turn in travel direction. This desirable characteristic is consistent with driver expectancy. In contrast, interchanges that utilize loop ramp configurations may confuse unfamiliar drivers since loop ramps require making a right turn at the interchange for a movement that would normally be considered as a left turn in their intended direction of travel. Diamond interchanges can be further categorized based upon the ramp separation distance, ramp terminal control strategy, and the crossroad cross-section.

4.1.2 Conventional diamond

Applicable mostly to rural conditions where space allows, a conventional diamond is typically characterized by an intersection spacing of 800 to 1200 ft (centerline to centerline) between where the two sets of ramp terminals intersect on the crossroad. Several options may be utilized for the traffic control at the two ramp terminal intersections with the crossroad. Lower volume ramps may simply be stop controlled. Adequate sight distance based on unsignalized intersection criteria must be provided and can play a key factor in the bridge design at the interchange. If higher volumes exist, actuated traffic signals or roundabouts may be appropriate. To accommodate potential future traffic growth, consideration should be given for coordination of the signals and for needed lengths of left-turn bays on the crossroad. The bridge width is typically the significant factor influencing the cost of a conventional diamond interchange. If the two intersections of the ramp terminals are spaced far enough apart, then typically the bridge width need only accommodate the crossroad through lanes (plus any median) since the left-turn lanes on the crossroad can be formed beyond the bridge structure.

4.1.3 Compressed diamond

A "compressed" diamond interchange is typically characterized by having the ramp terminal intersections spaced 400 ft to 800 ft apart along the crossroad. This form of the diamond interchange is sometimes used where right-of-way is restricted. In some instances, only one side of the diamond is "compressed" (i.e. the nearest ramp terminal is 200-400 feet from the freeway centerline). Under higher volume conditions, obtaining traffic signal progression becomes challenging in the compressed diamond configuration. Also, because the spacing between the two intersections is less than at a conventional diamond, it may be necessary for the bridge width to also include the left turn lanes on the crossroad. The compressed diamond is best suited to rural or suburban areas where traffic demands are low to moderate. Under higher volumes, the inability to achieve efficient crossroad signal coordination makes the compressed diamond much less operationally efficient than the tight diamond or the single-point diamond.

4.1.4 Tight diamond

The tight diamond has the same form as the conventional diamond, with the spacing between the two at-grade intersections usually between 250 and 400 feet. Because of the close spacing between the intersections, both must be signalized, and the signals must be coordinated to allow through traffic to pass through both intersections with at most one stop. For maximum operational efficiency, special treatment of channelization and traffic control is required: left turns from the minor road must store in advance of the first intersection (not between the two ramps). This feature may increase the risk of wrong-way movements (improper left-turns from the crossroad onto the freeway exit ramp) and therefore enhanced wrong-way warning signing and marking strategies may be appropriate. This form also allows easy accommodation of pedestrian crossings of the minor road.

4.1.5 Single-point diamond

The single-point diamond interchange (SPDI) consolidates all the left-turn movements to and from entrance and exit ramps into a single intersection in the center of the interchange. All four left-turning moves are controlled by a single multi-phase traffic signal system and opposing left turns keep to the left of each other. The advantages of a SPDI include:

- The operation of only one signalized intersection on the crossroad, as opposed to two in conventional diamond interchanges, typically offers improved operations and reduced delay through the intersection area.
- Right-turn movements may be signalized to allow for a signalized pedestrian crossing or they may be free-flow movements.

- Curve radii for left-turn movements through the intersection are significantly flatter than at conventional intersections, and, therefore, the left turns discharge more efficiently and better accommodate trucks.

The primary disadvantages of the SPDI are its higher costs because of the need for a larger structure and the need for a careful design of channelization for the left turns to minimize driver confusion (overlapping turn paths and wrong-way maneuvers). Also, SPDIs with a skewed angle between the two roadways increases the signal clearance intervals and adversely affects delay.

Single-point diamond interchanges may be designed such that the crossroad either passes over or under the freeway. Constructing the crossroad intersection over the freeway allows the structure columns to be located in the freeway median thus reducing the clear span of the structure and substantially reducing costs associated with girder depth. Also, when the at grade-intersection is located on the top level it is exposed to an even lighted surface, thus not requiring the driver to go from sunlight into shade and back into sunlight.

<u>4.1.5 Split diamond</u>

Split diamonds serve multiple crossroads connected by frontage roads that are usually one-way. In addition to the ability to serve multiple crossroads, split diamonds offer the advantages of reducing conflicts by handling traffic at four, rather than two, intersections and at each intersection the number of left -turn movements is reduced from two to one. This form typically is more costly due to the need for two or more bridges. The split diamond form is commonly used near central business districts. This form allows easy accommodation of pedestrian crossings of the minor road.

<u>4.1.6 Cloverleaf Interchanges</u>

Cloverleaf interchanges use loops to accommodate some movements. Interchanges with loops in all four quadrants are referred to as "full cloverleafs" and others with loops in one or more quadrants are referred to as "partial cloverleafs" or "parclos."

<u>4.1.7 Full Cloverleaf</u>

With full cloverleafs, because all the left turn movements are made via loops, there is no need for intersections on the crossroad. This typically decreases the delay encountered by these movements and increases the efficiency of operations on the crossroad. A major disadvantage of the full cloverleaf is the weaving that must occur between the loop ramps. Weaving is very frequently a problem in all but very low volume conditions. The AASHTO Green Book recommends that when the sum of traffic on two consecutive loops approaches 1000 vph, that either another interchange form be used or that a collector-distributor (C-D) system separated from the mainline traffic be added to accommodate the weaving traffic.

Full cloverleaf interchanges require more right-of-way than most other forms depending on the design of the loop radii. The speed of travel on a loop may be increased by using larger loop radii. On the other hand, tighter radii may be more susceptible to run of the road crashes.

<u>4.1.8 Partial Cloverleafs (ParClos)</u>

Parclos use one, two, or three loops to handle certain movements. Typically, the heavier left turn movements are the ones accommodated via loops. Parclos are highly adaptable and can accommodate high traffic volumes. Parclo configurations are generally most applicable in situations where a specific left-turn movement pair has a comparatively high volume that would be operationally problematic on the ramp terminals of a diamond interchange. They are also advantageous when one or more quadrants must be avoided due to right of way restrictions.

There are a variety of forms of parclos and common terminology describes them based on the location of the loops and if ramps are in four, three, or two quadrants.

In Parclo A interchanges, entrances to the freeway are made via loop ramps. This provides for improved operations on the crossroad by eliminating the left turns onto the freeway entrance ramps. It also eliminates the need for providing those left turn lanes on the crossroad and therefore typically allows for reduced structure costs. Exits off the freeway are made via direct connection ramps to the crossroad and the intersection at the crossroad requires either signalization or stop control.

A parclo A may also have ramps in only two quadrants and eliminate the two direct freeway entrance ramps from the crossroad. Whereas in a four-quad parclo A all traffic entering the freeway is made via a right turn off the crossroad, in a two-quad parclo A two entry movements are made via a left turn from the crossroad onto the loop ramps. With either form of Parclo A, there are two intersections and minor road through traffic may have to stop twice. Each stop is usually controlled by a 2-phase signal.

In Parclo B interchanges, the loop ramps accommodate traffic exiting the freeway. In a four-quad parclo B, the loops eliminate the need for the traffic exiting the freeway from having to make a left turn at the crossroad. Although the parclo B configuration requires two intersections, the through traffic on the crossroad would only have to stop once at most. If the intersections are signalized, the signals can be designed such that the crossroad through traffic receives a continuous green indication. Another major advantage of the four-quad Parclo B is that because the movements exiting the freeway are unsignalized, there is a lower risk of traffic queues on the exit ramp. The ramp terminal design of the four-quad parclo B interchange also makes wrong-way ramp entry movements highly unlikely.

In Parclo AB interchanges, all ramps are located on one side of the crossroad. This form is mainly used where the right-of-way is restricted on one side of the mainline because of a stream or railroad.

In full cloverleafs, Parclo AB, and 3-loop Parclos, because loops are present in adjacent quadrants, weaving is a problem that may lead to a breakdown in traffic operation and more crashes.

4.1.9 Directional Interchanges

Directional interchanges allow for all high speed direct movements from one facility to another and are particularly applicable for system interchanges. Directional interchanges may also incorporate loop ramps to accommodate traffic of lower-volume directional movements. The volume on a tight loop ramp (30-40 mph design speed) is limited to approximately 1,200 DHV. Several agencies have constructed loop ramps with two-lanes.

The entrance to loop ramps should be designed with consistent radii, without compound curves entering the loop from a high-speed condition. Compound curve design is acceptable when leaving the loop and entering the acceleration lane.

4.1.10 T and Y Interchanges

Interchanges having three legs are commonly referred to as "T" and "Y" interchanges and are used where a freeway or major highway begins or terminates. Three-leg interchanges should only be considered when future expansion to the unused quadrant is unlikely since they are difficult to expand, modify, or otherwise retrofit as a four leg facility. The trumpet type (with a single structure) has three of the turning movements accommodated with direct or semi-direct ramps and one movement by a loop ramp. In general, the semi-direct ramp should favor the heavier left-turn movement and the loop the lighter volume. Where both left turning movements are fairly heavy, the design of a directional T-type interchange is best-suited.

4.2 Is the selected interchange configuration appropriate for the operational needs, fits the topography and potential site conditions and constraints, and is consistent in exit pattern with other nearby interchanges?

While interchanges should be custom designed to fit specific site conditions and traffic operational needs, it is desirable that the overall pattern of exits along the freeway have some degree of uniformity. An inconsistent arrangement of exits between successive interchanges may cause driver confusion and result in drivers slowing down on high-speed lanes and making unexpected maneuvers. From the standpoint of driver expectancy, it is desirable that all interchanges have one point of exit located in advance of the crossroad wherever practical. Exhibit 10-45 of the AASHTO Green Book presents examples of inconsistent and uniform exit patterns.

4.3 Are all directional traffic movements provided for?

The AASHTO Interstate Standards Policy states: *"Each interchange shall provide for all traffic movements."*

Unless demonstrated to be impractical, all interchanges should provide for all movements even if the anticipated demand volume for that movement is low. The omission of the ability to make full movements between the freeway and crossroad or between two freeways can create confusion for unfamiliar drivers looking for the connection. When drivers exit the freeway, there is an expectation that they can re-enter in the same direction of travel at the same interchange or within a short distance on a frontage road. In addition to creating driver confusion and frustration, omitting movements at service interchanges may contribute to increased wrong-way movements as confused drivers attempt to re-enter the freeway via the ramp they exited from. Even proposals to omit connections for very low volume movements should be highly scrutinized. As a minimum, the right-of-way should be obtained to construct any missing connections in the future. Future land use changes and development may significantly increase the demand for the maneuver. Considerations of the risk of not providing for all movements should include the amount of travel misdirection required for a driver to make the movement via an adjacent interchange and the ease to reach the adjacent interchange.

4.4 Are all the exits and entrances on the right side of the freeway mainline?

It is highly preferable to use right-hand entrance and exit ramps in the design of new interchanges. Entrance and exit ramps on the left-side of the freeway are contrary to driver expectation and studies indicate that crashes may be reduced as much as 25-70 percent with the use of right-off, right-on ramps as compared to left hand ramps. Traffic speeds are typically faster in the left-most lanes of the freeway, and therefore speed differentials between entering and exiting traffic and through traffic is usually greater with left-hand ramps.

If possible, existing left hand entrance/exit ramps should be replaced with right hand ramps when reconstructing an interchange. If this is impracticable because of unacceptable economic, environmental or social impacts then such reasons should be well documented and justified. Such justification should include a crash data analysis showing that the existing left hand ramp is not a substantial safety hazard.
If it is not feasible to eliminate left-side ramps, consider the following mitigation measures:

- Extend auxiliary lanes in advance of exits and beyond entrances to reduce the speed differential conflicts
- Provide full decision sight distance in advance of a left-side exit
- Providing supplemental advance signing for left-side exit ramps
- Provide ramp geometry near the point of physical merge or diverge that accommodates a high design speed (provide at least 75 percent of mainline design speed)

4.5 Is there a weaving section within the interchange as proposed?

Weaving sections on freeways involve the crossing of traffic streams created by merging and diverging maneuvers. This may occur within an interchange or between two closely spaced interchanges. Full cloverleaf interchanges have weave sections occurring between the loop ramps (a freeway entrance from a loop is immediately followed by an exit onto a loop). The entrance and exit are joined by a continuous auxiliary lane.

Considerable traffic turbulence occurs throughout weaving sections. Interchange designs should avoid creating weaving sections or at least have the weaving section placed on collector-distributor lanes. Designs that incorporate collector-distributor lanes and/or grade-separate closely spaced ramps by "braiding" are typically more costly. Evaluation of the total interchange cost and the expected traffic operational benefits of improved design alternatives is needed to reach a sound decision between design alternatives.

Traffic operations within a freeway weaving segment are greatly dependent upon the volumes of weaving traffic and the length of the weaving segment. Heavy weaving volumes (particularly with high truck volumes) require longer lengths to allow vehicles to change lanes safely and at reasonable speeds. Key risk factors such as the volume of weaving and non-weaving traffic, the free-flow speed of the freeway, the weave configuration, and the length of weaving segment should be considered in evaluating design alternatives.

As the length of a weaving segment increases, the effects of the weaving maneuvers diminish and the merging and diverging maneuvers themselves mostly contribute to disruptions within the traffic stream. Under most typical conditions, weaving lengths of 2500 ft or more are of low risk. Weaving lengths between 1600 ft and 2500 ft should be evaluated closely and may or may not operate acceptably depending on specific volumes and site conditions. Weaving lengths of less than 1600 ft may be appropriate if volumes are low, however, they should be considered a high risk for operational failure during times of higher volume conditions.

For weaving segments that may be problematic, consider the following design alternatives:

- Relocating one or both ramps to eliminate the weave.
- Constructing a collector-distributor road on which the weaving could occur at lower speed.
- Redesigning the interchange to lengthen the weave.
- Continuing an auxiliary lane beyond the weaving section to aid entering drivers.

4.6 Is the interchange configured with the crossroad over the freeway?

At service interchanges it is desirable to design the interchanges with the crossroad above the freeway due to:
- The crossroad above the freeway results in longer sight distances to the exit ramp and gore area.
- The crossroad above the freeway allows gravity to assist the operation of both accelerating vehicles (the on-ramp has a down-grade) and decelerating vehicles (the off-ramp has an up-grade). In addition, the resulting grades generally provide longer sight distances.

4.7 Route Continuity - Is the interchange configured so that the priority route is the through facility?

The concept of route continuity is applicable to system interchanges and is based on a driver's expectation that through travel on a primary route should be provided without a need to make excessive lane changes or an exit type of maneuver. The principle of route continuity is an extension of the principle of operational uniformity coupled with the application of proper lane balance and the principle of maintaining a basic number of lanes as described in Chapter 10 of the AASHTO Green Book . Designs that adhere to the principle of route continuity will greatly simplify the driving task by reducing forced lane changes and simplify directional signing.

Desirably, the through driver should be provided a continuous through route on which changing lanes is not necessary to continue on the through route. In maintaining route continuity, interchange configuration may not always favor the heavy traffic movement, but rather the through route. In this situation, heavy movements can be designed on flat curves with reasonably direct connections and auxiliary lanes.

On existing interchanges where this principle is violated and it is not practical to reconfigure the interchange to provide route continuity, consider the following mitigation strategies:

• Provide enhanced advance guide signing and gore signing
• Provide auxiliary lane(s) to minimize lane changing.

5.0 Ramp Design

5.1 Is the design speed of the ramp proper at least 50 percent of the mainline design speed?

The design speed of the ramp proper must be at least 50% of the design speed of the mainline freeway. It is desirable that the design speed of the ramp proper be 70%-85% of the design speed of the freeway mainline (see Exhibit 10-56 of AASHTO Green Book). This is particularly important for interchanges in rural settings where operating speeds tend to be higher and congestion levels lower than in urbanized areas. Rural Interstates also carry a higher percentage of truck volumes and a higher percentage of unfamiliar drivers. Drivers tend to become accustomed to high travel speeds and the transitions between design speed changes should be at the desirable range rather than the minimum standards.

Directional ramps and diamond interchanges should be designed in the upper range (within 85% of the mainline design speed). Loop ramps in cloverleaf or partial cloverleaf interchanges are typically in the lower range (within 50% of the mainline design speed). The minimum design speed on ramps or turning roadways associated with interchanges is normally 30 mph. A minimum design speed of 25 mph may be used on loop ramps when the mainline design speed is 50 mph or less. Because of the increased lengths and large areas required, in many cases the upper practical design speed on loop ramps is 30 mph. Connections between freeways in a system interchange are generally free-flow and should also be made via high design speed (85% of mainline) connections.

If the design speed of the ramp proper is not consistent with the desired middle and upper ranges, consider the following design alternatives or improvements:

- Increase the ramp radius of curve
- Increase the ramp superelevation
- Widen the ramp cross section
- Improve the roadside on the approach to and on the low-speed curve
- Provide transition curvature between the high-speed mainline and low-speed ramp

5.2 Is sufficient length for acceleration at entrance ramps provided?

An entrance ramp requires sufficient length to transition between the elevation differences of the freeway and crossroad over a reasonable grade. It is desirable that grades on ramps not exceed five percent. A maximum grade of eight percent should only be used if the length of such grade is relatively short. In addition, the ramp also serves to facilitate transitions in vehicle speeds (acceleration). Some acceleration may occur on the ramp proper depending on the grade and curvature of the ramp. When the ramp lane joins with the freeway mainline, additional length may be needed to achieve further acceleration. Also, a "gap acceptance" length should be provided to allow entering vehicles to adjust speed and safely maneuver into the freeway mainline. Freeways with higher volumes and/or high truck volumes typically warrant longer gap acceptance lengths at entrances to provide safe and efficient merging maneuvers.

The two general forms of entrance ramps are the parallel type and the taper type (see AASHTO Green Book Chapter 10). The operational and safety benefits of long acceleration lanes provided by parallel type entrances are well recognized. The parallel type entrance ramp is recommended for new interchange construction or for the reconstruction or reconfiguring of existing interchanges. An acceleration lane length of at least 1200 ft is desirable (longer if on upgrades exceeding 2%). Merge tapers at the downstream end of parallel-type entrance ramps should have a minimum taper length of 300 ft. The parallel type entrance ramp is particularly advantageous when the geometrics of the ramp proper limit the ability of vehicles to accelerate to near freeway operating speeds. Desirably, a curve with a radius of 1000 ft or more and a length of approximately 200 ft should be provided in advance of the parallel ramp. If the approach curve has a short radius, drivers tend to drive directly onto the mainline without using the acceleration lane.

Some agencies use, or have previously used, taper-type entrance ramps where the entrance is merged into the freeway with a long uniform taper (70:1 or greater desired). When using a taper style entrance, it is important that the geometrics of the ramp proper be such that vehicles may attain a speed within 5 mph of the operating speed of the freeway by the time they reach the point where the left edge of the ramp joins the traveled way of the freeway. If properly designed, the taper-type entrance ramp is an acceptable alternative. However, parallel entrance ramps are generally preferred and studies have shown that parallel entrance ramps are typically safer than tapered. In particular, the parallel design offers advantages to older drivers. With the tapered entrance, the driver has poorer angles in which to use side/rear-view mirrors to monitor surrounding traffic prior to merging. Taper-type entrance ramps can also cause confusion in mainline horizontal curve situations when the driver may have difficulty identifying the mainline alignment.

Entrance ramps and merging areas should be visible to approaching main line traffic for a minimum distance equivalent to the design stopping sight distance and desirably to decision sight distance values.

5.3 Is sufficient length for deceleration at exit ramps provided?

The appropriate length of the deceleration lane varies depending on the design speed of the mainline and the design speed of the first geometric control on the exit ramp (usually a horizontal curve but could be the stopping sight distance on a vertical curve or the back of an anticipated traffic queue). Exhibit 10-73 of the AASHTO Green Book provides the minimum lengths of deceleration lanes for exit ramp terminals. When the average grade of the deceleration lane exceeds 2%, the deceleration length should be adjusted by the factor obtained from Exhibit 10-71.

The two general forms of exit ramps are the parallel type and the taper type (see AASHTO Green Book Chapter 10). A well-designed taper-type exit fits the direct path preferred by most drivers, permitting them to follow a natural exit path within the diverging area. The divergence angle should normally be between 2 and 5 degrees. At ramp terminals on curves, the parallel type of exit ramp is preferred because it provides increased "target" value of the diverge point and reduces the steering demands on the exiting driver. Exit ramps should diverge in such a way that the vertical curvature will not restrict visibility along the ramp to a value less than the stopping sight distance for the ramp design speed. Ramps that "drop out of sight" create a definite problem in driver recognition of queuing at the crossroad intersection and should be avoided.

Consider the queue storage requirements along the exit ramp (influenced by the traffic control device operations such as signals, roundabouts or ramp meters at the ramp termini) when determining appropriate deceleration length needs on the ramp proper. It is desirable to provide decision sight distance to the back of any stopped queue along a ramp. It is also suggested to use ninety percentile queue lengths when considering ramp length needs.

5.4 Are the exit and entrance lanes balanced?

The principle of lane balance involves providing an operationally balanced arrangement of lanes in conjunction with exiting and entering traffic. At exits, lane balance simply means the provision of one more lane going away (the combined number of lanes on the freeway and ramp after the exit should be one more than on the freeway preceding the exit). Compliance with this principle essentially avoids having a "trap" lane or lane drop situation with an exit-only lane. Redesigning exit-only ramp diverges to continue the right lane at least 600 ft past the physical diverge has been a successful strategy used in many states.

At entrance terminals, the sum of lanes before the merge (on freeway and ramp) is equal to the total number on the freeway after the merge (or one more than the total if a lane is being added).

It may be necessary to obtain lane balance by adding an auxiliary lane upstream from the diverging nose. The length of each additional lane should be 2,500 ft. and should be introduced using a 0 to 12 ft. taper with a length of at least 300 ft.

There may be conditions off the mainline, such as on collector-distributor roads, where lane balance and lane continuity are less important.

6.0 Signing

6.1 Is the proposed signing in accordance with the MUTCD and suggested limits on message units? ________

The Manual of Uniform Traffic Control Devices (MUTCD) provides guidance on Interstate signing standards and criteria. The concept signing plan should provide for simple signs that can be accommodated within the interchange layout. Avoid using diagrammatic signs when simpler signing will suffice. Other opportunities to address human factors within interchanges areas include the following strategies.

- Use pavement markings and signs to assist the driver with simplifying decisions, but the number of signs or special markings should be used judiciously.
- Consider the effect of intelligent transportation systems on driver workload and decision making. Avoid providing too much information to drivers in too short of a drive time.

Sign designs should strive to provide the necessary information with consideration of practical driver comprehension limits of message units.

6.2 Evaluate the proposed signing from a driver's point of view. Assess the risk of driver confusion and strategies to simplify the signing.

The complexity of the freeway guide signing should be a major consideration in concept development and the early design stages of an interchange project. The need to provide clear and simple signing that an unfamiliar driver can understand while traveling at freeway speeds is a critical design consideration. Signing needs may directly influence design choices such as interchange spacing, ramp locations, and interchange layouts.

7.0 Crossroad Design

7.1 Are sidewalks and bicyclist facilities provided along the interchange crossroad? Pedestrians and bicyclists are particularly vulnerable to high speed approach vehicles turning at ramp terminals. Are the crossings at interchange ramps controlled or uncontrolled?

Pedestrian and bicycle accommodations (such as sidewalks, bicycle lanes, and shoulders) should be maintained on the crossroad through the interchange area. Pedestrians and bicyclists are particularly vulnerable to high speed approach vehicles turning at ramp terminals. In areas with pedestrian usage, avoid channelization designs at the crossroad/ramp intersection that provide free-flow movements and consider providing accessible pedestrian signals across all crossings.

The PEDSAFE Guide (www.walkinginfo.org/pedsafe) is a comprehensive guide to the wide range of treatments available to enhance pedestrian safety and mobility. PEDSAFE includes diagnostic software which allows a user to find appropriate treatments taking into account the location, goal of the treatment, types of pedestrian crash, and site characteristics.

The design of accessible pedestrian facilities is required and is governed by implementing regulations under the Rehabilitation Act of 1973 and the Americans with Disabilities Act (ADA) of 1990. These two Acts reference specific design and construction standards for usability. Other reference material for pedestrian and bicyclist facilities are AASHTO's "Guide for the Planning, Design, and Operation of Pedestrian Facilities, 1st Edition," and FHWA's "Designing Sidewalks and Trails for Access Part D of II: Best Practices Design Guide."

Providing a dedicated grade-separated freeway crossing for pedestrians and bicyclists away from the interchange area may be preferable and appropriate in some instances. Another potential strategy is to include connecting pedestrian and bicyclist facilities to a route parallel to the one crossing at the interchange, such as a smaller street without an interchange.

7.2 Is sufficient control of access along the crossroad beyond the interchange being provided to ensure its integrity? (The AASHTO standard of a minimum of 100 ft in urban areas and 300 ft in rural areas is usually insufficient where additional development is likely).

7.3 Are adequate land development and access management measures in place for the interchange area?

Poor and inadequate access management along the interchange crossroad is the most likely cause of operational failure at an interchange. Proper control of access must be maintained within and near an interchange in order to ensure its integrity. This is accomplished by acquiring sufficient right of way, and restricting the proximity of public and private access to the ramp/minor road at-grade intersection. The AASHTO standard of a minimum of 100 ft in urban areas and 300 ft in rural areas is usually insufficient where additional development is likely. The values suggested in the TRB Access Management Manual Tables 9-14 and 9-15 should be obtained when new interchanges are proposed and the ability to obtain right of way and access control rights are more practical.

For improvements to existing interchanges, consideration should be given to extending control of access limits if possible. Also, implementing strategies such as using raised medians to restrict turning movements in the interchange area should be considered. Projects that will expand the capacity of the interchange should closely evaluate the effect of the spacing/separation of traffic signals within the crossroad interchange area and the interrelated effects on queue storage and progression through the intersections.

Entrance and exit ramps should not be allowed to have side road or private driveway connections on the ramps. Such access within interchange ramps is counter to driver expectancy and may also contribute to wrong-way ramp movements.

7.4 Ensure elements of the ramp/crossroad intersection are properly designed, especially with regard to:

7.4.1 Turning radii for design vehicle

The intersection turning radii should be appropriate for the number and type of trucks. An AASHTO WB-62 or WB-67 vehicle is recommended as the minimum design vehicle for all turning movements for interchanges on the Interstate System.

7.4.2 Capacity

Consideration of capacity requires assessing the necessary traffic control devices and certain physical geometric design elements such as number of turning lanes, angle of intersection, grade, and channelization. In urban areas where traffic volumes may be high, inadequate capacity of the ramp/cross road intersection can adversely affect the operation of the ramp/freeway junction. In a worst case situation the safety and operation of the mainline may be impaired by a back-up onto the freeway. Therefore, special attention should be given to providing sufficient capacity and storage for the at-grade intersection with the cross road. This could lead to the addition of lanes at the intersection or on the ramp proper, or it could involve traffic signalization timing modifications where the ramp traffic will be given priority. The analysis must also consider the operational impacts of the traffic characteristics on the intersecting road and signal timing for pedestrians.

7.4.3 Traffic control

The ramp/cross road intersection is typically controlled by stop signs, roundabouts, or signals. Use of roundabouts at ramp terminals has been used very successfully in several states and offers many advantages in regard to safety, capacity, user delay, and accommodating nearby frontage roads.

7.4.4 Channelization

Most wrong-way movements originate at the ramp/cross road intersection. This intersection must be properly signed and designed to minimize the potential for a wrong-way movement.

7.4.5 Intersection Sight Distance

Intersection sight distance needs are dependent upon the type of traffic control used. Addressing sight distance issues at at-grade intersections is a critical design concern. Special attention must be given to the location of the bridge pier or abutment because these may present major sight distance obstacles. The combination of a bridge obstruction and the needed sight distance may result in relocating the ramp/cross road intersection to provide the needed sight distance.

Appendix D – Sample Outline for Interstate System Access Requests

NOTE– This sample outline for Interstate System Access Requests (Change of Access Reports in Arizona) is provided solely as an example and should not be construed as a minimum acceptable format or presentation. Change of Access Requests vary widely in complexity – ranging from temporary or permanent locked gates, to relatively simple and straightforward new diamond interchanges in rural and remote locations several miles from adjacent interchanges, to complex new or revised interchanges placed in close proximity to other existing interchanges in very congested urban areas. The scope, organization and presentation of Change of Access Reports may vary to appropriately fit the nature of the Change of Access Request it is associated with.

Sample* Outline for Interstate System Access Requests

* The FHWA Policy does not prescribe a specific format for the reports supporting a request for Interstate System access. This sample outline provides a comprehensive framework that could be used for developing an Interstate access request. This sample is for illustrative purposes only. The format and content of reports supporting Interstate access requests should be commensurate with the project scope. Alternative formats and variations in report content may be appropriate. The state DOT, based on agreement with the FHWA Division Office, should ensure that all Interstate access requests contain sufficient information to allow an independent evaluation of the proposed action, with thorough consideration of all pertinent factors and alternatives. The extent and format of the documentation should be jointly agreed upon by the state DOT and the FHWA Division Office to accommodate the review and approval operations of both agencies. The documentation should be consistent with the complexity of the proposal. For example, information needs in support of isolated rural interchanges may not be as extensive as for complex interchanges in urban areas.

SUMMARY
A summary section should be provided at the beginning of the report that clearly and concisely expresses the proposed action. A brief description of the project location and the intended action should be provided along with the purpose and need for the action (i.e. project). A summary of the project goals and objectives should be stated. The summary should address the problems or deficiencies which the project is looking to address or overcome. If a preferred alternative is known, the summary should include a concise description of the recommended improvement or action for which the FHWA concurrence in engineering and operational acceptability is being sought.

INTRODUCTION
An introduction to the project should be provided that summarizes the following:

Project Description (location and proposed actions) and Background – Identify the subject interchange location and describe the surrounding area (i.e. area of potential influence). Include maps and/or aerial photography of the general project area and area of influence. Maps, aerial photos, or conceptual schematic drawings should be to an appropriate scale and show approximate distances between interchanges, major intersections, and other key features. The subject interchange location should be identified by milepost and by relation to adjacent interchanges and major roads in the system. Factors used to define the area of influence should be discussed, including interchange spacing, signal locations, anticipated traffic impacts, anticipated land use changes or other proposed transportation improvements. The report should identify whether the proposed interchange is located within a Transportation Management Area (TMA).

This section should also discuss the project history and relationship to other related projects planned, pending, under construction, or recently completed. A summary describing consistency with the local planning process should also be included. Identify and reference any supporting companion studies or reports to support the project.

Purpose and Need - The specific purpose and need for the proposed action should be described. Describe what problem or deficiency the project is looking to address or overcome. The following are some possible needs and purposes to justify changes in access to the Interstate System:

- Provide new or improved systems linkage or connectivity
- Support planned local land use changes and economic development
- Provide access to areas currently not served
- Address an existing congestion or safety problem (road user benefits)
- Prevention of future congestion or safety problems (road user benefits)

This section should also identify the specific and measurable performance goals and objectives for the project and define the performance criteria used to evaluate the effectiveness of the project alternatives to satisfy the stated purpose and objectives.

Consistency with FHWA Policy – The FHWA Policy identifies eight "Considerations and Requirements" that an Interstate access request must satisfy and document for obtaining FHWA approval. The supporting report should include a section describing how the proposed action is consistent with each of the eight required policy points. This is a very important component of the documentation since appropriately satisfying the eight points is the basis for approving the recommended change in access. There are many possible formats for addressing the eight policy points. Some agencies chose to format the entire report around the eight points by making a separate chapter for each point. Regardless of the report format used, a thorough description of how the proposed action satisfies each point individually must be provided in some fashion. For convenience and clarification, the eight policy points are paraphrased and summarized below:

1. *The access needs cannot be adequately satisfied by existing interchanges and/or local roads and streets in the corridor can neither provide the desired access nor can they be reasonably improved to satisfactorily accommodate the design year traffic demands*

   Intent: It must be demonstrated that the existing interchanges and/or the local network in the area can neither provide the necessary traffic service nor be improved to satisfactorily accommodate the design-year traffic demands. Reasonable improvements to the existing network must be considered, including improved access management along the crossroads, improved traffic control strategies, modifying ramp terminals and intersections, and adding turn lanes or lengthening turn lane storage.

2. *All reasonable alternatives for design options, location and TSM improvements have been considered*

   Intent: All reasonable alternatives for interchange design configuration options, new interchange location choices, and transportation system management type improvements (such as ramp metering, mass transit, and High Occupancy Vehicle facilities) have been assessed and provided for if currently justified, or provisions are included for accommodating such facilities if a future need is identified. A thorough description of the alternatives considered should be presented in a subsequent chapter of the report, however, a summarizing statement to affirm that all reasonable alternatives were considered is appropriate in this section.

3. *Proposal does not have a significant adverse impact on safety and operations*

   Intent: The proposed action does not have a significant adverse impact on the safety and operation of the system (including the freeway mainline lanes, the existing new or modified ramps, the intersections of the ramps and the crossroads, and the local street network) based on an analysis of current and future conditions. The analysis shall include at least the first adjacent existing or proposed interchange on either side of the proposed change in access. The crossroads and the local street network shall be analyzed to the extent necessary to fully evaluate the safety and operational impacts that the proposal may have (at least to the first major intersection on either side of the proposed change in access). Requests for a proposed change in

Interstate access must include a quantitative and qualitative assessment and summarizing description of the expected safety and operational impacts. The assessment should confirm that the existing and/or improved local street network is able to safely and efficiently accommodate and distribute the traffic resulting from the proposed change in access. Providing designs that are intuitive to the unfamiliar driver is a key element of the likely safety performance of the proposal. Therefore, as a part of the access request, a conceptual plan of the type and location of the signs proposed to support the design alternatives must be provided. (The conceptual signing plan may be included as an Appendix, but the discussion regarding policy point #3 should address the issue of signing the proposal for ease of driver understanding.)

4. *An interchange that connects to a public road, meets or exceeds design standards, and provides for all traffic movements is provided*

   Intent: The report should verify that the proposed access change connects to a road that is owned and operated by a public entity. The proposal should provide for access that safely and efficiently accommodates all traffic movements on the Interstate and along the primary intersecting crossroad. Partial interchanges may be considered on a case-by-case basis if unusual circumstances exist. The proposed access improvement project should meet or exceed current standards for the Interstate highway system. Any anticipated design exceptions should be discussed in the access proposal.

5. *The proposal is consistent with local and regional land use and transportation plans*

   Intent: The documentation must affirm that the proposal considers and is consistent with local and regional land use and transportation plans. Prior to receiving final approval, all requests for new or revised Interstate access must be included in an adopted Metropolitan Transportation Plan, Statewide or Metropolitan Transportation Improvement Program (STIP or TIP), and the Congestion Management Process within transportation management areas as appropriate, and as specified in 23 CFR part 450, and the transportation conformity requirements of 40 CFR parts 51 and 93.

6. *Consistency with corridor and comprehensive network studies and master plans*

   Intent: The request for a new or revised interchange must demonstrate coordination with appropriate master plans and/or comprehensive transportation network system improvement studies. In corridors where the potential exists for future multiple interchange additions, a comprehensive corridor or network study must accompany all requests for new or revised access with recommendations that address all of the proposed and desired access changes within the context of a longer-range system or network plan.

7. *Coordination with the area's development and other transportation system improvements*

   Intent: Requests generated by new or expanded development requires appropriate coordination between the development and related or otherwise required transportation system improvements. The report must demonstrate that appropriate coordination has occurred between the development and any proposed transportation system improvements. The request must describe the commitments agreed upon to assure adequate collection and dispersion of the traffic resulting from the development with the adjoining local street network and Interstate access point.

8. *Consideration and coordination with environmental process*

   Intent: To assure coordination of the access request with the NEPA process. The report should affirm that the proposal is, or is expected to be, included as an alternative in the required environmental evaluation, review and processing. The access request report should describe the current status of the environmental processing and any known environmental issues or information that could be substantial to the decision-making process.

EXISTING CONDITIONS
This section should identify the conditions existing in the project's base year. Text, figures and tables should be used to provide relevant information to describe the existing transportation system, travel demand, performance (operations and safety), land use and environmental conditions considering the following:

Existing Facility and Transportation Network – Important characteristics of the Interstate route and other major facilities within the project area of influence should be stated. Information including functional classifications, number of primary lanes, level of access control (e.g., limited - or controlled-access), and current ADT should be provided in text, table or graphic format for major facilities within the study area. This section should describe the existing configuration, geometry and other design features of existing interchanges and their cross roads in the area of influence, including identifying any elements that do not meet current design standards. This section should summarize existing conditions based upon field reviews and site visits during peak and off-peak periods. Information on geometric conditions should include: number of lanes, lane widths, shoulder widths, acceleration lane lengths, deceleration lengths, weave section lengths, grades and available sight distances at key locations. This section should also identify any other interchanges being developed within the area of influence and discuss their status and relation to the proposed change in access. This section should also summarize the existing safety performance and operating conditions (quality of service) of the facility and network. This section should summarize existing operational conditions (daily volumes, peak hour volumes, LOS, delay, queue lengths or other criteria) of the system within the area of influence. Existing transit operations within the area of influence should also be summarized along descriptions of the transportation network for pedestrians and bicyclists.

Existing Land Use and Demographics - Existing land use within the project area should be summarized by general land use classifications (residential, commercial, industrial, institutional, recreational, etc.). Major developments within the study area should be identified. This section should also identify significant population and employment statistics and trends within the project area. If appropriate, include a summary of traffic analysis zones for the base year from the selected travel demand forecasting model.

Environmental Constraints - This section should identify any known major environmental issues or areas of concern that will be addressed in subsequent project studies. This analysis is not intended to provide extensive examination of environmental and community impact issues that will be accomplished in the NEPA process, but should describe any known controversies or issues of community concern associated with this or related projects.

METHODOLOGY
This section should summarize the methodology for performing the analyses used in developing the Interstate access request. The discussion should provide sufficient detail for the reader to understand the tools and processes used and summarize the assumptions made in the analyses. Examples of what should be included here are descriptions of the basis for selecting the project influence area and the analysis years. Also, this section should describe the basis used for deriving the future year traffic forecasts, any deviations or refinements from established planning models, sources of the traffic volumes used, assumed growth rates, assumed peak hour factors, truck percentages, K-factors, and other assumptions used in the analyses.

Future Year Traffic Development (Travel Demand Forecasting)
This section should include a narrative on the development of the future year design traffic used for evaluating the alternatives. Information to be contained should include network and project validation, future travel demand projections and the design traffic projections.

Area of Influence
The Interstate access request should identify an area of influence based on safety and operations concerns. The area of influence for safety and operational considerations should be based on appropriate boundaries for examining the potential impacts of the proposed action, upstream and downstream of the new or modified access. At

a minimum the area of influence should extend to the adjacent interchanges and along the crossroad extending one-half mile from the ramp terminal, or at least to the first adjacent signal in either direction along arterial roadways, or to the first major intersection.

Operational Analysis Procedures
Provide a summary of the methodology or methodologies used for conducting the operational analyses. As a minimum, the operational analyses should be conducted based on procedures specified in the current edition of the Highway Capacity Manual (HCM). Computations are commonly performed using the Highway Capacity Software (HCS+) and Synchro software. Computations should be performed on mainline freeway segments, the ramp merge/diverge locations, ramp terminal intersections and other significant intersections within the project area of influence. Traffic simulation models such as CORSIM may be extremely useful to supplement the HCS analyses. This section should discuss the use of the traffic analysis tools utilized and the calibration process used for any analyses with simulation models. Traffic analysis models should be applied using the methodology outlined in the FHWA's *"Traffic Analysis Toolbox".*

Safety Analysis Procedures
Provide a summary of the methodology or methodologies used for conducting the safety analysis. A review of historical crash data is suggested to identify if any patterns exist of an overrepresentation of crash frequency, crash types, or crash severity. The safety analysis methods described in the latest edition of the AASHTO Highway Safety Manual (HSM) are suggested for application on Interstate access projects. The HSM methodology includes comparison of past safety performance to statistical estimates using available Safety Performance Functions (SPFs).

ALTERNATIVES
This section should thoroughly discuss the alternatives considered. A narrative regarding the location and design elements should be provided for each alternative.

No-Build Transportation Network
The No-Build Alternative provides for a baseline comparison and describes the expected future operating conditions for the transportation network. The No-Build network should include the existing transportation network plus any funded or programmed improvements that are scheduled to be open to traffic in the analysis year. Level-of-Service analyses for the No-Build Network should be performed and used as a baseline for comparison.

Improvements to Existing Interchanges and Local Road Network
Reasonable improvements to the No-Build network (beyond any funded or programmed improvements that were included in the No-Build Network) should be assessed.

Transportation Systems Management Alternatives
Lower cost TSM type strategies must be considered.

Build Alternatives Involving New or Modified Access
The proposed modifications and engineering factors including structures, landscaping, schedule, cost and traffic control devices should be discussed for each alternative considered.

Issues for consideration in alternatives development

- System improvements needed to support the interchange operations
- Consequences of phased construction of an ultimate improvement
- Select a design LOS and design criteria consistent with project context
- Construction feasibility (constructability and maintenance of traffic)

ALTERNATIVES ANALYSIS

This section should describe the alternatives that have been considered and discuss the analysis of alternatives based on the evaluation criteria as well as how the alternatives satisfy the purpose and need, the applicable engineering policies and standards, traffic operations, and environmental impacts. The alternatives may then be evaluated in economic cost and benefits terms. A summary of the analysis that was performed, the methods and tools utilized, the assumptions, and the conclusions is recommended. The evaluation of alternatives should be made using measures of effectiveness that allow comparisons to the conditions anticipated to occur in the analysis years under the No-Build Alternative.

This analysis would normally consider, at a minimum, the following:

Safety – A safety assessment, including the potential safety benefits should be discussed if the proposed improvements will contribute to a reduced number or severity of crashes. This section should also discuss the project's relationship regarding public safety issues such as emergency service and evacuations if appropriate. The assessment should include:

- Nominal safety assessment
    - Conformance with applicable design criteria
    - Selection of good geometry and design choices
    - Check the simplicity of interchange signing
    -
- Substantive safety assessment
    - Overrepresentation of crash frequency, crash types, or crash severity
    - Comparison of past safety performance to statistical estimates using available Safety Performance Functions (SPFs)
    - Assessment of future safety performance using available SPFs

Operational Performance - The quality of operational service for various network elements within the interchange area of influence (including and along the crossroads) for the existing and proposed access conditions should be presented. The operational performance should be addressed in accordance with the performance targets established for the project. These measures may include Level of Service (LOS) as defined in the *Highway Capacity Manual,* the project's effect on system wide vehicle-hours of travel, average travel speed, or other measures of effectiveness (MOE).

The traffic operational analysis should consider conditions in the current year, the implementation year, and design year (at least 20 years from the PS&E year). The analysis should include adjacent segments of the freeway as well as adjacent existing and proposed interchanges.

Typical components of a traffic operational analysis:

- Summarize traffic volumes (typically for both an AM and PM Peak Hour):

  –Existing / Current Year
  –Design Year No-Build
  –Design Year Build
  –Interim Year as warranted or needed

- Analysis utilizing the methodology of the Highway Capacity Manual

    - Basic Freeway Segments level of service
    - Ramps and ramp junctions level of service

  - Weaving level of service
  - Ramp termini (intersection) level of service
  - Arterial operations as warranted

- Analysis using other traffic analysis tools (i.e. simulation modeling) as appropriate
- Provide analysis input data and assumptions used to enable an FHWA QC check
  Identify assumptions and variables used (PHF, K, T, terrain, etc.)
- Summarize results on a schematic or table for easy interpretation

A summary of the traffic operational analysis must be presented in a form readily understandable and usable to a reviewer unfamiliar with the project.

Stakeholder and Environmental Concerns – This section should summarize stakeholder involvement or any public involvement which has occurred during the project and summarize any issues identified. A preliminary assessment of potential environmental impacts considering all NEPA elements from a fatal flaw perspective for each alternative should be presented.
Conformance with Transportation Plans - This section will discuss the proposal's relationship to Interstate Corridor Studies or similar investment studies. This section should identify the attainment status of the area for the National Ambient Air Quality Standards (NAAQS) established in the Clean Air Act Amendments. If the project is located in a non-attainment or maintenance area for ozone, the relationship of the proposed improvements to the conforming TIP, State Implementation Plan (SIP) and MPO Long-Range Transportation Plan should be discussed.

Evaluation Matrix - A matrix that summarizes the analysis of the alternatives using the key evaluation criteria is extremely useful to examine the trade-offs and potential consequences of the alternatives.

FUNDING AND SCHEDULE
This section should identify the projected funding sources (including any private sources or toll revenues) needed to implement the improvements proposed. The project schedules should also be discussed (anticipated ROW acquisition, construction, etc.).

SUMMARY AND RECOMMENDATIONS
This section should summarize the requested change in Interstate access, identify the preferred alternative (or alternatives), summarize the results of the analysis for engineering and operational acceptability, and state recommendations for further action, such as programming the NEPA or design phases.

APPENDICES
Appendices will be used for other supporting documents such as traffic operational analysis documentation. Preliminary design (functional design) plans showing lane configurations and proposed design features should be provided. These figures should clearly show dimensions for the acceleration and deceleration lane spacing, lane transition taper lengths, auxiliary lanes and interchange spacing (measured from the centerline of grade separation structures.) A conceptual signing and marking plan should also be provided.

Guidelines for appropriate design level of effort:
- Horizontal plan concept or schematic with sufficient detail to establish geometry (scale of 1" = 200' or 1"=100')
- Cross section, profiles or other sketches as necessary
- Detail sufficient to provide reasonable cost estimate
- Summary of alternatives considered and reasons for preferred plan
- Supporting information (e.g., bridge and retaining walls)

It is critical to accurately develop and reflect geometry on urban freeways and in locations where right-of-way is tight. *The level of detail and effort included in the IJR should be sufficient to give assurance that the plan will not substantially change as the project moves ahead to preliminary and final design.*

Other Appendix **material as appropriate:**

- Copy of the portion of MPO plan showing proposed project
- Copies of previous engineering studies or reports
- Letters of support from units of government

Appendix E –Methods and Assumptions Document Procedures

Change of Access Report
Methods and Assumptions Document Procedure

The intent of this document is to capture the assumptions to be used in the analyses within the Change Of Access (COA) report. This document will be developed in the beginning stages of the study [before the 15% design] and will account for the parameters and decisions set by the team.

Provided below is an example outline of the document to be produced and items to consider:

1. **Stakeholder Acceptance**
   The page after the cover page ("Change of Access Report, Methods and Assumptions for the <Title of Project>") should have concurrent ADOT & FHWA signatures with the following information –

   "The undersigned parties including all members of the team from ADOT, FHWA and the local agencies, concur with the Change of Access Report, Methods and Assumptions for the <Title of Project> as presented hereinafter."

ADOT:	FHWA:
______________________ (Signature)	______________________ (Signature)
______________________ (Title)	______________________ (Title)
______________________ (Date)	______________________ (Date)

   The recommended ADOT stakeholder should be the Roadway Group Manager and the FHWA stakeholder should be the Operations Senior Engineering Manager.

   If the stakeholders feel it is necessary the following notes may also be added:

   " (1) Participation and/or signing of this document does not constitute approval of the <Title of Project> Change of Access Report.
   (2) All members of the project team will accept this document as a guide and reference as the study progresses through the various stages of project development. If there are any agreed upon changes to the decisions in his document, a revision will be made, and resigned by the stakeholders."

2. **Introduction and Project Description**
   There should be background information including: scope, potential environmental study, project schedule, involved stakeholders, and team members.

   As well as project specific items such as: project location, type of interchange (i.e. partial/ service/ system), existing/ future conditions, project study area and traffic area of influence (all affected interchanges, intersections and streets to be included within the analysis).

3. **Need for the Project**
   Briefly define the current need for the project. What are the traffic related congestion issues which are hoped to be resolved? What are the project constraints?

4. **Analysis Years**
   The existing year (base), opening year (facility opens to the public), interim years (phased construction, if deemed necessary) and design year (at least 20 years from the opening date to traffic) should all be decided upon. If interim conditions exist, it should be defined if it is of the mainline traffic and/or interchange structure

   Also, the peak hour should be discussed. If the project is located with a highly urbanized condition or if the location is currently (existing conditions) at or close to capacity, the peak hour may need to be extended into a peak period for AM and PM.

All Alternatives		**Year of Analysis**			
		Existing	*Opening*[1]	*Interim*[2]	*Design*
No Build		✓	✓	✓	✓
Build	Preferred Alternative		✓	✓	✓
Build	Other Alternatives		✓	✓	✓
TSM Alternative		✓	✓	✓	✓

Notes:
1: Opening year can either be an interim configuration or build out configuration, must be defined
2: Interim year can either be an interim configuration or build out configuration, must be defined

5. **Data Collection**
The type of data that will be used should be discussed and can include:

- Land use – existing and proposed, should be based on approved MPO model if within the MPO planning boundary. If outside a planning boundary the team should decide the most appropriate land use.
- Traffic data:
    - Geometry (interstate, ramps, intersections, arterials)
    - Control (signal timing, signs, ramp meters, time of day parking restriction, etc)
    - Volume (mainline, intersections, and other movements as needed)
- Traffic factors: identified traffic factors to be collected (PHF, K30, D30, Truck Traffic (T), Recreational Vehicles (RVs))
- Pedestrian, bicycle and transit data as warranted to multi-modal operational
- Calibration data (volumes, travel times, speed, queues, etc)

6. **Travel Demand Forecasting**
A consensus should be reached between the project team, MPO and ADOT as to how to determine the future traffic to promote consistency between studies and adjacent projects. This section should describe what regional traffic model or trend line analysis will be used to take into account historical/ projected growth rate. Documentation should include the selected approved model/ studies for the traffic area of influence and the travel demand forecasting methodology (model to be used, validation / calibration efforts, etc). Also future improvements outside the control of the project (i.e. improvements in the long range planning model) should be decided if they will be included in the analysis as assumptions – if so, this should be clearly stated.

7. **Traffic Operations Analysis**
Based on the project scope and traffic area of influence, describe what tool and what latest version will be used for Traffic Operation analysis. The tool could be deterministic (HCS, Synchro, etc), Mesoscopic Simulation (Dynasmart, Paramic, etc), or Microscopic Simulation (CORSIM, VISSIM, etc). The analysis tool should be established based on the specific objectives and goals of the project.

The traffic operation analysis efforts should include analysis of the following:

- Mainline analysis (performance MOE should be identified early in the process)

- Ramp roadway analysis
- Weave analysis
- Arterial analysis (intersections, queues, etc)
- Merge/ diverge analysis

8. Safety Analysis

Detailed collision (crash) data within the study area should be analyzed (number of crashes per mile per year, with consequences of those crashes as specified by injuries, fatalities, or property damage). Suggested steps for analysis:

1) Establish the safety influence area (in some cases, will be the same as the traffic area of influence)
2) Collect traffic & geometric data (field data)
3) Collect safety data
4) Analysis of safety & traffic data
5) Assess existing & proposed geometric & operational conditions
6) Consider future safety conditions & corrective (countermeasure) actions (based on the imperial data that was collected)
7) Document safety considerations

The safety analysis should demonstrate the proposed project will not have significant or adverse impacts on the safe operation of the Interstate. This could not be due to better operation that the safety will be improved. Operational safety needs to be based on the analysis of the proposed geometrics and by addressing the findings from the crash data.

9. Selection of Measures of Effectiveness (MOE)

Selection of metrics for displaying results of the traffic analysis – MOE's – should be done in support of and in order to accomplish the project objectives. Examples of common MOE's are:

- Travel time on network/ Interstate (minutes)
- % of demand served at pre-agreed to locations
- % of demand served in peak hour/period
- % of capacity used on signalized ramp terminals
- Confidence interval (allowable % of error)
- Maximum queue length at critical locations and intersections
- Average queue length
- Persons/vehicles served (vehicle-miles)

- Average speed & density
- Average trip length (vehicle/hours per trip)
- Duration of congestion (hours at defined density, speed or flow rate)
- Extent (segment miles congested)
- Reliability (buffer index)
- Variability in travel time
- LOS as defined by HCM

10. Deviations/ Justifications

Briefly discuss any potentially known deviations (i.e. software, model, studies, etc.), why they might be necessary and the possible justifications.