110 Initial Engineering Design Process

Modification for Non-Conventional Projects:
Delete ***FDM 110***, and see RFP for specific requirements.

110.1 General

This chapter discusses the engineering design process which begins with the approval of the Project Location and Design Concept Acceptance and ends with the construction letting. It may include an update process when the construction plans and specifications are ready and on hold in the district and require revising to make them contract ready. Throughout this design process, quality control will be performed by those responsible for the engineering design and plans preparation activities.

The engineering and design activities and the schedules depend on the type of project and the required effort to accomplish the desired objectives. There are three basic types of projects:

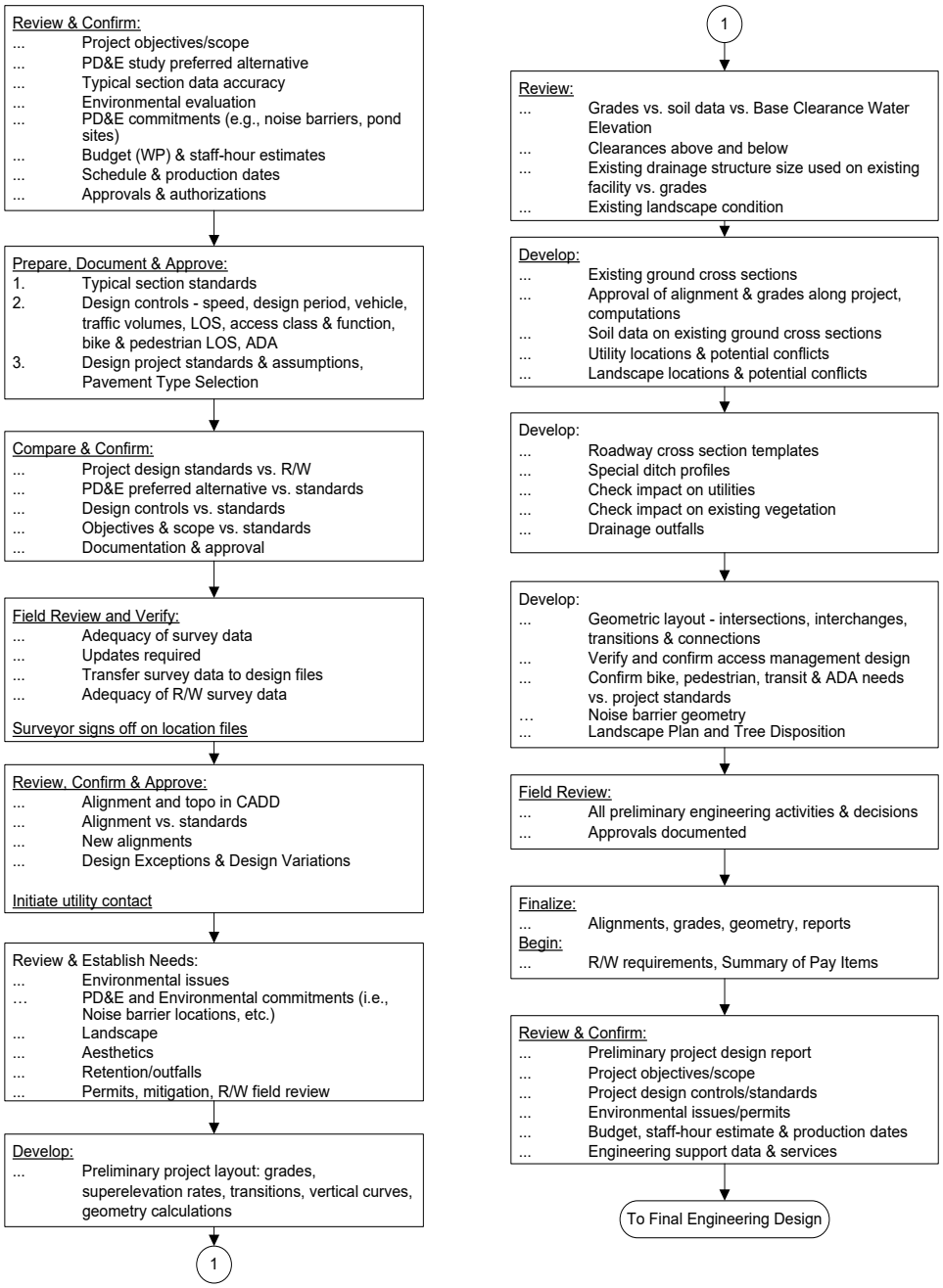
(1) **New Construction -** A highway or bridge project along a new corridor on new horizontal and vertical alignments.

(2) **Add Lanes and Reconstruction -** A highway project along an existing facility to add lanes, widen or replace bridges, or improve intersections to improve capacity, safety, or operation.

(3) **Other Projects -** May include Resurfacing, Restoration and Rehabilitation (RRR), operational improvements, safety enhancements, or improvements to extend the service life of an existing highway or bridge. These projects generally do not require a PD&E phase. The scopes are so varied that it is difficult to define them, except project by project. They can vary in magnitude from installing highway lighting for enhanced safety or resurfacing pavement to extend the service life, to minor lane and shoulder widening, bridge rail modification or intersection improvements. These projects may also include transit facilities, bike paths, sidewalks and landscaping.

Figure 110.1.1 shows the major activities included in the initial engineering design process.

Figure 110.1.1 Major Activities – Initial Engineering Process



110.2 Initial Engineering Design

Generally, the initial engineering process should accomplish or complete the following activities:

(1) Completely and fully define and document the objectives of the project and the scope of activities to accomplish them. This will almost always require an on-site review.

(2) Document the surrounding context as it relates to aesthetics and accommodating trees (existing and proposed) and other long-lived plants.

(3) Develop and document a realistic staff-hour estimate and production schedule to accomplish the scope of activities identified.

(4) Coordinate with the District Interchange Review Coordinator to determine if a re-evaluation of the approved Interchange Access Request (IAR) is necessary. The Interchange Access Request Users Guide (***IARUG***) provides the requirements for performing a re-evaluation of the Interchange Access Request (IAR).

(5) Establish and document the design controls, criteria, assumptions, project design standards, Design Exceptions, and Design Variations. Significant changes to previously approved PD&E concept may result in a re-evaluation of the Environmental Document. Discuss with the District Environmental Management Office.

(6) Review Project Commitment Record (PCR) that was completed during PD&E and identify all prior PD&E commitments that will be addressed during design; e.g., the need to design and locate noise barriers (with insertion loss calculations), special pond site requirements, landscape or aesthetic considerations, pedestrian and bicycle commitments, access commitments, wildlife management commitments, wetland issues, transit issues.

(7) Identify and document additional engineering, data gathering, and support services.

(8) Determine and document the structural design requirements.

(9) Determine and document if R/W is required.

(10) Establish and document the review procedure and number of submittals, if different from guidelines provided in this manual.

(11) Establish preliminary geometry, grades, and cross sections.

(12) Identify and implement needed public involvement activities. See ***FDM 104***.

(13) Develop Pavement Type Selection Report based on FDOT ***Pavement Type Selection Manual*** ***(Topic No. 625-010-005)***.

If a PD&E phase has been completed, some of the activities listed above may have been performed to varying levels during that phase. The information contained in the preliminary engineering report should be considered as the starting point for the initial engineering phase. When there was no PD&E phase, the initial engineering design activities must establish the project scope, controls, criteria, and standards, data gathering requirements, right of way (R/W) needs, and major design elements necessary to determine that the project is viable and R/W can be cleared.

110.3 Scope, Objectives, Schedule and Budget

The Department's project manager is responsible for the development, review and approval of the project objectives, scope of work, and schedule in accordance with the ***Project Management Handbook***. They must also verify that required funds are in the work program.

The project objectives and scope are best confirmed and completed by:

(1) Reviewing the PD&E study recommendations, conclusions and commitments.

(2) Performing a field review of the project with the project manager and personnel from appropriate FDOT offices, such as Roadway Design, Traffic Operations, Safety, Right of Way, Utilities, Landscape, Survey, Maintenance and Construction.

(3) Requesting a review of the draft scope of services activities by FDOT offices, such as Maintenance, Construction, Design, Traffic Operations, Access Management, Public Transportation, Pedestrian and Bicycle, and Environmental Management.

(4) Developing the scope of services sufficient to advertise for professional services. After the scope of services is completed and approved, the schedule and budget may be confirmed and updated by the engineer/project manager and approved by the appropriate district manager. The scope of services should anticipate and include:

   (a) The most cost-effective methods that may be used in Subsurface Utility Engineering (SUE) for locating subsurface anomalies, structures, and utilities.

   (b) Opportunities to accommodate existing trees, proposed trees, and other long-lived plants.

After consultant selection or in-house assignment, the designer or consultant should review and confirm the scope of services.

110.4 Project Design Controls and Standards

Selection of appropriate project design controls and standards ensure that the facility will function safely at the level desired and expected by motorists, pedestrians and cyclists. The Engineer of Record (EOR) is responsible for establishing project design controls and standards to be used in the development of the construction plans. Place documentation for the selected project design controls and standards in Project Documentation (see ***FDM 111.7***).

The design controls as addressed in this manual include:

- design speed
- design vehicle
- design period
- traffic volumes
- level of service
- functional classification
- access classification
- context classification

Other factors that control the selection of project design controls and standards include right of way constraints, utility conflicts, and preservation of large trees.

The Preliminary Engineering Report (PER) or project concept report may include some of the project design controls and standards to be used on the project. These design parameters should be reviewed, confirmed as valid and consistent with the overall corridor or system, and documented.

See ***FDM 201.4*** for information on selecting the appropriate design speed for the project.

Either a Design Exception or Design Variation, as described in ***FDM 122***, must be obtained when selected project design controls and standards do not meet Department's criteria.

110.4.1 Proprietary Products or Processes

A proprietary product is defined as "a sole source or patented product or process. A product or process is also considered proprietary if it is identified by a plan note or specification so narrowly defined that only a sole source or patented product or process can meet the requirements."

It is important to identify these features as early in the design process as possible. If a project proposes to include a proprietary product or process, the process outlined in the ***Proprietary Products Review and Certification procedure (Topic No.: 630-020-005)***

must be completed. This process requires approval by the District Design Engineer. Additional information on proprietary products is included at the following web site:

http://www.fdot.gov/programmanagement/ProductEvaluation/ProprietaryProducts/ProprietaryList.shtm

110.5 Support Services

Review information or support services that have been provided to determine the completeness and currency of data used in previous studies/reports.

Technical data required for the design of a roadway project can be available from various sources, such as:

(1) Surveys - design, topographical, aerial, drainage, right of way location, soil, utilities
(2) Traffic Data
(3) Pavement Design
(4) Environmental Documents (including Noise Study Report and wildlife connectivity recommendations)
(5) Original Plans
(6) Crash Data
(7) Roadway Characteristics Inventory (RCI)

During the design process, the project will require coordination with different sections or offices. When engineering decisions, information, or other support services are required from FDOT functional areas, it is the project manager's responsibility to coordinate and facilitate the request and expedite a timely response. The functional areas include but are not limited to:

(1) Planning and Programs
(2) Surveying and Mapping
(3) Traffic Plans
(4) Geotechnical
(5) Drainage
(6) Maintenance
(7) Construction
(8) Utilities
(9) Estimates and Specifications
(10) Right Of Way
(11) FHWA
(12) Value Engineering
(13) Traffic Operations
(14) Environmental Management
(15) Access Management
(16) Structures

(17) Safety
(18) Plans Review
(19) Public Transportation
(20) Landscape Architecture
(21) Central Office

110.5.1 Aviation and Spaceports

Coordinate with the District Aviation Coordinator when a project is within 10 nautical miles (11.5 statute miles) of an airport or spaceport.

Federal, state, and local regulations exist to protect the national airspace system and must be considered when planning and implementing construction that may adversely impact:

(1) Military or public-use aviation facilities (airport, seaport, or heliport),
(2) Navigational or communication facilities, or
(3) Instrument approach flight procedures.

Federal law, ***Title 14 Code of Federal Regulations (CFR), Federal Aviation Regulations (FAR), "Part 77, Subpart B – Notice Requirements"*** ***(Part 77, Subpart B)*** requires that prior notification be given to the Federal Aviation Administration (FAA) regarding any proposed construction or alteration (permanent or temporary) of structures. Refer to ***FDM 110.5.1.2*** for FAA notification requirements.

Structures may include:

- Traverseways
  - Interstate Highways
  - Public Roadways
  - Private Roads
  - Railroads
  - Waterways
  - Other traverse ways
- Parking or rest areas
- Bridges and overpasses
- High-mast light poles
- Utility poles
- Antenna towers
- Buildings
- Signs or billboards
- Fences or gates
- Temporary-use construction materials or equipment, including dirt piles and cranes
- Natural growth, vegetation, and landscaping, depending on proximity to an aviation facility, navigational aid, or instrument procedure ground track

110.5.1.1 Required Coordination

For guidelines on airspace obstruction permitting, refer to ***Chapter 333, Florida Statutes (F.S.)***, "Airport Zoning", and ***Chapter 14-60, Florida Administrative Code***, "Airport Licensing and Airspace Protection".

While the responsibility for filing FAA notifications and local government permitting applications for Airspace Obstruction Permits, if applicable, rests with the Engineer of Record, the FDOT Aviation and Spaceports Office provides technical assistance on proposed projects to determine impact to the national airspace system in Florida. Please direct your inquiries to the following:

FDOT Aviation and Spaceports Office
Airspace and Land Use Manager
605 Suwannee St., M.S. 46
Tallahassee, FL 32399-0450
Tel: (850) 414-4500
http://www.fdot.gov/aviation/

110.5.1.2 FAA Notification Guidelines

Part 77 – Subpart B requires that prior notification be given to the FAA regarding any proposed construction or alteration of structures that exceeds the criteria of ***Part 77, Subpart B***. The FAA provides a ***Notice Criteria Tool*** via the Obstruction Evaluation/Airport Airspace Analysis (OE/AAA) website (***https://oeaaa.faa.gov/***) that should also be used to determine if notice to the FAA is required due to possible obstruction of navigation or communication facilities.

If FAA notification is required, ***FAA Form 7460-1, "Notice of Proposed Construction or Alteration"*** can be submitted either electronically through the FAA's Obstruction Evaluation/Airport Airspace Analysis (OE/AAA) website, or manually to the FAA Southern Regional Office in Atlanta. Submitting electronically is the preferred notification method. Submission of the ***Form 7460-1*** will result in the FAA issuing a Determination whether the proposed structure constitutes a hazard to air navigation. If the structure is determined to be a hazard the construction may not proceed, according to ***Chapter 333, F.S.*** The Form must be submitted at least 45 days before the earlier of the following dates:

(1) Date proposed construction or alteration is to begin.

(2) Date an application for a construction permit is to be filed.

Note that construction may not commence until the FAA issues a Determination that the structure is not a hazard.

FAA Emergency Notification:

> In the case of an emergency involving essential public services, public health, or public safety that requires immediate construction or alteration, the 45-day advance notice requirement does not apply. In such a case, the required notification may be sent by telephone or any expeditious means to the nearest FAA Flight Service Station, and within 5 days thereafter, a completed copy of the ***FAA Form 7460-1***, must be submitted to the FAA Southern Regional Office in Atlanta.

110.5.2 Projects Involving Existing Bridges

Special coordination efforts are required of the Design Project Manager on projects that involve demolition, renovation, repair, repainting or replacement of any bridge.

110.5.2.1 Projects Involving Steel Bridges

For all projects that involve the repair, repainting or replacement of a steel bridge, the Design Project Manager must contact the State Corrosion Engineer in the State Materials Office and the District Contamination Impact Coordinator (DCIC) to determine if the bridge contains lead or other hazardous elements. The State Corrosion Engineer and DCIC will furnish a Modified Special Provision for disposition of the lead based paint waste for that particular project.

The Design Project Manager must provide the Modified Special Provision to the Engineer of Record who is preparing the contract plans and specifications. The Engineer of Record must ensure that the project specifications include Modified Special Provision and that they prohibit the use of lead based paint. A mandatory pre-bid conference is not required unless special conditions exist and the district determines one is needed.

110.5.2.2 Projects Involving Bridges with Asbestos-Containing Materials

There may be asbestos-containing materials (ACM) used in bridges. Projects involving bridges that are to be either partially or fully demolished or renovated require an asbestos survey to be conducted by a licensed Asbestos Consultant. This should be completed as early in the project as possible to determine the nature and extent of ACM and if

abatement is required. Some bridge elements potentially containing asbestos include (but are not limited to) the following:

(1) Tender House Roof Materials (e.g., felts, flashings, mastics)

(2) Tender House Floor Materials (e.g., tiles, sheet flooring, mastics)

(3) Tender House Wall Materials (e.g., drywall muds, joint compounds)

(4) Tender House Window Materials (e.g., caulks, gaskets)

(5) Bridge Equipment Materials (e.g., gaskets, packings, linings, insulation)

(6) MSE Wall Gaskets

(7) Beam/Deck Bearing Pads

(8) Asbestos-cement pipes (e.g., scuppers)

(9) Bascule Bridge Machinery Brake Pads

(10) Trowelled-on or Sprayed-on Decorative Coatings

110.5.2.3 Projects Involving Bridge Demolition

At or before the 30% plans phase, the Department will determine if it has a need for the debris resulting from the demolition of a bridge. If no such need exists, and in response to ***Section 1805, SAFETEA-LU Legislation,*** the Department is then required to notify local, State and Federal government agencies of the availability of the bridge debris for their beneficial use (use as shore erosion control or stabilization, ecosystem restoration, and marine habitat restoration). For any projects that involve the complete demolition of a bridge, the Design Project Manager is required to notify these agencies of the availability of the resulting debris. The Bridge Development Report (BDR)/30% Structure Plans (see ***FDM 121***) will include the approximate volume of debris and the estimated timeframe in which the material will be available.

The Design Project Manager must coordinate with the receiving agency and the District Construction Engineer to develop a Joint Project Agreement. The receiving agency will be responsible for all additional costs associated with the processing, delivery, placement and use of the material. The following items must be determined in order for the Joint Project Agreement to be developed:

(1) The volume of raw (unprocessed) debris (a more detailed quantity than original estimate).

(2) The estimated timeframe for the debris availability.

(3) The location of the receiving agency's staging/storage site to which the raw debris is to be delivered. Any further work involving processing and final placement of the material is expected to be the responsibility of the receiving agency and not part of the FDOT's contract for bridge demolition.

(4) An estimated cost to transport the debris to that site. This estimate will be amount the receiving agency must pay the FDOT.

Once this information is determined, the contract plans will include the instructions for the delivery of the debris.

If no agency expresses interest in the debris material, then the material will be disposed of in accordance with FDOT Specifications.

Requirements for the original notification to agencies (including a sample Notification Letter) and the resulting Joint Project Agreement are found in the ***Project Management Handbook, Part 2, Chapter 3.***

The demolition of bridges with ACM requires that Asbestos Abatement Plans be developed by a licensed Asbestos Consultant. ***FDM 110.5.2.2*** and the ***Construction Project Administration Manual*** (***CPAM***), ***Section 10.4*** contain additional requirements for projects involving demolition of bridges with ACM.

110.5.3 Projects Involving Bridges Over Navigable Water

For projects involving bridges over navigable water, the Design Project Manager must provide the District Structures Maintenance Engineer (DSME) sufficient notification prior to engaging in any action in, on, or around the bridge(s). This includes any field reviews involving persons conducting activities that may be perceived as suspicious (e.g., parking on the bridge, repeated viewing from a boat or other vehicle, carrying cameras and other electronic equipment like a GPS, etc.) This will allow the DSME to notify the U.S. Coast Guard prior to such activities taking place.

110.5.4 Wildlife Connectivity

Wildlife connectivity features include new or modified structures; e.g. bridges, bridges with shelves, specially designed culverts, enlarged culverts, or drainage culverts. Exclusionary devices such as fencing, walls or other barriers may be included to funnel wildlife to a crossing. Disciplines that may be involved in this effort include Structures, Roadway, Drainage, Environmental Management, Permitting, Right of Way and Utilities.

Wildlife connectivity needs are usually identified during the PD&E study. However, coordinate with the District Environmental Management Office and District Permit Office early in the design phase for determination of the type, size and other parameters for the wildlife crossing feature. For further guidance on wildlife connectivity refer to the ***FDOT Wildlife Crossing Guidelines***, commitments section of the Environmental Document, and any other documentation regarding the wildlife connectivity related to the project.

In the event that wildlife connectivity needs are not identified until after the design process has begun, immediately start the coordination process with the District Environmental Management Office and District Permit Office.

110.5.5 Interstate Projects Affecting Logo Structures

Determine if the construction activities on Interstate mainline or ramp projects may impact logo sign structures. Any affected logo structures must be identified so those logo structures can be properly addressed in the plans. Once the affected logo structures are identified, the designer must coordinate with the State Outdoor Advertising and Logo Manager, the Logo Program Contractor, and the District Traffic Operations Office to determine if the logo structures need to be relocated or redesigned during construction. Through this coordination, the following questions must be answered:

(1) Will the construction activities require the relocation of any logo structures during construction?

(2) Where will the logo structures be reinstalled?

(3) Will an upgrade of the sign panel, support or foundation of the affected logo structure be required?

The disposition (e.g., relocate, furnish & install) of affected logo structures must be addressed in the plans and paid for as specified in the ***Basis of Estimates Manual***.

Refer to the Logo Sign Program web page for additional information:

http://www.fdot.gov/rightofway/LogoSignProgram.shtm

110.5.6 Buy America Provisions

All manufacturing processes for steel or iron materials, including application of a coating, utilized in all highway construction projects must occur in the United States, in accordance with the Buy America provisions, established in ***23 CFR 635.410***. Buy America requirements are covered in ***FDOT Standard Specifications, Section 6***. The allowable

levels of foreign steel or iron and contractor certification requirements are identified in ***Specification 6-5.2***.

While ***Specification 6-5.2*** applies to contractors, designers also have a responsibility to ensure Buy America provisions are met. When Buy America provisions are not met, the entire project is not eligible for Federal funds. The design engineer of record needs to do sufficient research to determine that any steel or iron called for in the plans is manufactured in the United States. This is necessary when the plans include the following:

(1) Non-standard or special grade steel components and shapes.

(2) New proprietary products containing steel or iron materials.

(3) Sole source products containing steel or iron materials.

(4) Special machinery with steel or iron components.

(5) Heavy sections of steel sheet pile wall.

It is not necessary to conduct such research for the following:

(1) Standard domestic steel beams and shapes of standard grades as shown on the National Steel Bridge Alliance (NSBA) website.

(2) Standard concrete reinforcing steel sizes and grades.

(3) Standard steel drainage pipe sizes and gages.

(4) Items covered in the ***Standard Plans*** including:

  (a) Standard mast arm assemblies.

  (b) Standard steel guardrail, posts, and end treatments.

  (c) Standard drainage grates.

  (d) Standard steel fences.

  (e) Standard steel sign supports and structures.

If it is determined that a steel or iron product being proposed is not manufactured in the United States, then the Designer must determine if the estimated costs of such foreign steel or iron is within the thresholds stated in the specification. If the costs exceed such threshold, the Designer must explore alternatives that utilize domestic steel or iron, or seek a waiver from FHWA. Generally, it is preferred to select a different engineering solution utilizing domestic products.

Should a waiver become necessary, it must be obtained before the contract letting to ensure federal funding is not jeopardized. Submit Buy America waiver requests to the Central Office for concurrence by the Directors of Design and Construction and notify the Office of Work Program of the requests. Upon concurrence, requests will then be forwarded to the FHWA Florida Division Office for approval and coordinated with the FHWA headquarters in Washington, D.C. for further concurrence. Originals will be returned to the District by the Central Office. These issues must be identified early in the plans preparation process.

110.5.7 Traffic Monitoring Sites

One or more traffic monitoring sites should be considered for addition to each construction project which has a type of work consistent with the construction of such sites. Examples of compatible work types include traffic signals, resurfacing, reconstruction, and other work that involves either pavement surfaces or electrical systems. Inquiries about monitoring sites should be addressed to the Traffic Data Section Manager of the Transportation Statistics Section, Office of Planning.

110.5.8 Fire Suppression Systems

FDOT owned fire suppression systems are not allowed on bridges, retaining walls or limited access facilities unless they are approved by the Chief Engineer due to special circumstances. Commonly occurring traffic related incidents will not be considered as special circumstances or as justification for the installation of any fire suppression system. If an FDOT fire suppression system is approved, agreements must be executed with a local agency to bear all installation costs, repair costs and maintenance functions.

Any fire suppression system that is not owned by FDOT is defined by ***Section 337.401, (F.S.)*** as a utility and is not to be issued a utility permit unless approved by the Chief Engineer in accordance with ***Rule 14-46.001, Florida Administrative Code*** and the Utility Accommodation Manual.

110.5.9 Trees, Landscape, and Landscape Irrigation Systems

Consistent with Department policy, determine how the project can be designed to accommodate existing desirable trees and proposed trees. Determine if commitments have been made to preserve or provide trees, landscape, or landscape irrigation systems. Determine if a landscape project is programmed or proposed as a component or standalone by the Department or a local agency.

The District Landscape Architect will determine the level of preservation, tree relocation, or invasive species eradication involved. Projects that impact a small number of existing trees typically only require a Tree Disposition Plan (per ***FDM 323.4***). Projects that impact many desirable trees typically require Selective Clearing and Grubbing plans (see ***FDM 229*** and ***323***).

Coordinate with the District Landscape Architect to determine the following:

- Whether design alternatives could reduce impacts to existing vegetation.
- Whether existing trees will be saved or relocated (if avoidance is not an option). This will determine the prioritization of the level of required funding.

110.6 Preliminary Geometry

To establish geometry, the following activities should be accomplished or near completion:

(1) Supporting data such as surveys, traffic and pavement evaluation data.

(2) Typical sections and pavement design.

(3) Standards, Design Variations, and Design Exceptions.

(4) PD&E commitments addressed.

(5) Need for R/W phase addressed.

(6) Utility initial contact and survey data.

(7) Transit initial contact and facility location.

The initial engineering design activities to establish the preliminary project plans are:

(1) Set and calculate the horizontal alignment.

(2) Set the proposed profile grade lines.

(3) Develop preliminary cross sections at selected intervals or control locations.

(4) Develop preliminary layout of roadway, intersections, interchanges, transitions, and connections.

(5) Field review all proposed preliminary engineering layout and decisions for conflicts, R/W needs, connections, updates and additional needs.

The initial engineering review is used to obtain confirmation and approval of the objectives, scope, standards, decisions, and assumptions to be used as the basis for the engineering and design.

The above activities should result in the following:

(1) Structures can now be given the horizontal and vertical alignment and clearance requirements for bridges.

(2) R/W Engineering can be furnished with mainline R/W requirements for the project.

(3) Plan-profile sheets can be clipped.

(4) Traffic plans development can be initiated.

(5) Cross sections, grades and alignments, as required, can be provided to the drainage section.

(6) Work sheets, as needed, can be provided to the permits section for initial evaluation.

(7) Utility/Agency Owners (UAOs) can be provided plans, profiles and cross sections as required to identify/verify and designate their existing utilities as well as indicate proposed installations.

(8) The list of pay items can be loaded into Designer Interface by identifying the items of work involved at this stage of design.

(9) The need for noise barriers has been confirmed and locations established.