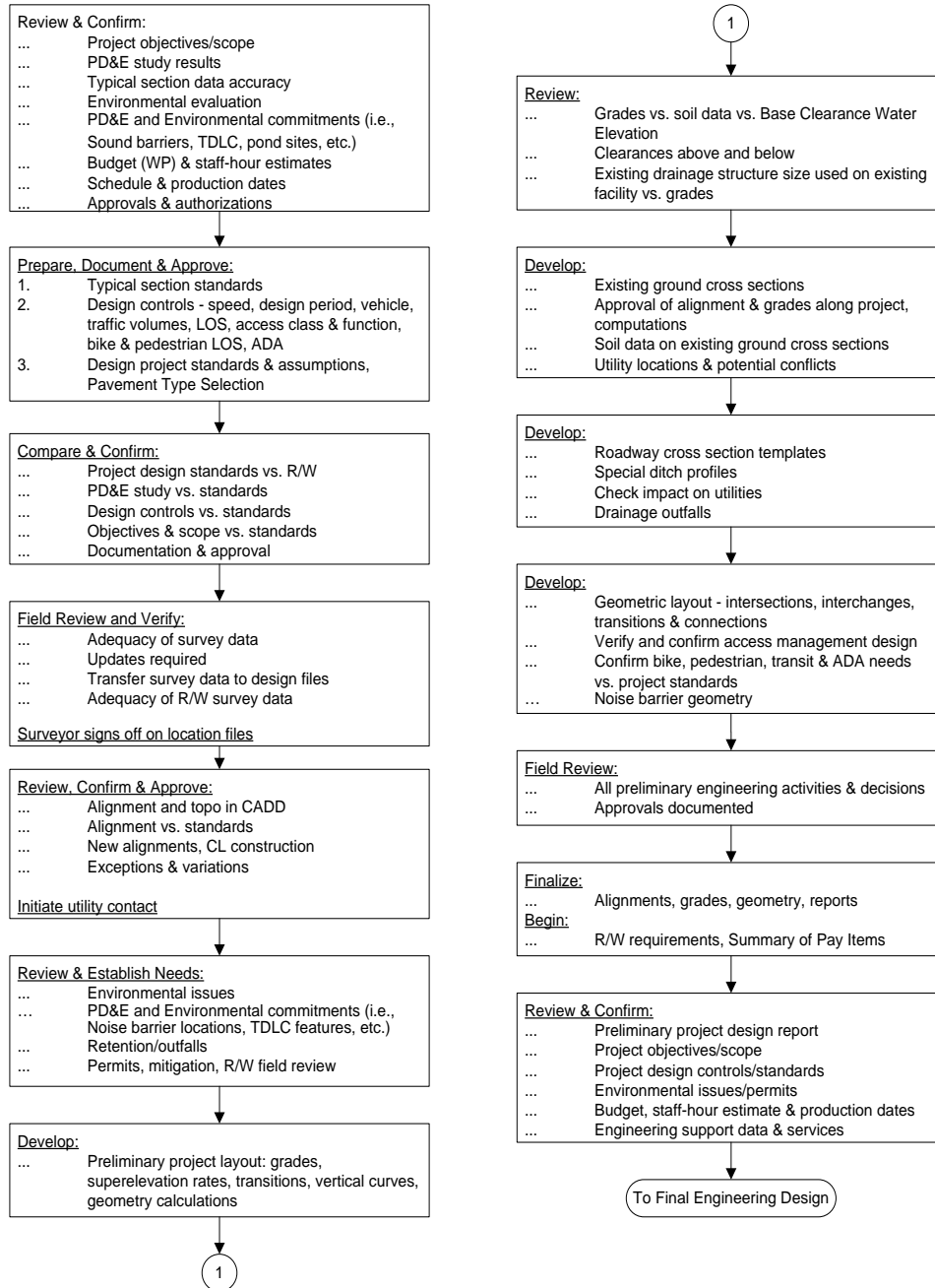


Chapter 13

Initial Engineering Design Process

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Exhibit 13-A Major Activities – Initial Engineering Process



Chapter 13

Initial Engineering Design Process

Modification for Non-Conventional Projects:

Delete *PPM* Chapter 13.

13.1 General

The engineering design process, as discussed in this and following chapters, includes the data gathering, development and contract preparation phase of highway construction projects. It begins with the approval of the Project Location/Design and ends with the construction letting. It also includes the 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 exercised by those responsible for the engineering design and plans preparation activities by having a plan-do-check routine for each and every significant task or operation.

The engineering and design activities and the schedules depend on the type of project and the required effort to accomplish the desired objectives. Projects can be designated as three basic types:

1. **New Construction** - A highway or bridge project along a new corridor on new alignments, horizontal and vertical.
2. **Add Lanes and Reconstruct** - A highway project along an existing facility to add lanes, widen or add bridges, improve intersections, and, in general, upgrade and improve the capacity and safety of the facility.
3. **Other Projects** - May include Resurfacing, Restoration and Rehabilitation (RRR), Local Agency Program (LAP), or other projects such as a highway and/or enhancement projects - A highway and/or bridge project undertaken to extend the service life of an existing facility and to enhance the safety of the facility. 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 projects.

13.2 Initial Engineering Design

It is important to distinguish the initial engineering design activities from planning and the preliminary engineering done during the Project Development and Environmental (PD&E) phase. If a PD&E phase has been completed, some of the activities discussed here 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. In the case where there was not a PD&E phase, the initial engineering design activities must establish the project scope, controls 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.

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. Develop and document a realistic staff-hour estimate and production schedule to accomplish the scope of activities identified.
3. Establish and document the design controls, assumptions, project design standards, Design Exceptions, and Design Variations. Significant changes to previously approved PD&E elements may result in a re-evaluation of the environmental document. Discuss with the District Environmental Management Office.
4. Identify all prior PD&E and environmental commitments such as the need to design and locate noise barriers (with insertion loss calculations), special pond site requirements, landscape or aesthetic considerations, transportation design for livable community issues, pedestrian and bicycle commitments, access commitments, wildlife management commitments, wetland issues, transit issues, etc.
5. Identify and document additional engineering, data gathering, and support services.
6. Determine and document the structural design requirements.
7. Determine and document if R/W is required.
8. Establish and document the review procedure and number of submittals, if different from guidelines provided in this manual.
9. Establish preliminary geometry, grades, and cross sections.
10. Identify and implement needed public involvement activities.
11. Develop Pavement Type Selection Report based on FDOT ***Pavement Type Selection Manual (Topic No. 625-010-005)***.

13.3 Scope, Objectives, Schedule and Budget

The project manager and other FDOT managers are responsible for the development, review and approval of the project objectives, scope of work, and schedule in accordance with the ***Project Management Guidelines***. They also must verify that required funds are in the work program.

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

1. Reviewing the PD&E study recommendations, conclusions and commitments, if they exist.
2. Performing a field review of the project with the project manager and personnel from other FDOT offices, such as Roadway Design, Traffic Operations, Safety, R/W Engineering, Utilities, Survey, Maintenance and Construction, as appropriate.
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, etc.
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/or updated by the engineer/project manager and approved by the appropriate district manager.
5. After consultant selection or in-house assignment, the designer or consultant should review and confirm the scope by completing steps one through four above.
6. The scope should anticipate and include the most cost effective methods that may be used in Subsurface Utility Engineering (SUE) for locating subsurface anomalies, structures, and utilities. Its use may affect the design process and should be considered in the scoping process. Selecting which methods to be employed should be accomplished by balancing risk versus benefit. Seldom will the use of only one method provide the most value. For example: Using radar tomography may have an initial higher cost but yield significantly more information much earlier in the design process which can facilitate drainage design, shorten the overall project time, reduce contractor risk, minimize redesign, and identify unknown facilities. Conversely, radar tomography has limited depth and resolution issues in a salt or high mineral environment, but other high technology methods exist and are worthy of consideration. The designer must recognize that SUE is a process that has many old and new technologies at its disposal. Consulting a SUE provider who can demonstrate state of the art knowledge will yield the most benefit.

13.4 Project Design Controls and Standards

Among the activities the Engineer of Record (EOR) will accomplish on a project are the identification of the given design controls and the selection of the appropriate design standards. These will be documented in the project file(s).

The design controls as addressed in this manual and AASHTO include such things as rights of way constraints, major utilities, design speed, design vehicle, design period, traffic volume and service level, functional classification of the corridor, the access class, and other factors that control the selection of project standards that will ensure the facility will function safely at the level desired and expected by the motorists.

Establishing the project standards is one of the first requirements of the engineering design process. The decisions, assumptions and calculations for the design are based on these factors. All project standards shall be documented in the project file(s).

The preliminary engineering report (PD&E) or concept report may include some of the controls and standards to be used on the project. These values should be reviewed, confirmed as valid and consistent with the overall corridor or system, and documented. Significant changes to approved PD&E elements of design may require a re-evaluation of the environmental document.

The Engineer of Record must coordinate with the District Design Engineer, the District Traffic Operations Engineer, and the responsible PD&E engineer to discuss the anticipated posted speed and determine the appropriate design speed for the project.

If project standards must be used that do not meet recommended values, these must be documented and receive approval/concurrence by the appropriate FDOT and/or FHWA engineer. These are either Design Exceptions or Design Variations as described in **Chapter 23** of this volume and must be maintained in the project file(s).

When all project standards are selected, documented, and agreed upon, the engineer should get the District Design Engineer to concur that the appropriate standards are being used. The Typical Section package will include some of the project standards. Those not included, and all known Design Exception/Design Variation justification shall be documented in the project file(s).

13.5 Support Services

Any information or support services that have been provided must be reviewed by the Engineer of Record to determine the completeness of the information. Conditions and data may have changed drastically if they are not current.

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)
5. Original Plans
6. Accident Data
7. Access Management Classification

During the design process, the project will require coordination with different sections or departments. 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 | 11. FHWA |
| 2. Surveying and Mapping | 12. Value Engineering |
| 3. Traffic Plans | 13. Traffic Operations |
| 4. Geotechnical | 14. Environmental Mgmt. Office |
| 5. Drainage | 15. Access Management |
| 6. Maintenance | 16. Structures |
| 7. Construction | 17. Safety |
| 8. Utilities | 18. Plans Review |
| 9. Estimates and Specifications | 19. Public Transportation Office |
| 10. Right Of Way | 20. District Landscape Architect |

13.5.1 Aviation and Spaceports Office Coordination

If it is determined that an airspace obstruction exists (based on the criteria contained in **Table 2.10.3**), refer to **Table 13.5.1** for applicable FAA notification guidelines. For guidelines on airspace obstruction permitting, refer to **Chapter 333, Florida Statutes, "Airport Zoning"**, and **Chapter 14-60, Florida Administrative Code, "Airport Licensing and Airspace Protection"**.

While the responsibility for filing FAA notifications and permitting applications for FDOT Airspace Obstruction Permits or Variances to the local ordinance rests with the Engineer of Record, the FDOT Aviation and Spaceports Office will provide technical assistance on planned projects to determine impact to the national airspace system in Florida. Please direct your request 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
Fax: (850) 414-4508
Internet: <http://www.dot.state.fl.us/Aviation/>

Table 13.5.1 Construction of Airspace Obstructions - Notification

FAA Notification

Federal law, **Title 14 Code of Federal Regulations (CFR), Federal Aviation Regulations (FAR), Part 77, "Objects Affecting Navigable Airspace"**, requires that prior notification must be given to the Federal Aviation Administration (FAA) regarding any construction or alteration of structures that meet specific criteria (See **Table 2.10.3**, this volume).

If FAA notification is required, **FAA Form 7460-1, "Notice of Proposed Construction or Alteration"** is submitted to the FAA Southern Regional Office in Atlanta. This notification 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.

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.

13.5.2 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.

13.5.2.1 Projects Involving Steel Bridges

For all projects that involve the repair, repainting or replacement of a steel bridge, the Design Project Manager shall contact the State Corrosion Engineer in the State Materials Office to determine if the bridge contains lead or other hazardous elements. The State Corrosion Engineer will furnish a site specific specification for disposition of the lead based paint waste for that particular project.

The Design Project Manager must provide the site specific specification to the Engineer of Record who is preparing the contract plans and specifications. The Engineer of Record must ensure that the project specifications conform to the site specific specifications 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.

13.5.2.2 Projects Involving Bridges with Asbestos Containing Materials

There may be asbestos containing materials used in bridges. For projects involving bridges that are to be either partially or fully demolished or renovated, the Project Manager must follow the Department Procedure on ***Asbestos on Bridges / Inspection, Abatement and Notification (Topic No. 625-020-020)*** which requires coordinating as early in the project as possible with the District Asbestos Coordinator for information on asbestos inspections, abatement and for notification requirements. Some bridge elements potentially containing asbestos include (but are not limited to) the following:

1. Tender House Roof Materials (felts, flashings, mastics, etc)
2. Tender House Floor Materials (tiles, sheet flooring, mastics, etc.)
3. Tender House Wall Materials (drywall muds, joint compounds, etc.)
4. Tender House Window Materials (caulks, gaskets, etc.)
5. Bridge Equipment Materials (gaskets, packings, linings, insulation, etc.)
6. MSE Wall Gaskets
7. Beam/Deck Bearing Pads
8. Asbestos-cement pipes (scuppers, etc.)
9. Bascule Bridge Machinery Brake Pads
10. Trowelled-on or Sprayed-on Decorative Coatings

13.5.2.3 Projects Involving Bridge Demolition

At or before the 30% plans phase, the Department shall 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 **Chapter 26**) 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/or 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**.

Section 13.5.2.2 contains additional requirements for projects involving bridge demolition.

13.5.3 Projects Involving Bridges Over Navigable Water

For projects involving bridges over navigable water, the 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 (i.e., 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.

13.5.4 Interstate Projects Affecting Logo Structures

Designers shall 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 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 of any affected logo structures shall be addressed in the plans. Logo structures requiring relocation will be paid for using pay item 700- 21- 40 (Multi-post Sign, Relocate). Logo structures requiring replacement will be paid for with the appropriate multi-post sign removal, and installation pay items.

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

<http://www.dot.state.fl.us/rightofway/LogoSignProgram.shtm>

13.5.5 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 **Design Standards** 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 shall 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 shall 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.

13.5.6 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.

13.6 Preliminary Geometry, Grades, and Cross Sections

To establish geometry, grades, and cross sections, 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 and environmental commitments addressed and if necessary, re-evaluation.
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 Engineer now has the decisions and direction necessary to perform final engineering. If this is not the case, the necessary initial engineering activities must be accomplished before continuing to the final design process.

The results of the above activities should be that:

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 TRNS*PORT pay item listing can be initiated by identifying the items of work involved at this point.
9. The need for noise barriers has been confirmed and locations established.

13.7 Distribution of Exempt Public Documents

It is the policy of the Department to protect the State Highway System's infrastructure by defining the responsibilities of disclosure and use of sensitive documents showing the structural elements used in the design and construction of Department structures. **Section 119.071(3)(b), F.S.**, provides that these sensitive documents are exempt from **Chapter 119, F.S., Florida's Public Record Law**. In accordance with **Section 119.07(3)(b), F.S.**, the Department has adopted **Procedure Topic No. 050-020-026, Distribution of Exempt Public Documents Concerning Department Structures and Security System Plans**, to define the method and responsibilities for disclosure and use of these sensitive documents.

Structure is defined in **Section 334.03(27), F.S.**, as "a bridge, viaduct, tunnel, causeway, approach, ferry slip, culvert, toll plaza, gate, or other similar facility used in connection with a transportation facility" which would include related pipes and pipe systems. However, for the purpose of the public records law and **Procedure 050-020-026**, the Department has determined that the term "structure" includes "bridges with an opening of more than 20 feet between undercopings of abutments or spring lines of arches or extreme ends of openings for multiple boxes, and those other bridges subject to safety inspection under **Section 335.074, F.S.**" A roadway is not otherwise a structure for the purposes of **Procedure 050-020-026**.

Therefore, plans, blueprints, schematic drawings and diagrams of structures owned by the Department are exempt from the public records provisions of **Chapter 119, F.S.** This exemption includes draft, preliminary and final formats as described in **Procedure 050-020-026** and includes paper, electronic, and other formats. The Department has provided for the limited release of such documents in **Procedure 050-020-026**.

Entities or persons outside the Department requesting or receiving copies of any portion of plans or other documents considered Exempt Documents under **Procedure 050-020-026** must complete a request form (**Form No. 050-020-26**). The form also advises the requestor that the entity or person receiving the documents shall maintain their exempt status. This procedure applies to all Department internal or contracted staff who have access to such Exempt Documents in their Department work. Refer to **Procedure 050-020-026** for additional requirements.

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