Chapter Eleven

PHASE I STUDIES

BUREAU OF DESIGN AND ENVIRONMENT MANUAL

Chapter Eleven
PHASE I STUDIES

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Chapter Eleven
PHASE I STUDIES

Chapter 11 discusses the goals and objectives of Phase I studies for projects administered by the Department. Phase I studies include both engineering and environmental studies, each requiring a separate decision-making process. Chapter 12 discusses the applicability of the various Phase I engineering report types, as well as their content, format, processing, and approval.

For the engineering and environmental analyses and any public involvement conducted in a Phase I study, Chapter 11 references the applicable chapters in the *BDE Manual* and other applicable documents (e.g., other Department manuals, FHWA publications).

11-1 GENERAL

11-1.01 <u>Phase I Studies</u>

11-1.01(a) Scope

Phase I work can vary from a very minor type study to an in-depth investigation of corridors, alternative alignments and cross sections, different highway types, and other design features with consideration of social, economic, environmental, and engineering factors. In addition, safety, serviceability, and economy must be considered during project development. The Phase I study should clearly describe the need for the improvement and how to implement the improvement in a logical and organized manner.

To effectively analyze a proposed improvement, coordinate and develop Phase I studies concurrently with public involvement activities and any required environmental analyses. The Phase I study will culminate in the completion of a Phase I report that documents the findings of the study. Chapter 12 describes the recommended content and format of, in addition to the submittal and approval processes for, the different types of Phase I engineering reports.

11-1.01(b) Purpose

Phase I studies are developed to ensure that, as practical, highway locations and proposed designs are consistent with Federal, State, and local goals and objectives. Consider the following when performing a Phase I study:

1. <u>Design Uniformity</u>. When conducting Phase I studies, ensure that proposed improvements will satisfy a need, are designed and constructed according to IDOT policies and criteria, and that uniform designs are used statewide. Designers must seek, however, to use all of the flexibility inherent in the policies included herein to craft the best possible solutions to identified transportation problems.

2. Public Involvement. Develop the final design in conformance with the public involvement requirements of Chapter 19.

3. Public Interest Considerations. Make final project decisions in the best overall public interest. A Phase I study should fully consider the need for safe and efficient transportation, public services, and the costs of eliminating or minimizing adverse impacts to the social and natural environment.

4. Adverse Effects of Project. Ensure that the potential adverse economic, social, and environmental effects of any proposed action have been fully considered. See Part III, Environmental Procedures.

11-1.01(c) Types of Phase I Studies

For complex projects, a separate corridor and design study may be required to determine the location and design of a proposed improvement. However, for minor type improvements only a separate Phase I engineering study is required. Depending upon the complexity and potential impact of a proposed improvement, the following types of Phase I studies are prepared:

1. Corridor Study. A corridor study is required for a complex highway project on new location of significant length and where alternative corridors are available. A corridor study will determine, in part, the selection of a specific corridor for the proposed highway. Alternative alignments should be developed within a general corridor location during the corridor study to determine the suitability of that corridor. These improvements typically will have a substantial social, economic, and environmental effect, or they will essentially change the layout or function of connecting roads and streets. The impacts of a complex highway project, such as a freeway on new location, will also require the preparation of a separate environmental document (normally an environmental impact statement (EIS)) to address the environmental issues of both the corridor and subsequent Phase I design studies.

2. Major Design Study. For complex highway projects requiring a separate corridor study, a Phase I design study is prepared after the corridor location has been selected and approved. The design study determines, in part, the specific alignments, profiles, and the major design features (e.g., typical sections, location and type of interchanges, road closures) of the proposed highway improvement. Because a separate environmental report is required with this category of work, environmental investigations are initiated during the corridor phase and are completed concurrently along with the design study.

3. Combined Design Study (Combined Corridor and Design Study). A combined design study is conducted for a proposed highway project within a predetermined highway corridor or location. The acceptability of the corridor or location usually results from a decision to use the existing highway alignment due to constraints imposed by land use and development, or due to the results of prior engineering studies (e.g., a transportation systems plan). For example, the reconstruction of an urban arterial highway requiring additional right-of-way and some business or residential relocations will normally be a

suitable project for a combined design study. Other examples include upgrading an existing two-lane rural highway to a four-lane expressway, the addition of an interchange, or a change in type for an existing interchange. For these types of projects, an environmental assessment (Chapter 24) is usually required. However, if significant impacts are known in advance, an EIS (Chapter 25) will be required.

4. Minor Design Study. For categorical exclusion type projects, conduct and document any necessary engineering and environmental analyses to substantiate the categorical exclusion determination; see Chapter 23. As discussed in Chapter 12, a Project Report, Abbreviated Project Report, 3P Report, or SMART Report will be prepared for this type of project. Examples of highway improvement types normally addressed include:

   - bridge rehabilitation or replacement projects,
   - intersection improvements,
   - most 3R projects, and
   - resurfacing of the existing traveled way with no other improvements.

5. Feasibility Study. A feasibility study is typically initiated to assess whether or not a proposed highway improvement warrants further study or whether additional Phase I engineering studies are needed. Feasibility studies typically are conducted to address the following types of questions:

   - Will a new four-lane highway or major river bridge promote economic development in a certain region of the State and create more benefits than costs, or would upgrading existing two-lane highways be a better solution for promoting economic development?
   - Is a missing link of a four-lane highway causing traffic operational problems, which, in turn, are creating a high number of crashes? Would a new four-lane highway or bypass alleviate the problem or would some other type of improvements be more cost effective?
   - Would it be possible and cost effective to build a new four-lane highway on new alignment through rugged terrain in comparison to upgrading the existing alignment? Also, what would be the projected benefits?
   - Will a new four-lane highway (typically an expressway) promote economic development in a certain region of the State and create more benefits than costs? With this scenario, there may be two closely spaced corridors (10 to 12 miles (15 to 20 km) apart) that tie into the same termini at each end. Both corridors are worthy of consideration for upgrading to a new four-lane highway and a determination is needed as to which corridor would provide more benefits. The feasibility study provides this answer and the need as to whether to proceed with location/design study type work in one corridor. However, to proceed with only one corridor, sufficient corridor environmental investigations must be completed, documented, and then carried forth into the location/design study phase.

- Other similar situations where additional information is needed before making a decision to proceed with more detailed engineering studies (e.g., major drainage alternatives, alternate locations for a proposed interchange).

A feasibility study can be similar to a corridor study.

11-1.02 <u>Social, Economic, and Environmental Considerations</u>

Part III, Environmental Procedures, discusses in detail the procedures for evaluating the social, economic, and environmental impacts of proposed actions. Consider the following items when developing a highway improvement:

- effects on regional and community growth;
- conservation and preservation of natural resources;
- public facilities, services, and recreational areas;
- community cohesion;
- displacement of people, businesses, and farms;
- air, noise, and water pollution; and
- aesthetic values.

The depth of environmental analysis will vary depending upon the scope and nature of the project, the location, the stage of project development, and the magnitude of any adverse impacts. For complex projects, the district will prepare a separate environmental document (i.e., an environmental impact statement or an environmental assessment). For categorical exclusion projects, the project report will document the environmental analysis.

11-2 DESIGN AND ENGINEERING CONSIDERATIONS

11-2.01 General

11-2.01(a) Scope

Phase I studies are used to identify the following:

- need for highway improvement,
- capacity deficiencies,
- need to improve safety,
- level of service,
- project termini,
- specific locations,
- design criteria,
- cross section elements,
- horizontal and vertical alignments,
- need for right-of-way,
- hydraulic design (drainage),
- need for intersection design/interchange designs,
- access control features or access management guidelines,
- location of bridge and traffic structures, and
- project costs.

The scope and depth of engineering analyses for Phase I studies will vary depending on the project scope of work. These studies may be less than that required for final plans, but they should be sufficiently accurate to preclude significant design or major cost estimate revisions during final construction plan preparation. When determining the scope, extent, and accuracy needed for a specific engineering study, the effects on adjacent property owners are often a good indicator.

11-2.01(b) Design Policies and Guidelines

One objective of a Phase I engineering study is to compare existing highway features (or topography and land use for possible new highway locations) to current design policies and criteria and then to determine the needed improvements that are cost and safety effective. This requires resourcefulness and engineering judgment in the development of alternatives and the preparation of project designs.

Location/design study personnel must ensure that major design decisions are finalized during the Phase I engineering studies. This minimizes the time and effort needed to prepare design details during final plan preparation in Phase II. Examine and document any design exceptions from current policies and explain the reasons for the variance; see Chapter 31. A few of the most frequently referenced policies and guidelines are as follows:

1. New Construction/Reconstruction. Part IV, Roadway Design Elements and Part V, Design of Highway Types provide cross section and alignment criteria for new construction projects on new location and for reconstruction projects.

2. Rehabilitation, Restoration, and Resurfacing (3R). Chapter 49 presents the Department 3R criteria for non-freeways, and Chapter 50 presents the Department 3R criteria for freeways.

3. Intersections/Interchanges. Chapters 36 and 37 provide design guidance for intersections and interchanges.

4. Access Control/Access Management. Chapter 35 presents Department policies and guidelines for the control of access on freeways and expressways and access management principles.

5. Bikeways/Pedestrians. Chapters 17, 48, and 58 present Department policies for the accommodation of bicyclists and pedestrians within the highway right-of-way.

6. Roadside Safety. Chapter 38 discusses the selection and layout of roadside safety appurtenances. The design policies for protective barriers (e.g., median barriers, longitudinal barriers, impact attenuators) included in Chapter 38 are for new construction/reconstruction projects. For 3R improvements, Chapters 49 and 50 present roadside safety design policies.

7. Structures. For the structural design and rehabilitation of existing bridges, the Bureau of Bridges and Structures maintains several manuals for design. For structure geometrics, Chapter 39 documents bridge width and vertical clearance criteria for new construction/reconstruction improvements. Chapters 49 and 50 present geometric design criteria for bridges within the limits of 3R projects.

8. Pavements. Chapters 52, 53, and 54 present information for determining pavement preservation, pavement rehabilitation, and pavement design, respectively.

9. Other Department Manuals/Publications. The Illinois Department of Transportation publishes and maintains a wide variety of engineering documents in addition to the *BDE Manual*. These address other aspects of roadway projects, including standards and specifications, policies for local roads and streets projects, land acquisition, surveying, CADD, traffic engineering, structural design, hydraulics, materials, and construction. Chapter 60 of the *BDE Manual* briefly describes these publications. As needed, the Phase I designer should review other Department manuals/publications for use in project evaluation.

To properly conduct engineering analyses and to develop a functional design, diverse sources of information must be used. This includes contact with Central Office and district bureaus. The designer must be familiar with data available from outside sources and needs to understand how to use the data. In addition, the designer must ensure that the scope, extent, and accuracy of the data requested from other sources are commensurate with the intended use of the engineering analysis being performed.

11-2.01(c) Phase I Study Procedures

The successful implementation of a Phase I study will depend upon timely coordination among all parties involved in the process. Chapters 2 and 3 present Phase I Project Development Networks that illustrate the proper interrelationships among the IDOT central office bureaus, the district, resource agencies, and the public for different types of projects. Depending on the scope of the project and design policies used, the Phase I designer should, as practical, use one of these networks.

11-2.02 Need for Highway Improvements

Engineering investigations in a Phase I study must determine if the proposed highway improvement satisfies the need for safe, economical, and efficient transportation and provides other relevant benefits (e.g., traffic benefits, public services, reduction of crashes, pedestrian facilities, and transit considerations). Having a clear and provable need will help the project avoid pitfalls later on. The following informational sources are important in establishing the need for the highway improvement.

11-2.02(a) Functional Classification

The Office of Planning and Programming has departmental responsibilities for functionally classifying all State highways. For information on functional classification, see the FHWA's document entitled, "*Highway Functional Classification Concepts, Criteria and Procedures",* 2013 Edition, available on the FHWA website *and IDOT's Five Year Classification Maps*, available on the IDOT website. Section 43-1 discusses the application of the functional classification system in Illinois for geometric design applications. All highway improvements must be compatible with the functional classification of the highway under design. A highway's functional classification and highway type are important factors in determining which design policies and criteria to use and for establishing programming priorities for new construction, reconstruction, or 3R type improvements.

11-2.02(b) Multi-Year Program

The Office of Planning and Programming annually issues the IDOT publication "Statewide Program Planning – Programming Guidelines." This usually occurs in the autumn of each year. This publication includes programming criteria for:

- improvement categories,
- pavement surface conditions,
- deficient bridges,

- safety improvements,
- Interstate rehabilitation,
- widening narrow and rough pavements,
- improving intersections and reducing traffic bottlenecks,
- new construction/reconstruction of major facilities,
- enhancement projects,
- Congestion Mitigation Air Quality (CMAQ) projects, and
- bicycle accommodation.

The publication also contains criteria for district selection of projects for inclusion in the annual and multi-year programs, such as bridge deficiencies for improvement eligibility when based upon highway classification and average daily traffic.

11-2.02(c) Highway Data Bank

The Office of Planning and Programming, Planning Systems Section, is responsible for maintaining and updating the Illinois Roadway Information System (IRIS,) and corresponding *Illinois Highway Information System Roadway Information and Procedure Manual*, in addition to the Illinois Structure Inventory System (ISIS) and corresponding *Illinois Highway Information System Structure Information and Procedure Manual*. Maintaining IRIS and ISIS is accomplished through the district data collection and highway field inventory operations. The Planning Systems Section can provide computer-generated route log listings for State routes, local roads, and municipal streets. The available data is dependent on the highway system. A key route number designates each roadway. IRIS contains information on roadway administrative classification, physical dimensions, characteristics, traffic data, pavement cross sections, pavement surface type, shoulder and median type, and historical construction information. ISIS contains detailed inspection and appraisal data, in addition to existing physical characteristics and historical construction information, on bridges and large culverts.

11-2.02(d) Urban Transportation Planning

The urban transportation planning process produces information on local governmental functions in urbanized areas of over 50,000 inhabitants. The Metropolitan Planning Organizations (MPOs) administer a continuing, cooperative, comprehensive transportation planning process that results in transportation improvement plans and programs consistent with the planned development of the urbanized areas. This process determines the transportation modal choice. In urbanized areas, Phase I reports should discuss the consistency of proposed improvements with local transportation planning agencies. Major urban freeway improvements shall meet joint FHWA/FTA regulations for major highway improvements in urban areas. The urban transportation planning process also can provide other social-economic-environmental-engineering information for Phase I studies.

11-2.02(e) Traffic-Carrying Capacity

A facility's current and future traffic-carrying capacity is one of the most critical elements for establishing the need for a highway improvement. Two elements impact this analysis:

1. Current and Projected Traffic Volumes. Under the general guidance of the Office of Planning and Programming (OP&P), the districts count and classify existing traffic volumes on the State highway system. OP&P also maintains data used to project future traffic volumes (i.e., annual traffic growth factors). The following data are available from the districts:

    - current hourly and daily traffic volumes,
    - current turning movement volumes,
    - traffic projections and assignments for new facilities, and
    - traffic projections for future design years on existing facilities.

    Similar data, developed in conjunction with the Urban Transportation Planning Process, also may be obtained from a local MPO. OP&P maintains a list of MPOs on the Department's webpage. Phase I reports should document current year average daily traffic (ADT), design year ADT, and design year 30th highest hourly traffic volumes (DHV). Also, provide the directional distribution factor and the percent of trucks for the proposed highway and for other affected facilities. Because the design of a project is so greatly dependent upon the projected design hourly volumes, these figures must be carefully examined and questioned before using for design purposes. Improper traffic projections can result in the assumption of unnecessary highway improvements.

2. Highway Capacity Studies. The desired level of service (LOS) (i.e., mobility and freedom from delay and congestion) for a State highway is determined by its functional classification and urban/rural location. The tables of geometric design criteria in Part V, Design of Highway Types present the Department's LOS criteria for each functional class. The *Highway Capacity Manual* provides the analytical techniques to determine the level of service for all highway elements (e.g., for basic segments, intersections, interchanges) for a given set of traffic and roadway conditions. For a major highway segment, for example, the capacity analysis will determine if an existing roadway will accommodate future traffic demands at the desired LOS or if roadway improvements are necessary (e.g., the addition of travel lanes). Section 31-4 discusses highway capacity analyses for Department projects in more detail.

11-2.02(f) Crash and Skid Reduction Analyses

The districts are able to access crash data through the use of GIS applications and the Safety DataMart, which are linked to the Bureau of Safety Programs and Engineering Crash Information System (CIS). The Bureau of Safety Programs and Engineering may also furnish the district with traffic crash information upon request. The following is a partial listing of available crash information for Phase I studies:

- State highway Five-Percent Report and computer-generated listings that report supplemental data for high-crash spots and roadway sections;
- county crash summaries;
- municipal crash summaries;
- reports which can be generated for individual locations, selected geometric feature, or type of crash:

  + Five-Percent Report,
  + Intersection Profile,
  + Segment Profile,
  + Location Summary,
  + Crash—One-Line Listing,
  + Intersection Summary,
  + Cross Tab—Time of Day by Severity,
  + Cross Tab—Crash Type by Severity,
  + Cross Tab—Conditions by Severity,
  + Cross Tab—Time of Day by Day of Week,
  + Roadway Description,
  + Roadway Summary, and
  + Deer/Vehicle Collisions.

- Statewide average crash rates (distributed annually for comparison with existing project crash rates for proposed improvement justification);
- collision diagram printouts for requested project locations, including intersections. Coding sheets are available for interpreting collision diagram printouts of vehicle maneuvers and involvements. Collision diagram summary sheets document percentages of collision types (on or off the roadway), weather conditions, and light conditions. Crash rates also may be requested for specific locations. Sufficient information is included to assist in manually drawing a collision diagram. Collision diagram computer plots also may be requested for intersections;
- individual crash reports at specific locations (upon request from a microfilm or imaging retrieval system);
- summaries of Motor Vehicle Traffic Crashes and Class of Trafficway (statewide average percentages) by type of collision, light condition, and road surface (these percentages may be compared with project percentages from collision diagram summary sheets to help identify over-represented crash patterns).

The Phase I study should include, as appropriate, the following crash analyses to assist in demonstrating the need for a highway improvement:

1. Spot Map. Provide a crash spot map as basic crash information in the Phase I report. As applicable, also include a comparison of the calculated project crash rates with the statewide average crash rates for the same class of highway. Collision diagram summary sheet percentages also may be compared with statewide averages.

2. High-Crash/Crash Pattern Analyses. In the Phase I study, identify Five-Percent Report locations, rates, and all crash patterns (e.g., fixed objects, sideswipes, rear-ends, overturns, wet-weather, night-time, etc.) at various sites throughout the project. Also, include schematic collision diagrams, results of field checks, crash analyses, and recommended countermeasures for these items, or provide a statement that no high-crash locations or other crash patterns exist along the proposed improvement.

   For projects with a high percentage of wet-weather crashes, include friction numbers, if available, in the analysis of critical wet-pavement crash locations. Also include existing and projected traffic volumes, existing geometric features, and countermeasure alternative(s) such as grooving, reprofiling, and/or high-friction resurfacing. Specify a high-friction resurfacing type and mix design during Phase II.

3. Time Period. Analyze the traffic crash data available for the most recent five years and update the data accordingly. Notify BDE of any resultant changes to project design elements, if appropriate.

4. IDOT Procedures. See Chapter 12 for a discussion on processing Phase I reports for the "Highway Safety Improvement Program" at isolated Five-Percent Report locations identified and selected for the Illinois Safety Improvement Program. Include project/program sheets in the Phase I report, with benefit/cost ratio calculations and district safety committee signatures.

5. Other Publications. For additional information on analyzing crash patterns, see the Institute of Transportation Engineers (ITE) publications *Manual of Transportation Engineering Studies* and *Traffic Engineering Handbook,* the FHWA publication *Highway Safety Engineering Studies Procedural Guide, or the Highway Safety Manual (HSM)*.

11-2.02(g) Pavement Condition

The Condition Rating Survey (CRS) is performed biennially by the districts in cooperation with the Office of Planning and Programming. This information is most often used to determine the extent of pavement rehabilitation for a 3R project, or eligibility for potential SMART or 3P resurfacing projects. All State highway pavements are rated on a scale from 1.0 (poorest) to 9.0 (best) that measures pavement serviceability based upon cracking, patching, potholes, rutting, deterioration, maintenance, and visual physical condition. Resurfacing and rehabilitation needs may be determined from the surface condition rating in combination with the functional classification criteria and the traffic volume/crash criteria presented in the multi-year program. Include the most recent CRS values for pavement improvement eligibility in the Phase I report. See Chapter 53 for more information on pavement condition surveys and pavement rehabilitation strategies.

11-2.02(h) Bridge Condition Information

For existing bridges within the limits of a proposed project, coordinate with bridge maintenance engineer to obtain information on the bridge condition and to prepare a Bridge Condition Report; see Section 39-3. Identify any deficiencies in a bridge's physical condition and load-carrying capacity. Also, contact the Bureau of Bridges and Structures for inventory and operating load ratings and the results of physical inspection ratings for the substructure and superstructure. Determine any bridge improvement needs from this information and the multi-year program.

11-2.03 Access Control/Access Management

Access control features are dependent upon a variety of factors (e.g., type of highway, either freeway or expressway, urban/rural location) and will affect traffic benefits, access to adjacent properties, and right-of-way costs. Proposed access control features for freeways or expressways must be determined for public presentation and discussion because of their effects on adjacent properties. The *BDE Manual* discusses access control elements and access management concepts in several locations. These are summarized as follows:

11-2.03(a) Overall Policy

Chapter 35 presents the overall Departmental policies and guidelines for access control and access management on the State highway system. This includes:

- definitions of access control terms,
- access control at interchange crossroads,
- access control along expressways and at sideroads,
- the development of access control plans, and
- access management concepts and techniques.

11-2.03(b) Highway Type

The tables of geometric design criteria in Chapters 44 through 48 interrelate access control or access management with highway functional classification (i.e., principal and minor arterials, and collectors). Section 43-1 discusses, in general, the relationship between access, mobility, and functional classification.

11-2.03(c) Median Crossovers and Openings

These are discussed in various locations in the *BDE Manual* as follows:

- Section 44-2.04 discusses median crossovers on freeways.
- Chapter 45 discusses median crossovers on expressways.
- Chapter 46 discusses median openings on Strategic Regional Arterials.

- Chapters 34 and 36 discuss median openings on all other facilities.

11-2.03(d) Frontage Roads/Service Drives

Frontage roads and service drives and how they relate to access control are discussed in Sections 44-2.05 (freeways) and 45-2 (expressways).

11-2.03(e) Driveways

Locate driveways to provide good service to users while simultaneously minimizing interference to highway traffic. The *Policy on Permits for Access Driveways to State Highways,* (92 Ill. Admin. Code 550) provides guidance for driveway design in conjunction with the permit process and may be used as a starting point for developing access management studies.

11-2.03(f) Changes in Access

For new or revised points of access to an existing freeway, see Section 37-1. For changes in access control along an expressway, see Section 45-2.04.

11-2.03(g) Signing Policies

For the current IDOT policies on signing of access controlled highways, see the Bureau of Operations *Traffic Policies and Procedures Manual*.

11-2.04 Geometric Design Criteria

Part IV, Roadway Design Elements and Part V, Design of Highway Types of the *BDE Manual* present the Department's geometric design criteria for the different types of highways. This is an important element for all Phase I studies. The following sections briefly summarize the information in Parts IV and V.

11-2.04(a) Basic Design Controls

Chapter 31 discusses the design controls that have an overall impact on the geometric design of a highway facility; therefore, this is an important chapter for Phase I studies. As discussed in Chapter 31 and as appropriate, the designer should evaluate the following:

1. Project Scope of Work. Section 31-6 defines the following project scopes of work:

   - new construction,
   - reconstruction,
   - 3R (non-freeways), and

- 3R (freeways).

The project scope of work will be determined before the initiation of a Phase I study. The definitions in Section 31-6 indicate the conceptual objective of the project under study.

2. Design Speed. This is a critical highway design element and is selected before initiating any studies. Section 31-2 discusses the overall philosophy in design speed selection. Chapters 44 through 50 present specific numerical criteria for project design speed based on functional classification, highway type, urban/rural location, and project scope of work.

3. Traffic Volume Analysis. Section 31-4 provides definitions of highway capacity terms and selection of the design year and design hourly volume for highway capacity analyses. It references the *Highway Capacity Manual* for detailed highway capacity techniques.

4. Sight Distances. Stopping sight distance (SSD) is a determining factor in an acceptable highway design, especially for vertical alignment. Section 31-3 presents Department criteria for SSD based on design speed. Other sight distances which may be applicable are:

   - decision sight distance,
   - intersection sight distance, and
   - passing sight distance.

5. Design Exceptions. Section 31-7 describes the Department's process for justifying and approving design exceptions to geometric design criteria on its roadway projects. There are two categories of design exceptions:

   a. Level One. Level One design exceptions involve the controlling design criteria established by FHWA, but only on the interstate system, pursuant to the FHWA/IDOT Stewardship and Oversight Agreement. When not met, Level One design exceptions require documentation and justification by the district, concurrence by BDE, and formal approval by FHWA.

   b. Level Two. Level Two design exceptions involve two distinct sub-sets. In addition to the 13 FHWA controlling design criteria for projects off the interstate system, Level Two design criteria are also design criteria identified by IDOT, on both interstate and non-interstate projects. When not met, Level Two design exceptions require documentation and justification by the district and formal approval by BDE only.

11-2.04(b) Horizontal Alignment

Chapter 32 discusses horizontal alignment for new construction/reconstruction projects in general. A significant portion of this chapter applies to the Phase II detailed design (e.g., superelevation development, mathematical details for horizontal curves). However, during Phase I studies, the designer should review and evaluate the following based on Chapter 32 and Section 48-5:

1. General Design Controls. The overall horizontal alignment of a highway facility impacts the safe and efficient flow of traffic and the aesthetic appeal of the facility. Section 32-5 presents several general design controls for horizontal alignment that will enhance the performance of the highway (e.g., avoidance of alignment reversals and broken-back curvature). The designer should ensure that alignment development is consistent with these goals.

2. Minimum Radii. Section 32-2 presents minimum radii for horizontal curves assuming open-roadway conditions, which applies to high-speed urban facilities and all rural facilities. When developing and evaluating alternative alignments in Phase I, the designer should, as practical, avoid the use of minimum radii. Section 48-5.03 discusses design criteria for horizontal curves for low-speed conditions ($V \leq 45$ mph (70 km/h)).

3. Coordination with Vertical Alignment. See Section 11-2.04(c) and Chapter 33.

11-2.04(c) Vertical Alignment

Chapter 33 discusses vertical alignment for new construction/reconstruction projects. A portion of this chapter applies to the Phase II detailed design (e.g., mathematical details for vertical curves). However, the majority of Chapter 33 applies to the decision-making during Phase I studies. This reflects the significant impact that vertical alignment has on a highway’s safety, aesthetics, operations, and costs. Therefore, the Phase I designer must carefully review the following from Chapter 33 before proceeding with alignment development:

1. General Design Controls/Coordination with Horizontal Alignment. Sections 33-6.01 and 33-6.02 present several general design controls for vertical alignment (e.g., avoidance of roller-coaster profile) and in coordination with horizontal alignment (e.g., balance between horizontal and vertical curvature). Using these controls will enhance the overall design of the highway. The designer should ensure that profile development is consistent with these goals.

2. Aesthetics. The combined effect of horizontal and vertical alignment on highway aesthetics is considered to be very important. A highway alignment should fit gracefully into its surroundings and become an integrated component of the natural landscape. The guidance in Section 33-6.03 describes how to accomplish this objective.

3. Maximum/Minimum Grades. Section 33-2 discusses, in general, the use of maximum and minimum grades. These values determine the limits of vertical profiles studied in Phase I. Avoid the use of maximum grades, as practical. Chapters 44 through 48 present specific criteria for maximum and minimum grades based on highway types, design speed, and urban/rural location.

4. Minimum Vertical Curvature. Section 33-4 presents K-values for minimum curvature at crest and sag vertical curves, which are based on minimum stopping sight distances. When developing and evaluating alternative profiles for new construction and reconstruction projects, the designer should, as practical, avoid the use of minimum vertical curvature.

5. Truck-Climbing Lanes. Section 33-3 presents the warrants and design of truck-climbing lanes. If truck-climbing lanes are warranted, the designer should determine the critical design elements (e.g., starting and ending points, width).

6. Vertical Clearances. Section 33-5 discusses vertical clearances in general, and Chapters 39 and 44 through 50 present specific clearance criteria based on highway type, urban/rural location, highway feature crossed (e.g., highway bridges, railroads, traffic signals), and the type of proposed improvement. Profiles must meet the vertical clearance criteria listed in these chapters.

7. Gradelines. In addition to previously discussed elements, the proper selection of the gradeline in Phase I will depend on many other factors (e.g., geotechnical, right-of-way impacts, snow drifting, drainage, earthwork balance). Section 33-6.04 discusses the evaluation of these factors in selecting a profile gradeline.

11-2.04(d) Cross Section Elements

Chapter 34 presents the Department's general criteria for cross section elements, and Chapters 44 through 48 present specific numerical criteria for cross sections based on highway type, design speed, traffic volumes, and urban/rural location. The designer must review the cross section criteria in these chapters and determine the most appropriate design for the given conditions. The selected roadway cross section will determine the type of operations, maximum allowable design speed, safety, costs, and right-of-way needs of a highway facility. The proposed typical section must identify:

- the number and width of travel lanes;
- the selection of an urban (curbed) or rural section;
- the shoulder width, if applicable;
- cross slopes;
- the type and width of median;
- parking lanes, if applicable;
- sidewalks and bike lanes/paths, if applicable;
- side slope configuration (i.e., fill slopes, cut slopes, roadside ditches);
- right-of-way width; and

- type and thickness of pavement.

11-2.04(e) Intersections

Chapter 36 presents the Department's criteria for the design of intersections. Chapter 14 specifically discusses the warrants and the criteria for the preparation of an Intersection Design Study (IDS). If IDSs are required with a project, the IDSs shall reflect the latest design alternative if displayed at a public hearing. The IDSs must be labeled as a draft version if it is not approved.

11-2.04(f) Interchanges

Chapter 37 presents the Department's criteria for the design and layout of interchanges. In some cases, type approval may be required before proceeding with detailed design. Chapter 15 discusses the warrants for an interchange and the criteria for the preparation of an Interchange Design Study (IDS). If IDSs are required with a project report, the IDSs shall reflect the latest design alternative if displayed at a public hearing. The IDSs must be labeled as a draft if it is not approved.

11-2.04(g) Roadside Safety

Chapter 38 presents the Department's criteria for roadside safety, including clear zones, barrier warrants, barrier design and layout, impact attenuators, and glare screens. Most of the information in Chapter 38 is applicable to the detailed design completed in Phase II. During a Phase I study, however, the designer should evaluate and establish the following:

1. <u>Clear Zones</u>. Section 38-3 presents the Department's clear zone criteria for new construction/ reconstruction projects. The applicable clear zone should be identified in Phase I. This will determine, in part, right-of-way needs and utility impacts.

2. <u>Median Barrier Warrants</u>. Section 38-7 discusses the Department's warrants for median barriers based on the median width and traffic volumes. The Phase I study should identify whether or not a median barrier is warranted.

3. <u>Roadside Barrier Warrants</u>. Section 38-4 discusses roadside barrier warrants. In general, the preferred design is to provide a roadside configuration and clearance that eliminates the need for roadside barriers. The typical section and alignment decisions made during Phase I must include the determination of the need for roadside barriers. Also, during Phase I a determination of the roadside barrier length may be included. Therefore, the Phase I study should, as practical, seek to find the balance between providing a safe roadside (which tends to increase project costs) and limiting construction, right-of-way, and environmental impacts (which tends to decrease roadside safety). Review Section 38-4.03, which discusses the Department's policies on roadside barrier warrants and cost-effective analyses.

11-2.04(h) Design of New Construction/Reconstruction Projects

In the Phase I study, use the appropriate chapter in Part V that corresponds to the type of facility under design.

Part V Highway Systems presents the following chapters based on functional classification and highway type for new construction or reconstruction type projects:

- Chapter 44, Rural and Urban Freeways,
- Chapter 45, Expressways,
- Chapter 46, Strategic Regional Arterials,
- Chapter 47, Rural Two-Lane/Multilane State Highways, and
- Chapter 48, Urban Highways and Streets.

These chapters are structured to present specific numerical criteria for each highway type and reference the chapters in Part IV, Roadway Design Elements for detailed information on specific geometric design elements (e.g., horizontal alignment). Chapters 44 through 48 also discuss geometric design features that are unique to a certain type of facility. For example, Chapter 44 discusses frontage roads adjacent to freeways, and Chapter 48 discusses urban design features (e.g., parking lanes, sidewalks, horizontal alignment on low-speed urban streets).

11-2.04(i) Design of 3R Projects

The applicable chapters in Part IV, “Roadway Design Elements” and Part V, “Highway Systems” present the Department’s design criteria that apply to new construction/reconstruction projects. For these projects, the designer often has the liberty of designing the highway to meet the most desirable criteria. However, available finances do not always permit the reconstruction of existing highways to this level.

Therefore, the geometric design of projects on existing highways must be viewed from a different perspective. These projects are often initiated for reasons other than geometric design deficiencies (e.g., pavement deterioration, crashes), and they often must be designed within existing right-of-way, with financial limitations, and environmental constraints. As a result, the design criteria for new construction and reconstruction are often not attainable without major cost and, frequently, adverse impacts. At the same time, however, the Department must make cost-effective and practical improvements to existing highways and streets.

For these reasons, the Department has adopted separate geometric design guidelines for 3R projects on existing highways. Chapter 49 presents guidelines for 3R projects on rural and urban highways, and Chapter 50 presents guidelines for 3R freeway projects. These guidelines are intended to find a balance among many competing and conflicting objectives. These include the objective of improving the riding surface; minimizing adverse impacts of highway construction on adjacent lands; targeting improvements where ADT is higher or safety performance is lacking, and improving the greatest number of miles (kilometers) with available funding.

Phase I studies for 3R projects will be based on the guidelines discussed in Chapters 49 and 50.

11-2.04(j) Design of 3P and SMART Projects

Chapter 52 presents the guidelines for SMART projects, as well as other pavement preservation strategies, which are intended to extend the service life of the pavement without significantly increasing its structural capacity. Chapter 53 presents the guidelines for 3P projects, as well as other methods of pavement rehabilitation, which are intended to address specific pavement deficiencies. Typically the scope of SMART and 3P project includes only ancillary items beyond resurfacing and does not include geometric improvements.

11-2.05 Hydraulics (Drainage)

For the hydraulic evaluations in conjunction with a Phase I study, use the following references:

1. *IDOT Drainage Manual*. The Bureau of Bridges and Structures is responsible for the *Drainage Manual*. The Manual is a compilation of Department policies and criteria on drainage and hydraulics for road and bridge projects. The *Drainage Manual* discusses:

   - division of responsibility for drainage;
   - legal requirements;
   - drainage policies;
   - permits;
   - preparation of drainage studies and hydraulic reports;
   - floodplain encroachments (hydraulic analysis);
   - hydrology;
   - open channel flow;
   - culvert hydraulics;
   - bridge hydraulics;
   - storm sewers;
   - encroachment onto traveled way adjacent to curb and gutter;
   - inlet spacing;
   - roadside ditches;
   - erosion and sediment control;
   - scour;
   - detention storage;
   - pumping stations; and
   - rules for construction in rivers, lakes, and streams.

2. Drainage Procedures. Chapter 40 of the *BDE Manual* discusses those procedures related to the evaluation of drainage design in a Phase I study. This includes the division of responsibility between the districts and Central Office, scope of the Drainage Study, and general drainage considerations in the design of highway projects.

3. Floodplain Finding. The *IDOT Drainage Manual* provides the hydrological requirements for a floodplain study. Section 26-7 of the *BDE Manual* provides guidance for the environmental documentation required for projects that will involve a significant floodplain encroachment.

4. Hydraulic-Related Permits. These include permits for Section 404, Section 9, Section 401, Section 402 (NPDES) and IDNR Construction in Floodways. Chapter 28 of the *BDE Manual* briefly discusses each of these permits.

11-2.06 Traffic Engineering

The Bureau of Operations has the primary responsibility for traffic engineering analyses on State highway projects. These responsibilities include:

- warrants and phasing for traffic signals;
- warrants, design, and placement for highway signs and pavement markings; and
- traffic engineering investigations (e.g., speed studies, school zone studies).

Many traffic engineering elements are addressed during detailed design in Phase II (e.g., selection and location of traffic signs and pavement markings). However, as appropriate for the project scope of work and a Phase I study, the designer will evaluate those traffic engineering factors which will impact the decision-making in Phase I (e.g., traffic signal warrants, preliminary signing plans for freeways and expressways). Chapter 57 of the *BDE Manual* provides guidance on traffic engineering issues important to highway design, and it references documents published by the Bureau of Operations for more detailed information.

11-2.07 Structures

The Bureau of Bridges and Structures is responsible for the design of highway structures (e.g., bridges, culverts, retaining walls). As appropriate for the project scope of work and a Phase I study, the designer will evaluate those structural factors that are appropriate for these studies. Section 39-3 of the *BDE Manual* discusses the bridge planning process, which documents:

- the necessary coordination between parties to identify needed bridge improvements,
- the preparation of a Bridge Condition Report and proposed Bridge Drawing,
- preliminary bridge investigations, and
- the preparation of Type, Size, and Location Plans for Phase II work.

The proper implementation of the bridge planning process will ensure that appropriate structural considerations are reflected in a Phase I study. This includes geotechnical, hydraulic, environmental, right-of-way, costs, and aesthetic factors. In addition, Section 39-4 presents the Department's criteria for bridge geometrics (e.g., widths, clearance).

11-2.08 Miscellaneous Highway Features

The Phase I study should reflect, as appropriate, other highway features as follows:

11-2.08(a) Utilities

The Illinois Administrative Code (92 Ill. Admin. Code 530) sets forth the requirements for the accommodation of utilities on the right-of-way of the Illinois highway system. The Bureau of Operations should be contacted for policies on the location of utilities (e.g., with respect to the roadside clear zone). Consider provisions for utilities when determining approximate project right-of-way requirements during the Phase I study. See Chapter 6 for utility adjustments required for highway improvements. Describe all utility locations and any proposed modifications, changes, or multiple uses of right-of-way, including a division of the estimated adjustment costs.

11-2.08(b) Railroads

The Phase I study must identify all railroad crossings within the proposed project limits, and it must determine if each crossing will be at-grade or grade separated. This will be a collaborative effort between the Department, the affected railroad, and the Illinois Commerce Commission. For existing crossings, the Phase I report should document the number of trains/day, the existing warning devices, the crash history, and the geometrics at the crossing. In most cases for at-grade crossings, it will be appropriate in Phase I to specifically determine the type of warning devices at the crossing (e.g., automatic gates, flashing signals). Section 7-3 provides additional information on the design of highway/railroad crossings.

11-2.08(c) Weigh Stations and Rest Areas

See Chapter 16 for guidance when a proposed project involves a weigh station or rest area. Analyze access and other design considerations (including effects on highway alignment and grade) where weigh stations, rest areas, or rest stops are proposed.

11-2.08(d) Lighting

Consult Chapter 56 for warrants for highway lighting and illumination. Describe existing and proposed illumination levels including uniformity ratios and glare levels. Provide descriptions of crash rates, night/day crash ratios, and illumination of adjacent highway sections, as necessary, to demonstrate the need for proposed lighting improvements.

11-2.08(e) Sidewalks and Pedestrians

See Chapter 17 for information on pedestrian accommodations and Chapter 48 for warrants and the design of sidewalks within the roadway cross section. Also, see Chapter 39 for sidewalks or bikeways on bridges. Describe the reasons for providing, or not providing, sidewalks and the coordination needed with local governmental units. See Chapter 58 for additional discussion on sidewalks and ADA compliance. The Phase I report must discuss any requests and the justification for deviations from the participation policies for sidewalks as discussed in Chapter 5 on Local Agency Agreements.

11-2.08(f) ADA

Chapter 58 discusses the Department's implementation of the Americans with Disabilities Act (ADA). The Phase I report must contain a discussion on satisfying ADA requirements including, if applicable, coordination with local officials. Any Intersection Design Study (see Chapter 14) prepared in Phase I must indicate the location of the curb cuts/ramps or other accommodations to be provided. The Phase I report also must discuss any request for a design exception from Department policies on accommodating disabled individuals and the justification for the request; see Section 31-7.04(c).

11-2.08(g) Landscaping/Stormwater Pollution Control

Consult the District Landscape Architect for tree removal/replacement, revegetation/erosion control, and other landscaping features and document the recommendations in the Phase I report. To avoid duplication, information contained in environmental documents that has been developed according to Section 26-17 and Sections 24-3.02(e) and 25-3.08(r) (e.g., environmental commitments and mitigation) should be referenced. Also, review Chapter 59 for guidance on landscaping and Chapter 41 for stormwater pollution control.

11-2.08(h) Existing Public Educational Facility Entrances

1. <u>Background</u>. Public Act 95-0271 amended the Department of Transportation Law of the Civil Administrative Code of Illinois by adding Section 2705-580 (20 ILCS 2705/2705-580) as follows:

   > "As part of State highway construction projects, the Department shall evaluate, fund, and repair, within the right-of-way, the entrances to public educational facilities that border State highways."

2. <u>Procedures</u>. The following procedures apply to all State highway projects with a public educational facility entrance onto a state highway. For the purpose of this policy the word "evaluate" shall mean to examine the existing public educational facility entrance and to determine any deficiencies and repairs needed as part of the roadway project. The intent is to improve the condition of such existing entrances, if unsatisfactory, as part of an improvement of the roadway onto which the entrances abut, consistent with the scope of the mainline improvement. For instance, it would not be appropriate to improve the unsatisfactory roadway surface condition of an entrance if the mainline project scope is only installation or modification of traffic signals.

a. Phase I Studies and Reports. The Phase I study and engineering report shall evaluate and document any entrance for a public educational facility that enters onto the project roadway.

b. New Construction/Reconstruction Projects. For these types of projects, the procedures for designing entrances and side roads as outlined in the *BDE Manual* and the *Handbook for the Policy on Permits for Access Driveways to State Highways* would apply. The entrance should be evaluated and a design provided based on operational needs, turning radii, left and right turn movements, safety, drop-off/pick-up zones, and accessibility for pedestrians, bicyclists, and persons with disabilities.

   Reconstruction types of projects are not limited to the existing right-of-way, but the entrance construction should not be the main reason for the right-of-way acquisition. If the reconstruction project could be done without any reconstruction or other upgrade to an existing public education facility entrance, such entrances should still be evaluated and repaired as necessary within the existing right-of-way, as described above.

c. 3R Projects. Use the same procedures as that for New Construction/Reconstruction Projects.

d. Pavement Rehabilitation and Preservation Projects. For pavement rehabilitation and preservation projects that are generally considered to be resurfacing only, such as 3P or SMART, the entrance to the public educational facility should be evaluated and any repairs/resurfacing should be extended to the right-of-way limits. The work shall be consistent with the work allowed by this type of project and in most cases match the existing grade and surface of the entrance.

11-2.09 Maintenance Considerations

See the FHWA publication *Integration of Maintenance Needs into Preconstruction Procedures*, Report No. FHWA-TS-78-216, for information on highway maintenance as it pertains to highway design. The section of this publication entitled “Maintainability Considerations in Highway Planning” provides guidelines for highway maintenance considerations related to highway location, right-of-way, and geometrics. Also, see NCHRP Report 349*, Incorporation of Maintenance Considerations in Highway Design*. In addition, develop Phase I studies in cooperation with bridge and highway maintenance personnel who are responsible for the highway section under design.

11-2.10 Geotechnical Considerations

See the IDOT *Geotechnical Manual* for information on geotechnical considerations. The Bureau of Materials and Physical Research maintains the *Geotechnical Manual*. The following applies:

1. Chapter 1, Geotechnical Investigations and Chapter 3, Geotechnical Analysis. These chapters provide guidelines to adequately assess the subsurface conditions on highway projects and to identify the soil and foundation concerns that need to be evaluated for structural support. This information facilitates preliminary highway location or design and can assist in determining the economies of various alignments considering soils and geology. Upon determining the general alignment, the data also assists in selecting the proposed gradeline.

2. Chapter 4, "Design Recommendations". This chapter describes design recommendations and reflects the conclusion of field and laboratory investigations and any office work. The conclusions are documented in a Geotechnical Report. The Soils Committee reviews district- or consultant-prepared Geotechnical Reports for proposed highway improvements. The district initiates the requests for reviews.

Conduct Phase I studies in cooperation with soils specialists and geologists when these disciplines influence the location and/or design of a proposed improvement. Also, the location of foundations for structures or high embankments may be an important item in the highway location.

11-2.11 Agreements

Consult with the Agreements Unit in BDE during the preparation of Phase I studies to determine if any agreements will be necessary. Depending upon the nature of the project, one or more of the following agreements may be necessary:

11-2.11(a) Local Agency Agreements

In general, agreements will be required with a local agency whenever it will participate in the improvement of a State route within its boundaries. Local agency participation may be a contribution of materials, services, or money (e.g., right-of-way, preliminary engineering, local funds). Although the Agreements Unit has the primary responsibility for processing local agency agreements after design approval, some agreements may depend in part upon decisions reached during the Phase I study. See Chapter 5 for information on local agency agreements. The agreement, or Letter of Understanding, will also define the division of costs between the State and local agency and the respective responsibilities for a variety of project elements and any maintenance or jurisdictional transfers.

11-2.11(b) Utility Agreements

A Utility Agreement will be necessary on all State highway projects that require an adjustment of a public or private utility. Chapter 6 documents the policies and procedures that apply to utility adjustments on Department projects. This chapter discusses Department reimbursement policies, procedures for agreement processing, the preparation of utility plans, and the preparation of cost estimates for utility adjustments.

11-2.11(c) Railroad Agreements

A Railroad Agreement will be necessary on all State highway projects that impact railroad right-of-way, either at a highway-railroad grade crossing or a grade-separation between a highway and railroad. Chapter 7 documents the policies and procedures for work that impacts railroad right-of-way. This chapter also discusses division of costs between the Department and Railroad, procedures for processing the agreement, and other activities related to railroads (e.g., removing abandoned highway-railroad crossings, preliminary engineering for design, and acquisition of railroad property).

The Phase I report should document the reasons for any deviations from current Department policies for these agreements, and it should describe the necessary coordination with the district and other affected entities. In addition, discuss the coordination with local officials, utility companies, and railroads that might affect the preparation of any agreements. Develop cost estimates for the Phase I study consistent with the division of costs between the State and other entities involved in the work. Also, describe any commitments made with the local agency, utility companies, or railroad.

11-2.12 <u>Right-of-Way Issues</u>

The district Land Acquisition Section develops preliminary right-of-way cost estimates and relocation assistance plans as necessary and in accordance with the *Land Acquisition Policies and Procedures Manual*.

Right-of-way costs are determined on a per acre (hectare) basis or on a parcel-by-parcel basis and include costs for displaced persons as a result of a proposed highway improvement. For projects where relocations are anticipated, it is a good practice to estimate the cost of each relocation when finalizing the overall right-of-way project cost estimate. The steps in the land acquisition process are shown in the *Land Acquisition Policies and Procedures Manual*.

When publicly owned facilities will be acquired, a decision should be made at the completion of the Phase I study to either pay the market value for the property or to functionally replace it. The guidance on this issue is in the *Land Acquisition Policies and Procedures Manual*.

See Section 34-5 when laying out highway alignments. This section provides guidance on right-of-way issues that could avoid adverse property severance, undesirable access features, unnecessary damages, and odd-shaped takings. Also, consider existing property lines and the value of property to avoid excessive right-of-way costs. Often, alternative locations and designs can be selected with lower right-of-way costs.

11-2.13 <u>Coordination with Airports</u>

Highway and bridge improvements within 2 miles (3.2 km) of publicly owned airports, within 1 mile (1.6 km) of privately owned airports open to the public, and within 0.5 miles (0.8 km) of restricted-landing areas will require coordination with Aeronautics. These coordination requirements concerning distance to an airport are in conjunction with height obstructions of 15 ft (4.6 m) or more above the roadway. In addition, the district must coordinate with Aeronautics for all realignments and construction improvements on new location regardless of the height of obstruction.

Airport clearance requirements could affect the controlling elevations and locations of pavements and structures. Discuss the necessary construction equipment (e.g., cranes, pile drivers), highway appurtenances (e.g., signs, lighting, traffic signals, utility poles), and environmental mitigation that might affect airspace clearances. During preparation of the Phase I study, also contact the local airport authorities to ascertain that any proposed airport expansion plans will not cause the highway improvement to conflict with future airspace clearances.

For those airports that are publicly owned, coordination with the Federal Aviation Administration (FAA) is required. Contact Aeronautics prior to communicating with FAA.

The Phase I report must include a discussion as to whether or not any airports exist within the distance requirements set forth above and if any obstructions will exist due to highway improvements. Any required vertical clearance permits must be obtained prior to PS&E approval. Airspace clearances are defined in the Illinois Administrative Code (Aviation Safety, 92 Ill. Admin. Code 14).

11-2.14 Traffic Control During Construction

The Phase I study must include a discussion on or development of a conceptual plan to accommodate traffic during construction. The following references are applicable:

1. Work Zone Traffic Management Studies. Chapter 13 documents the goals and objectives for developing a Transportation Management Plan (TMP) report. Each Phase I report should contain TMP indicating an overall strategy for accommodating traffic during construction. The TMP usually will be approved as part of a Phase I report and the decisions made in TMP will be used to prepare the detailed Traffic Control Plan (TCP) during Phase II work.

2. Work Zone Traffic Control. Chapter 55 presents detailed design criteria for accommodating traffic in a work zone (e.g., geometric design, roadside safety). During the Phase I study, the designer will need to review Chapters 13 and 55 to determine the appropriate design features for different methods of accommodating traffic during construction.

11-2.15 Estimate of Costs

At the completion of a Phase I study, prepare a cost estimate for the project. This cost estimate is used during the programming process at both the district and central office levels to determine a realistic annual construction budget. To accomplish this for complex projects requiring more than one construction season, provide cost estimates for individual usable segments. The multi-year highway improvement program can then be developed using the individual segment costs rather than an estimated proportional cost of the total project.

Sections 12-4 and 65-1.02 discuss the information needed to document project costs. Typical cost estimate sheets for minor complexity and major complexity Phase I projects are shown in Section 12-4. To provide statewide uniformity of items used in estimating costs, the designer should use these typical cost estimate sheets in Phase I reports.

11-3 ROUTE PLANNING

11-3.01 Scope

Route planning is the general term used for locating and selecting a design for a major highway facility on new alignment or, in some cases, along an existing highway. Route planning is typically accomplished by the Office of Planning and Programming and is conducted 10 to 15 years prior to a corridor study analysis. Typical examples where route planning would apply are with freeways, expressways, and bypasses. It involves the consideration of engineering, sociological, environmental, and economic elements. Proper planning will determine the traffic needs and the type of facility required to satisfy those needs. After this determination has been made, a study area and area of influence can be selected, and corridors within the study area can be proposed and investigated.

After selection and approval of a corridor, a Phase I study may be initiated and alternative alignments within the corridor may be developed to determine the optimum project design. During detailed project development, consider the requirements in Chapter 19 (public involvement) and Part III, Environmental Procedures.

11-3.02 Logical Termini

Phase I studies for route planning projects as listed above should span a route length that extends to logical termini. Also, ensure that the study addresses the social, economic, and environmental impacts of the ultimate improvement and provides for a uniform set of design criteria between logical termini.

Logical termini generally consist of population centers, major traffic generators, major crossroads, and other features that serve as a destination, either intermediate or final, for a significant portion of the traffic likely to use the route being considered for improvement. Consider the following when determining logical termini:

1. Population Centers. Population centers, typically considered as logical termini, will vary considerably in size. They may be defined, however, as those cities, towns, or villages that serve as trade or business centers in the geographical area where the improvement is located.

2. Major Traffic Generators. Major traffic generators are those shopping districts, factories, employment centers, recreational facilities, and other developments that serve as a destination for a significant portion of the traffic likely to use the facility being considered for improvement.

3. Major Crossroads. Major crossroads are those crossroads that have a functional classification equal to or higher than the route being proposed for improvement.

Section 22-6 discusses logical termini in more detail with respect to the selection of project alternatives.

11-3.03 General Considerations

Prior to developing a Phase I study in detail, reaffirm the location of logical termini for consistency with the project goals, objectives, and NEPA requirements. Logical termini usually have been predetermined by other methods (e.g., need studies, comprehensive transportation studies). Also, reaffirm the recommendations of any previous studies.

Upon reaffirming the recommendations of previous studies and selecting the major logical termini, consider the following factors in route planning for freeways, expressways, or bypasses:

- functional classification;
- directness;
- preliminary intersection or interchange locations;
- provision of good access to communities;
- effect on developed areas;
- route markings;
- plans of adjacent States for routes at State lines;
- location of major structures;
- flood hazards and longitudinal floodplain encroachments;
- displacement of businesses, families, and farms;
- property values and prime farmlands;
- public utilities;
- fire protection;
- traffic operations;
- operation and use of existing highway facilities and other transportation facilities during construction and after completion of project; and
- general environmental impacts including those on archaeological sites, historic sites, wetlands, special waste sites, and public lands (see Part III).

In the route planning process, it is necessary to use the knowledge and expertise from various disciplines and to obtain information from various sources. The following is a partial list of sources, information, and disciplines that are available in the route planning processes:

- photography;
- bridge condition reports, crash reports, and pavement condition ratings;
- natural resource and conservation agencies;
- local agencies;
- economists;
- geotechnical engineers;
- airport agencies;
- railroad agencies;
- sociologists;
- road designers;
- urban and regional transportation planning agencies;
- other resource, recreational, planning, and public agencies;
- utility companies; and
- special flood hazard area maps.

11-3.04 Overall Procedures

Once the route planning process is completed and a general route location is selected, the next step in the highway development process is to investigate and select a corridor location. Once the corridor location is selected, Phase I studies are initiated and the final alignment and design features are chosen.

For an overview of the Study Development Process for these types of projects, see Chapter 2, Figures 2-2.A and 2-3.A. Each of these stages is discussed elsewhere in this chapter, Chapter 19, and Part III, Environmental Procedures.

11-4 CORRIDOR STUDIES

As applicable, a corridor study must reflect general engineering evaluations as discussed in Section 11-2 and the environmental analyses in Part III, Environmental Procedures. Section 11-4 presents additional information that applies specifically to a corridor study. Section 12-3.01 discusses the content and format of a Corridor Report.

11-4.01 Purpose

The purpose of a corridor study is to investigate all feasible corridors within a regional area as determined by the route planning process. In some cases, such a study could be considered a Feasibility Study. The feasibility of a corridor depends on the social, economic, environmental, and engineering effects of the proposed highway improvement within each corridor. Corridor studies usually are prepared only for new freeways, for new expressways where two or more existing routes are being considered for upgrading, or for a new two-lane highway proposed on new location.

A separate corridor study usually is necessary for lengthy projects on new location where alternative corridors are available for a proposed action. This analysis will indicate that alternative corridors can cause substantially different social, economic, or environmental effects or will essentially change the layout or function of connecting streets or roads. Because alternative corridors may be able to provide similar functions, a corridor study provides the means to select the most appropriate corridor for detailed studies of a highway facility. Coordinate and fulfill the appropriate requirements of Chapter 19 and Part III concurrently with the corridor study. Chapter 2, Figure 2-2.A illustrates corridor study coordination on a highway with environmental studies and public involvement activities.

11-4.02 Reconnaissance During Corridor Study

11-4.02(a) Objectives

The objectives of the reconnaissance stage of the corridor study are to:

- reaffirm the need for the proposed improvement,
- establish goals and objectives,
- establish the study area and logical termini,
- identify preliminary corridors,
- analyze each of the preliminary corridors, and
- eliminate corridors not feasible for further study.

11-4.02(b) Sources of Information

Use the following sources of information during the reconnaissance stage:

- State, county, and city maps;
- ASCS photography or IDOT photography;
- USGS quadrangle topographic maps;
- National Wetland Inventory maps;
- Advanced Identification of Wetland maps (District 1 only);
- traffic maps and data;
- functional classification maps;
- Federal agency plans (e.g., U.S. Army Corps of Engineers, Coast Guard, Department of Interior, Department of Housing and Urban Development);
- special development plans (e.g., conservation, industrial, recreational, resource);
- population growth trends;
- utility maps;
- urban area transportation studies;
- other regional planning studies;
- road inventory data from the Illinois Road and Inventory System (IRIS);
- Illinois Department of Natural Resources (IDNR), including:
  + Office of Water Resources for regulatory floodway maps;
  + Office of Mines and Minerals for mined-out area maps; and
  + Office of Realty & Environmental Assessment for consultation, coordination, and Impact Assessment;
  + Office of Resource Conservation for endangered species, nature preserves, wildlife action plan, fishery data, and biological stream ratings;
- USDA, Natural Resources Conservation Services for county soils surveys and wetland maps;
- Federal Emergency Management Agency (FEMA) for flood hazard boundary maps and flood insurance rate maps;
- IEPA Illinois Integrated Water Quality Report and Section 303(d) List;
- USEPA/IEPA for a listing of special waste sites (e.g., LUST, USTS, CERCLIS sites); and
- IHPA for historic site location information.

This list is not all-inclusive, and the designer should consult all available sources prior to proceeding with the development of the corridor study.

11-4.02(c) Coordination

In accordance with Chapter 19 and Part III, Environmental Procedures, contact the following agencies during the reconnaissance phase:

- planning agencies;
- airport authorities;
- local agencies (e.g., counties, municipalities, townships);
- conservation, drainage districts, historical, recreational, and archaeological agencies; and
- other appropriate individuals or agencies.

Contacting these agencies will avoid conflicting improvements. See Section 22-5 for more information on coordination.

11-4.02(d) Study Area

Determining the need for a highway facility is a function of the Office of Planning and Programming and/or local urbanized area transportation agencies. Because the type of highway is selected during route planning, this identifies the geometric design requirements of the facility and the area of influence. Once the area of influence is determined, this allows an estimate of potential land development and, in turn, traffic growth within the corridor.

County or other area maps and USGS quadrangle topographic maps, combined with aerial photography, will furnish the locations of towns, streams, railroads, and other topographic features that will assist in defining the limits of the study area. Plot special flood-hazard areas, wetlands, and public lands on those maps for reference and analysis. Review these maps and locate feasible corridors upon the area maps with respect to local terrain, topographic features, and other controlling items. Use the area maps showing all feasible corridors as the basis to study and investigate different corridor locations.

The study area is determined through a general overview of area maps in the office and field trips. Field trips may be facilitated by prudent use of helicopter flights. The study area is that part of the area of influence within which the facility will be investigated. The limits of the study area may not be the same as the area of influence. Lateral limits are dependent on the distance between the major termini, the function of the highway, and the character of the area traversed.

11-4.02(e) Corridor Location

In general, locate new highway facilities as close as practical to major municipalities to maximize road-user and local-interest benefits and to contribute to the orderly growth of communities. Traffic volumes, combined with origin-destination studies and major transportation plans, reflect the need and extent of intersection or interchange connections to other highway facilities within the corridor. Determine whether these connections can be adequately developed (e.g., size of interchanges, length of access control on crossroads, profiles). It may be necessary to revise tentative corridors to accomplish this goal.

During this stage, determine the approximate location of major intersections and/or interchanges, major drainage structures, and the approximate number of proposed grade separations, if applicable. This information will be used for cost estimating. At this time, determine the need for frontage roads, service drives, and other related features, and their practicality. This will aid in the determination of corridor widths. Also, consider establishing an approximate gradeline for certain segments if:

- an abnormal amount of earthwork is anticipated,
- there is a major difference in the grading requirements of alternative corridors, or
- major drainage structures require that a gradeline be established.

In planning the location of a highway, avoid corridors that create longitudinal encroachments into floodplains. Transverse encroachments of a floodplain are unavoidable and, fortunately, create much less of an impact on floodways compared to longitudinal encroachments. However, transverse encroachments must still be investigated to establish the significance of floodway impacts.

Also, at this stage, a general geologic survey should be made to determine whether the study area contains any adverse soil conditions that could have a major impact on the suitability of a potential corridor. The district initiates the request for a Corridor Geotechnical Report by contacting the Soils and Foundations Unit in the Bureau of Bridges and Structures. If they are unable to conduct the study, the Soils and Foundations Unit will recommend hiring a consultant to complete the work.

Analyze the reconnaissance information and eliminate the unacceptable corridors. In the Corridor Report, note the reason(s) for the elimination of any corridors (e.g., environmental consequences, route planning considerations).

11-4.03 <u>Analysis of Acceptable Corridors</u>

11-4.03(a) Objectives

After completing the reconnaissance stage and eliminating unacceptable corridors, analyze the remaining corridor alternatives. The objective of this stage of analysis is to perform a detailed study of acceptable corridors. The following additional information will be useful during this stage:

- land use;
- habitat (e.g., forested, prairie, wetlands);
- drainage impacts and construction in floodplains;
- projected ADT's;
- fire districts, mail routes, school districts, drainage districts, and taxing districts shown on maps;
- recommendations from Geotechnical Reports;
- locations of major utility installations;
- other transportation facilities (e.g., commuter and freight railroads, airports, bus and trucking terminals);
- urban area transportation study reports and other data;
- regional planning agency reports;
- interagency coordination in accordance with Chapter 19 (public involvement) and Part III (environment);
- route planning considerations (see Section 11-3);
- private and commercial property owner reports; and
- location of cemeteries, public lands, wetlands, threatened and endangered species/habitat, nature preserves, natural areas, biological stream ratings, TMDLs, historic structures, archaeological sites, and special waste sites.

11-4.03(b) Final Corridor Exhibits

For rural areas, sketch corridors on aerial photography (screened half-tone positives) at a scale of 1 in = 600 ft (1:7500 metric). If recent aerial photography for rural areas is not available, county maps may be used initially until new photography is obtained. In highly urbanized areas, use aerial mosaics at a scale of 1 in = 100 ft (1:1000 metric). Sketch sensitive areas (e.g., parks, wetlands, nature preserves, historic sites) and other controlling features on the base maps of aerial photography. As practical, avoid any of these controlling features and sensitive areas.

In addition to the use of aerial photography, sketch the final corridors on USGS quadrangle maps. Using the quad maps, consider the characteristics of the land including flood-prone areas and the need for major drainage structures. Evaluate soils maps in conjunction with aerial photography and locate any areas of unstable or unsuitable materials that must be avoided or replaced. These areas may cause stability problems for embankments or may not be suitable for excavated material to be used in embankments.

See Section 11-5.02 for the services and products available from the Aerial Survey Section in BDE.

11-4.03(c) Final Field Inspections

During the final analysis of acceptable corridors, conduct a field inspection of each corridor. This inspection should consider any features previously noted and observations should be made of any new local developments. Also, investigate other major features in the corridors and make decisions on the suitability of each corridor.

11-4.03(d) Estimate of Costs

Prepare a generalized cost estimate for all acceptable corridors; see Sections 12-4 and 65-1.02. This estimate, by necessity, will be an approximation because only major design features will have been determined. Therefore, a road user benefit analysis comparing alternative corridors will not be required.

11-4.03(e) Public Involvement

Public involvement for corridor studies is a combination of meetings with different agencies, interest groups, municipalities and holding a number of informational meetings for the general public; see Chapter 19. The results of these meetings help determine the most suitable corridor or corridors for detailed design studies.

11-4.03(f) Selection of Final Corridor

When selecting the final corridor, consider the public involvement comments (see Chapter 19), environmental effects (see Part III), and engineering factors (Section 11-2). The final selection of a corridor is documented in a Corridor Report; see Section 12-3.

11-5 DESIGN STUDIES

As applicable, a design study reflects the engineering evaluations discussed in Section 11-2 and the environmental analyses in Part III, Environmental Procedures. Section 11-5 presents information that applies specifically to a design study for a complex project (e.g., freeway, expressway, bypass) as defined in Section 11-1. Section 12-3.03 discusses the content and format of a Design Report for a complex project.

11-5.01 Objective

Develop the purpose and need for the study of a complex project and then investigate all plausible alignments within an approved corridor by using topographic mapping and aerial photography. In developing the design study, address the following features or items:

- design criteria;
- typical sections;
- intersection/interchange designs;
- access control features;
- horizontal alignment and vertical profile;
- right-of-way limits;
- number of traffic lanes; and
- the rationale for the location of bridges, interchanges, intersections, and other structures.

In addition, public involvement activities (see Chapter 19) and environmental studies (see Part III) shall be conducted concurrently with the design study. The Project Development Network for complex projects shown in Chapter 2 illustrates the coordination needed in conjunction with public involvement activities and environmental studies.

11-5.02 Products and Services From Aerial Surveys

Extensive products or services are available from the Aerial Surveys Section for use in performing design studies and other types of work. Some of the more common products or services are:

- uncontrolled aerial photography (black and white or color);
- high-altitude statewide photography;
- aerial photographic mosaics (i.e., aerial photographs that are pieced together to eliminate most of the distortion and then re-photographed);
- contact prints;
- CADD-generated mapping at a scale of either 1 in = 50 ft (1:500 metric) or 1 in = 200 ft (1:2500 metric);
- digital terrain models;
- screened positives of aerial photographs (paper prints can be produced from this product);
- oblique photography for use at informational and/or public hearings;

- enlargements or reductions of exhibits and mapping;
- a complete USGS quadrangle file for use by the Department;
- plotting of centerline on mylar sheets;
- photo plan and profile sheets;
- orthophoto maps (controlled aerial photography with contour lines superimposed on photography); and
- reading of cross sections from mapping.

To determine more details on the use of the above products and services, contact the Aerial Surveys Section.

11-5.03 <u>Alignment Investigations</u>

11-5.03(a) Review of Corridor Selection

Review the Corridor Report in detail before proceeding with the design study and ensure that the corridor decisions are still valid. Throughout the design study process, reaffirm the approved corridor as contacts are made with planning agencies. Also, assess any changes in land use or development plans to determine if corridor modifications should be considered. This is especially important if several years have elapsed between the corridor and design studies or if new information is discovered during a more in-depth design analysis.

11-5.03(b) Preliminary Alignments

The objectives of the first phase of a design study for a complex project are to:

- Identify the preliminary alignments for study, including an analysis of the no-action alternative, and if applicable, analyze the alternative for improving existing highways. The no-action alternative is used as a base condition to determine the consequences of not proceeding with the project.
- Analyze the preliminary alignments identified in the previous step.
- Determine preliminary social, economic, environmental, and engineering factors that will affect the suitability of each preliminary alignment.
- Eliminate the preliminary alignments deemed unacceptable for detailed study.

Use county maps and USGS quad maps in the preparation of base maps for the remaining preliminary alignments. Indicate the following on these base maps:

- existing and projected land use;
- school districts;
- school bus routes;
- fire districts;
- neighborhood boundaries;
- parks and historic sites and districts;
- nature preserves; and

- other elements listed in Part III, Environmental Procedures that may affect the location of the alignments studied (e.g., flood-plain encroachments, natural areas, wetlands, special waste sites, cultural resources, public lands identified as 4(f) by FHWA).

Once the base maps have been prepared, determine and layout preliminary alignments from the following other known influences within the area:

- locations of municipalities,
- recreational areas,
- other highways,
- topography,
- property lines,
- acceptable locations of intersections or interchanges,
- industries, and
- the feasible locations of bridges (over railroads and waterways) and grade separations.

Once the preliminary alignments are identified on these base maps, eliminate the unacceptable alternatives. For the next step of alternative development, transfer plausible alignments to aerial photography. This is accomplished by requesting current aerial photography, scaled at either 1 in = 600 ft (1:7500 metric) or 1 in = 400 ft (1:5000 metric) for rural areas, and aerial photographic mosaics, scaled at either 1 in = 100 ft (1:1000 metric) or 1 in = 200 ft (1:2500 metric) for urban areas. The photographic exhibits are prepared as screened positives. This medium allows paper prints to be produced from the aerial photography. Depict the main influences and any other secondary influences on aerial photography. To proceed further with this phase of the design study, contact all affected agencies and planning commissions within the corridor again to obtain their comments and opinions. These agencies may be affected either directly or indirectly by the proposed improvement. This is part of the scoping process.

Analyze the results of these contacts. Revise or eliminate any of the alignments that are undesirable because of adverse engineering, environmental, economic, or social effects. Document the reason(s) any alignments have been discarded. Also, determine and discuss the impacts of the “no-action” alternative.

11-5.03(c) Mapping Requests

Long lead times are usually required to obtain mapping (one to two years) and, therefore, mapping requests must be made early so that delays do not occur in proceeding with a study. However, it must be noted that many times insufficient information may be available at the time mapping is requested and, therefore, some judgment must be used in deciding on the width limits of the mapping. Additional mapping always can be requested during the design study if needed for further alignment investigations.

In rural areas, the Department typically uses a 1 in = 200 ft (1:2500 metric) scale for topographic mapping where a freeway or expressway is proposed on new alignment. This mapping is commonly referred to as location mapping. However, if a freeway or expressway alternative is being considered along and adjacent to an existing rural highway, use a larger topographic map scale [i.e., 1 in = 50 ft (1:500 metric)]. This larger scale enables the location study staff to make informed, accurate decisions on the feasibility and impacts of using the existing alignment and it also can be used for the preparation of construction plans at a later time.

In urban areas, where a new freeway is being proposed or where an existing expressway is proposed for upgrading, or where the extension of an arterial route into an urban area is being proposed for reconstruction, use a 1 in = 50 ft (1:500 metric) scale topographic mapping for the design study. This larger scale mapping in urban areas provides the necessary detail to determine impacts, displacements, and right-of-way limits.

Submit all mapping requests to the Aerial Surveys Section. This Section will make the determination on whether the in-house staff can provide mapping or if there is a need to hire a mapping consultant. Also, requests for photography for the preparation of aerial photographic mosaics or digital imagery should be made at the same time as mapping requests. This procedure helps to ensure that the minimum number of flights is made to the project area.

11-5.04 Study of Design Alternatives

11-5.04(a) Objectives

After the set of plausible alternatives has been reduced to a set of feasible alignments, perform a detailed analysis to compare the remaining alternatives. Topographic mapping and aerial photography are the primary media used for this phase of the design study. The objectives of this phase are:

- to study and analyze the feasible alignments for a freeway, expressway, bypass, etc.;
- to identify acceptable design alternatives; and
- to choose and recommend a final preferred alternative for construction.

11-5.04(b) Sources of Information

The following are sources of information available, items to use, and items to consider for this phase of the design study:

- crash rate maps and collision diagrams (see Section 11-2.02);
- pavement and bridge condition reports (see Section 11-2.02);
- ADT traffic maps and DHVs for current and design year traffic (all affected routes) (see Section 11-2.02);
- detailed transportation maps and plans with all modes of travel included;
- utility installations and detailed maps from utility companies;
- fire, school, mail, and school bus routes; location of churches, drainage districts, and historic sites; and field-tile maps;
- commercial, agricultural, industrial, recreational, historic, and residential land use (see Part III);

- parks and conservation areas, archaeological sites, floodplains, wetlands, endangered and threatened species, nature preserves, special waste sites, biological stream ratings, etc. (see Part III);
- local, State, and Federal agency coordination (see Section 22-5);
- maintenance information on existing routes (see Section 11-2.09);
- current topographic mapping at a scale of 1 in = 50 ft (1:500 metric) in urban areas and 1 in = 200 ft (1:2500 metric) in rural areas on new alignment or 1 in = 50 ft (1:500 metric) in rural areas where existing alignment is studied;
- current aerial photographic mosaics at a scale of either 1 in = 100 ft (1:1000 metric) or 1 in = 200 ft (1:2500 metric) in urban areas and aerial photography at 1 in = 400 ft (1:5000 metric) or 1 in = 600 ft (1:7500 metric) in rural areas;
- geotechnical investigations (see Section 11-2.10);
- highway geometrics (see Section 11-2.04), development of access control plans (see Section 11-2.03), and right-of-way issues (see Section 11-2.12);
- joint development uses, scenic easements, and aesthetics of highway design (see Chapter 33); and
- cost estimate (see Section 11-2.15) and road-user benefits (see Section 11-7.01).

11-5.04(c) Locating Alignments

Upon receipt of the topographic mapping, plot property lines, property names, names of roads, and all other important cultural features on the original mylar sheets. Make paper copies of the mapping sheets and tape together. This procedure allows the designer to review long lengths of the alignment in one view and to see how lines may best fit together. Begin laying out feasible alignments. With freeways and expressways, the major controlling items in locating the highway alignment are as follows:

- the proper location of interchanges and major intersections;
- topography;
- waterway crossings;
- property lines;
- avoidance of cultural features, if practical; and
- avoidance of regulatory environmental constraints (e.g., wetlands, Section 4(f) lands, longitudinal floodplain encroachments).

In some cases, the placement of grade separations or major bridges may dictate the location of the highway and may require a revision to an initial proposed alignment.

After an alignment is laid out, determine the state plane coordinates of all control points (POTs and PIs) from the project mapping. This information, along with radii of horizontal curves, is then input into a computer file to mathematically describe each alternative. Once an alignment is mathematized and tied into digitizing mapping files, the alignment can then be stationed from west to east or south to north and the information stored as a computer file for further design work.

11-5.04(d) Establishing Gradelines (Procedures)

Once an alignment is judged to be a probable final alternative, the design of the profile may then be investigated in detail. This may require designing two to three trial vertical profiles and performing several complete earthwork calculations. However, before profile work can be completed, preliminary drainage investigations (see Section 11-2.05), using stream gauging data, USGS quadrangle maps, or topographic mapping, must be completed to set design high waters. Use computer programs to determine high waters and other drainage information. IDOT uses GEOPAK software for alignment, profile, and cross section designs. Once the overall design is finalized, compute earthwork using the GEOPAK software. This software allows the designer to quickly investigate trial profile designs, to determine quantities, and to determine construction limits. GEOPAK can also be used to generate perspective plots for any portion of the roadway. Use 3-D plots in the design process to assess potential safety problems and the aesthetic value of each final alternative.

The following procedures apply to the development of gradelines for construction and reconstruction projects:

1. Control Factors. Develop each feasible highway alignment on mapping sheets based on the following factors:

    - location of intersections or interchanges,
    - property lines,
    - topography, and
    - waterway crossings.

    These factors will be the main alignment design controls if environmental issues are not a significant factor.

2. Centerline Elevations. For each feasible alignment, develop a tabulation of groundline elevations along the centerline of the alignments at the selected station intervals. This may be done manually and plotted on a continuous roll of cross section paper or elevations may be read from digitized mapping and plotted using computer programs. The method of obtaining centerline elevations will be dependent on the length and complexity of the proposed project.

3. Controlling Features. Locate controlling features by station and elevation along the centerline profile, including:

    - railroad crossings or separations,
    - streams,
    - highway crossings or separations,
    - location and elevation of transverse utility crossings,
    - rock outcrops, and
    - known locations of unsuitable soils.

4. Trial Profile Gradelines. Once the groundline at the centerline of an alignment has been plotted, either manually or by using computer plots, and other controlling features such as PCs and PTs noted, the designer may then proceed to lay out the first trial profile gradeline. This procedure allows the designer to begin selecting VPI locations and elevations and to visualize how a profile might fit together over long distances. The selected VPIs are connected together by using a long, straight edge and drawing in the profile lines.

5. Vertical Profile. Examine the preliminary profile design considering the controls for vertical alignment discussed in Chapter 33. Make adjustments to ensure safety and to promote aesthetics. A good vertical alignment design should not be sacrificed only to achieve a balance in earthwork or solely to create a less expensive design.

6. Computations. Compile VPI elevations and stations and compute the gradient between VPIs. Determine the minimum length of vertical curves to be used at each VPI. Crest vertical curve lengths are set by using desirable K-values for the selected design speed or longer to emphasize aesthetic values. Sag vertical curve lengths have a more pronounced effect on the view of the road than crest vertical curves. Therefore, use longer lengths than the minimums wherever practical to provide a more pleasing profile.

Upon completing the first trial profile gradeline, use either of the following two methods to obtain cross sections from topographic mapping and to compute earthwork:

1. Method #1. Manually scale distances and groundline elevations from CADD-generated mapping sheets and compile data. Enter the data into a suitable earthwork program (available with either GEOPAK or equivalent software). Run the program using typical sections, special cross sections, superelevation runoff lengths, and the proposed profile.

2. Method #2. Provide state plan coordinate data for all POTs, PIs, horizontal curves, and beginning stationing. District staff then can submit this information to the Aerial Surveys Section for direct reading of cross sections from CADD-generated mapping. Enter the cross section data into a suitable earthwork program (available with either GEOPAK or equivalent software). Run the program using typical sections, special cross sections, superelevation runoff lengths, and the proposed profile.

Using either method, obtain a computer-generated mass-haul diagram and graphically investigate the earthwork balances. To assess the aesthetics of key roadway segments, use computer-generated perspective plots to critique the facility from a driver’s-eye view. Examine the results of the first trial profile and develop additional profiles as needed. Usually, two to three trial profiles are developed before a final profile gradeline is selected.

Upon selecting the final profile, request a computer-generated slope-stake table to determine right-of-way limits. Also, see Section 34-5 for guidance on setting right-of-way limits. Then save the final preliminary earthwork file and use this file to develop final cross sections during the Phase II design.

11-5.04(e) Evaluation of Alternatives

Analyze each of the proposed final alignments considering the social, economic, and environmental factors discussed in Part III “Environmental Procedures.” To properly analyze these effects, it may be necessary to meet again with affected agencies that had been previously contacted. See Chapter 19 for public involvement activities on complex projects and Section 22-5 for guidance on coordination.

After the results of further investigations have been analyzed, there may be legitimate reasons to eliminate one or more final alignments. Discuss the reasons these alignments were not given further consideration in the Design Report. For instance, traffic estimates for the no-action alternative may overload existing routes creating unacceptable congestion and, thereby, eliminating this alternative.

11-5.04(f) Access Control Plans

Once the design study has eliminated all but two or three major alternatives for the proposed project, prepare an access control plan for each freeway, expressway, or bypass alternative; see Chapter 35. Prepare the plan on aerial photographic exhibits (i.e., screened positives) at a scale defined in Section 11-5.03(b). The access control plan will consist of all interchange, intersection, frontage road, service drive, and entrance locations. Also, show all grade separations, major drainage structures, and any cattle underpasses or machinery underpasses that may be required. See Chapter 35 for the access control symbols.

Before an access control plan can be finalized, all intersection or interchange designs shall be developed and approved in sufficient detail to indicate all entrances and access control limits. Show all current property owners, property lines, and developments. In addition, indicate the approximate right-of-way limits for each alternative. If alternatives overlap or are closely spaced, it may be desirable to prepare separate sets of access control plans.

11-5.04(g) Exhibits

After completing all public involvement and environmental requirements, the original scaled mapping is reduced for insertion into an appendix to the Design Report. Prepare the reduced mapping sheets and other engineering exhibits on 11 in x 17 in sheets and place them in an appendix. In addition, place the aerial photography (access control plans) showing the alternatives advanced for environmental analysis and any other environmental exhibits on 11 in x 17 in sheets and place them in an appendix. The appendix can then be used in conjunction with a draft and final EIS or with an environmental assessment. Use the 11 in x 17 in format in all cases. This size format provides for ease of use of all final exhibits by planning, design, and land acquisition personnel.

11-5.04(h) Technical Reports

In completing a design study for an expressway, freeway, or bypass, it is usually necessary to prepare a number of technical reports. The following is a list of technical reports that may be required:

- Preliminary Drainage Report,
- Frontage Road/Service Drive and Access Road Justifications,
- Grade Separation/Road Closure Analysis,
- Crash Analysis Report Along Existing Route,
- Transportation Management Plan (TMP) Report,
- Preliminary Pavement Design Report,
- Agricultural Report,
- Noise and Air Quality Report,
- Water Quality Technical Report,
- Wetlands Technical Report,
- Tree Assessment Report,
- Biological Assessment or Detailed Action Report, and
- Geotechnical (Soils) Report.

Reference these technical reports in the Design Report and EIS, as appropriate. It is also recommended that each report be assigned a letter description (e.g., Technical Report A, Technical Report B).

11-5.04(i) Selection of Preferred Alternative

Resolve all public involvement comments (see Chapter 19) and consider all environmental impacts (see Part III) and engineering factors (Section 11-2) before recommending a preferred alternative. See Chapter 12 for processing and approval of reports, Corridor Protection, Route Location Decisions, and for the Order Establishing a Freeway.

11-6 COMBINED DESIGN STUDIES

Sections 11-4 and 11-5 address projects that require a separate corridor study and design study, respectively.

Many proposed projects (e.g., reconstruction of an existing urban arterial, adding a new interchange to a freeway, creating a one-way urban street couple, upgrading an existing two-lane highway to an expressway design) using predominantly the existing alignment are categories of improvements where the corridor or location is predetermined due to the design of the project and, therefore, a separate corridor study is not needed nor required.

For these types of projects, the investigation of how to design the project is designated as a "combined corridor and design study." To shorten the title of the engineering investigations, the Department has designated these studies as "combined design studies." Projects in this category of improvement are major in nature, use most or all of the existing alignment and right-of-way, and usually involve the purchase of additional right-of-way adjacent and contiguous to existing right-of-way.

The items covered in Section 11-2 apply to studies in this category of improvement types and, in some instances, the information in Section 11-5 "Design Studies" applies to the engineering investigations. Review both of these sections before proceeding with the scope of a combined design study.

Projects designated as combined design studies are set up to follow Federal environmental and public involvement procedures to be eligible for Federal-aid construction funding and may or may not involve separate environmental documentation. If the proposed project qualifies as a categorical exclusion type project, environmental documentation will be included in the Combined Design Report as a separate section. If not, a separate environmental report (EA or EIS) is prepared.

11-7 OTHER PHASE I STUDY CONSIDERATIONS

Section 11-7 discusses other analyses and procedures that might apply to Phase I studies.

11-7.01 Road User Benefit Analysis

11-7.01(a) Scope

To optimize the use of available highway funds, the Department's objective is to provide motorists with the safest and most economically efficient highway practical. Highway economy is not limited to the initial cost of construction. It also includes the cost of maintenance and operating costs to motorists. Any proposed improvement should be cost effective. It may be necessary to determine the comparative worth of likely alternative improvements where other considerations (e.g., highway location) do not clearly indicate a preferred alternative.

An aid in making these determinations is a road user benefit analysis. This analysis compares road user operating costs to highway construction and maintenance costs. Note, however, that the road user benefit analysis is not a complete economic analysis. It does not consider the solvency of the highway system or the economic impacts on adjacent land and communities. The road user benefit analysis, therefore, aids in making a selection between alternatives. It should not be used as the sole indication of engineering practicality.

Road user benefit analyses may be used, in conjunction with other considerations, for the following:

- comparing alternative alignments,
- determining the location of interchanges and grade separations, and
- determining the cost-effectiveness of providing freeway frontage or access roads.

Use the guidelines contained in the AASHTO publication *User and Non-User Benefit Analysis of Highways in* conjunction with this section when performing road user benefit analyses. Also, consult NCHRP Report 133 *Procedures for Estimating Highway User Costs, Air Pollution, and Noise Effects.*

11-7.01(b) Procedures

When it is determined that other social-economic-environmental-engineering considerations do not control a specific location or design element, a road user benefit analysis may be conducted. For each proposed alternative, determine the annual road user costs and the annual cost of improving, maintaining, and operating that section of highway over a selected period of time. Then, arithmetically compare the alternatives to express a benefit ratio or quotient of a cost difference.

In the simplest form of the analysis, one alternative will be the proposed improvement and the other will be the base condition, normally the no-action alternative. For two or more alternatives, calculate a benefit ratio for each alternative and compare the results to that of the base condition. The ratio indicates the relative merit of each alternative considering road user benefits.

The annual road user cost is the total of the computed vehicular operating costs, travel time costs, and traffic crash costs. The highway improvement is divided into as many sections as there are significant variations among the major elements of analysis. Summation of the sectional road user costs provides the annual road user cost for that specific alternative. Road user costs include the costs of all traffic directly involved or indirectly affected by the improvement. For example, an analysis may include the road user costs both for vehicles operating on the new or improved route and for those vehicles continuing to operate on parallel or connecting routes on which traffic flow is affected by the improvement.

The road user analysis should cover the entire design period, normally 20 years. Figure 11-7.A provides the average life expectancy, or period of amortization, for individual items comprising the highway cost.

Ensure that the alternative improvements are equivalent for those items not included in the road user benefit analysis. These items are primarily the degree of access control and the design features affecting operational safety. First, determine and analyze the provision of access control and the retention of substandard features only for similar alternatives, or consider qualitative factors for these differences in the final analysis.

11-7.02 Road Closures

11-7.02(a) General

During the project development process, it may be necessary to assess the practicality of eliminating at-grade crossings that are within the limits of the proposed improvement. The primary reasons for eliminating crossings are to promote the safety and convenience of highway traffic and to best serve the public interest. If at-grade crossings will be eliminated, perform a study of the existing road system and traffic patterns to determine the most effective method of elimination (e.g., relocation, grade separation, closure).

With the design of freeways, it is necessary to eliminate at-grade crossings for traffic safety. The Department has the legal authority to either close, relocate, or to grade separate at-grade crossings with proposed freeways. This includes any highway, road, street, alley, or other public way. When cost effective, the Department may choose to eliminate at-grade crossings by proposing grade separations and, thereby, continuing the public way over or under the freeway. Because relocations and grade separations provide for the continuation of through traffic, road closure proceedings are not required.

ITEM		PERIOD OF SERVICE LIFE
Right-of-Way		100 Years
Major Structures:	Substructures	100 Years
	Superstructures	50 Years
Concrete Pipe & Box Culverts & Heavy Grading		40 Years
Portland Cement Concrete Pavement		40 Years
High-Type Flexible Pavement		40 Years
Continuously Reinforced PCC Overlay		20 Years
Metal Culvert Pipe		20 Years
Bituminous Concrete Resurfacing of PCC Base (Depending upon thickness, base, and traffic)		5 to 15 Years
Low-Type Flexible Pavement		12 Years
Gravel or Crushed Stone Surface		10 Years
Bituminous Surface Treatment of Gravel or Crushed Stone		5 Years

Note: The cost of light grading shall have the same service life period as the proposed surfacing or resurfacing. Table F in the Benefit/Cost Methodology in IDOT's Illinois Safety Improvement Processes Manual *contains service lives to be used for spot safety improvement projects.*

PERIOD OF SERVICE LIFE FOR HIGHWAY COSTS

Figure 11-7.A

Expressways (partial access control) are more likely to require relocations of at-grade crossings or to remain in place than either grade separations or road closures. Complete closures of at-grade crossings primarily occur on freeways (full access control) where it is neither practical nor cost effective to provide a grade separation at each local road or street and where relocation may not involve such extensive adverse travel as to cause a serious disruption to local travel patterns.

During the design study, determine which at-grade crossings should be eliminated and document this information in a technical report to the Design Report or Combined Design Report. See Chapter 44 for a detailed analysis of whether or not to close a road. For appropriate signing guidelines on road closures, review the Bureau of Operations *Traffic Policies and Procedures Manual.*

Applicable sections of the Illinois Compiled Statutes discuss the authority to relocate or close roads and the means of implementation. Because closure procedures vary according to the type of improvement and jurisdiction, this subject will be treated in three sections:

- road closures for freeways (full access control),
- road closures for expressways (partial access control), or
- road closures for highways other than freeways or expressways.

The procedures described in the following sections are applicable to improvements on new location and improvements to existing facilities.

11-7.02(b) Road Closures for Freeways (Full Access Control)

The Department may close any intersecting road, street, alley, or other public way at its intersection with a freeway but only after holding a public hearing in the county in which the crossing is located. The hearing will consider the needs of local traffic and the effect of the closing on other highways in the locality. The authority for such closures is granted to the Department under 605 ILCS 5/8-106(b)(2).

Road closure hearings are discussed in Chapter 19. Specific requirements for road closure hearings are included where appropriate. If no specific requirements are mentioned, the general public involvement procedures will apply. When road closure hearings are advertised and integrated with design or combined design hearings, the project record submitted for design approval normally will contain the required information as described in Chapter 19 and shall include hearing transcripts, road closure comments, copies of notices, and handouts.

If the road closure hearing for each county is held as a separate hearing before design approval is requested, the road closure transcript, copies of notices, and handouts shall be included with the project record that is submitted for design approval.

When the requirements of a road closure public hearing are satisfied prior to receiving design approval or when a road closure public hearing is held subsequent to receiving design approval but before construction plans are completed, an “Order Closing a Public Way” shall be prepared.

11-7.02(c) Road Closures for Expressways (Partial Access Control)

Road closures on expressways usually are accomplished through agreements with appropriate local officials according to the *Illinois Highway Code*, 605 ILCS 5/8-106(b)(1). When using this procedure, the district shall secure an agreement with each local agency having jurisdiction over roads to be closed.

The district will prepare and present the agreement to the local officials together with a written request for their cooperation. In addition, the district will make available a written or verbal explanation of the need to close the roads in question to those entities expected to act on the agreements. Agreements need not be executed prior to design approval; however, the Design Report or Combined Design Report should include evidence of coordination with local officials.

In addition to the use of Section 605 ILCS 5/8-106(b)(1), Section 605 ILCS 5/8-106(b)(2) may also be used to propose the closing of any existing public road at its intersection with the expressway. In this case, the district will advertise and hold a road closure hearing.

Provide a statement in the Design Report or Combined Design Report that construction of the recommended expressway design will not be initiated until critical road closures, applicable to the operations and safety of the expressway, have been completed.

11-7.02(d) Road Closures for Highways Other Than Freeways or Expressways

In the rehabilitation, relocation, or construction of State routes that are not freeways or expressways, it may be necessary to relocate or eliminate intersections with local roads, city streets, alleys, or other thoroughfares, usually for the safety and convenience of the traveling public. The following describes two options available to the Department for this procedure:

1. <u>Traffic Control</u>. IDOT has the authority to eliminate an intersection using a traffic control measure or device as authorized under the *Illinois Vehicle Code*, 625 ILCS 5/11-302(c). This can occur if IDOT determines that a local road intersection may be a hazard to State highway traffic.

   See the *Illinois Manual of Uniform Traffic Control Devices* for the full range of traffic control devices available to protect and give preference to State highway traffic. The Prohibition of Left Turns, Right Turn Only, and No Outlet are traffic control measures that may be considered at an intersection. However, note that the restriction or prohibition of access to a State route from an intersecting highway is not the same as a road closure or, to be more definitive, as vacating the local highway.

   In addressing the isolated elimination of crossings for non-freeways, IDOT also considers the interest of all affected highway authorities based on the intent of the *Illinois Highway Code*. Section 605 ILCS 5/1-102 of the *Illinois Highway Code* declares legislative intent and indicates the need for an integrated system of highways based on cooperation between various highway agencies. Therefore, when applying the *Illinois*

Vehicle Code, 625 ILCS 5/11-302(c), consult with the local highway authority as a means of addressing any local concerns.

2. Road Closure and Relocation. The Department has the option to eliminate traffic at an intersection with a State route through a relocation or closing of the local highway. In this case, the local agency having jurisdiction over the intersecting roads or streets must authorize the relocation or closing. Municipalities, townships, and counties must meet different statutory requirements when asked to close roads under their jurisdiction. Counties and municipalities require action by their governing bodies, and township highway commissioners follow a specified procedure that allows for public input.

   Perform the following tasks when it is determined that a county or municipal road, street, or alley should be closed:

   - contact the appropriate local official;
   - explain the need to close the road, street, or alley;
   - provide adequate descriptions and information for the preparation of required legal documents; and
   - request that the local agency take the necessary action to accomplish the closing.

   Then, secure a reproducible copy of the passed resolution or ordinance on vacating the road and forward it to BDE for proper distribution. See the *Illinois Highway Code*, 605 ILCS 5/5-109 for counties and the *Illinois Municipal Code*, 65 ILCS 5/11-91-1 for municipalities.

If a township or district road closure is proposed, prepare and sign a certificate describing the roads affected and the need for altering or vacating such roads. Ensure that the certificate and its processing conform to the requirements of the *Illinois Highway Code*, 605 ILCS 5/6-303 and 605 ILCS 5/6-305.

Although it is not necessary to close local roads prior to design approval, include evidence of the coordination with the local agency having jurisdiction over such roads in the Phase I report. Also, state in the report that construction of the recommended design will not be initiated until critical road closures, applicable to the operation and safety of the improvement, have been completed.

11-7.03 Value Engineering

Value Engineering is the systematic application of recognized techniques by a multi-disciplinary team not directly involved with the planning and development phase of a project to identify the function of a product or service, establish a worth for that function, generate alternatives through the use of creative thinking, and provide the needed functions to accomplish the original purpose of the project, reliably and at the lowest life-cycle cost, without sacrificing safety, necessary quality, and environmental attributes of the project.

23 U.S.C. 106 and 23 C.F.R. 627 establishes value engineering (VE) requirements for Federal-aid projects developed and administered by the Department. These requirements include establishing a VE Program, conducting a VE analysis, providing VE program oversight, and reporting performance results annually. The preferred timing to conduct a VE study is during Phase I for complex projects.

A VE analysis is required for the following types of projects:

1. Each project located on the National Highway System (NHS) (as specified in 23 U.S.C. 103) with an estimated total project cost of $50 million or more that utilizes Federal-aid highway program (FAHP) funding (see Section 11-7.03(a), item 2, for definition of total project cost);
2. Each bridge project located on the NHS with an estimated total project cost of $40 million or more that utilizes FAHP funding;
3. Any Major Project (as defined in Chapter 20) located on or off of the NHS that utilizes FAHP funding in any contract or phase of the project;
4. Any project where a VE analysis has not been conducted and a change is made to the project's scope or design between the final design and the construction letting which results in an increase in the project's total cost exceeding the thresholds as identified in 23 USC 106 and 23 CFR 627; and
5. Any other project FHWA determines to be appropriate that utilizes FAHP funding.

The following links provide more information regarding Value Engineering:

FHWA VE Policy (https://www.fhwa.dot.gov/ve/)

Society of American Value Engineers (http://value-eng.org)

11-7.03(a) Procedures

1. Project Selection. Each district identifies applicable projects during the preparation of the multi-year program. However, other projects not meeting the definition may be selected for this program. Due to the complexity and scope of large projects, more than one VE study may be desirable.

2. Total Project Cost. Costs associated with environmental studies, preliminary engineering, final design, land acquisition, and construction should be used in determining the selected project cost. The project cost includes State, local agency, and Federal-aid highway funds.

3. VE Analysis.

a. Initiation of VE Analysis. Schedule the VE analysis in a manner so as not to cause delay of the project. For a Phase I report with multiple construction contracts, develop a plan for conducting the VE analysis based on the Phase I considerations and the nature and complexity of the work type, (e.g., one VE study may cover alike construction projects). A single VE analysis should cover as many construction contracts under the single Phase I report as practicable and beneficial. Initiate the VE analysis no later than the time the construction plans are 30% complete and to allow for the implementation of the recommendations without delaying the project.

b. Team Makeup. The VE team, selected by the district, consists of individuals not personally involved in the design of the project. The team leader should have attended the NHI course on Value Engineering or have equivalent experience in the preparation of VE studies. When making up the team, take into account the following:

- draw team members from either the district or central office;
- consider individuals from specialty areas depending on the project scope;
- assign personnel from construction, maintenance, and studies and plans (as applicable);
- include representatives from environment, operations, and land acquisition as necessary; and
- include individuals from the public and other agencies when in the public interest.

Qualified consultants may be retained to conduct VE studies provided the consultant has not worked on the subject project.

c. Conducting VE analysis. To accomplish the goals of VE, the district should follow the following seven phases when completing the VE Analysis. Figure 11-7.B shows the flow diagram of the Value Engineering Process.

1. Information Phase: Gather specific project information, including purpose and needs of all the owners/users/stakeholders,project commitments and constraints. The following list of information is usually assembled:

   - All project reports (Location Drainage Studies, Hydraulic Report, Bridge Condition Report, etc.)
   - Design Criteria
   - Plans and Specifications
   - Programmed Cost and Detailed Cost Estimate
   - Project Schedule (design approval and target letting)

2. Function Analysis Phase: Analyze the project to understand the required functions. The purpose of function analysis is to thoroughly familiarize all members of the VE Team with the functional aspects of the project, to ensure that all relevant issues are addressed, and to highlight any imbalances between cost and worth of functions.

3. Creative Phase: Generate ideas on ways to accomplish the required functions that improve project performance, enhance quality, and lower project costs.

4. Evaluation Phase: The VE Team evaluates and selects feasible ideas for development.

5. Development Phase: The VE Team develops the selected alternatives into fully supported recommendations (long-term as well as interim solutions).

6. Presentation Phase: The VE Team presents the recommendations to the project stakeholders. The team leader develops a report that documents the VE study.

7. Resolution Phase: District Office evaluates, resolves, and implements all approved recommendations.

d. Final VE Analysis Report. Each Study concludes with a formal VE analysis report, which outlines the decisions and recommendations and is presented to the Deputy Director/Regional Engineer or representative. The FHWA shall be invited to all VE closeout meetings. The district establishes a procedure for prompt review and implementation of the approved recommendations. When any recommendation is a major change to an approved Design Report or is a design exception to policy, the recommended change is coordinated through the appropriate central bureau.

Furthermore, district VE coordinators should ensure that the following eight required items are included in the VE report:

1. Project information;

2. Identification of the VE analysis team;

3. Background and supporting documentation, such as information obtained from other analyses conducted on the project (e.g., environmental, safety, traffic operation, constructability);

4. Documentation of the stages of the VE Job Plan, which would include documentation of the life-cycle costs that were analyzed;

5. Summarization of the analysis conducted;

6. Documentation of the proposed recommendations and approval received at the time the report is finalized;

7. Documentation of the proposed and approved recommendations, and related information to support the Department's and FHWA's VE program monitoring and reporting;

8. The formal written report shall be retained for at least 3 years after the completion of the project (as specified in 49 C.F.R. 18.42).

e. Monitoring. Each district appoints a VE coordinator who is knowledgeable in VE studies and trained in VE procedures. Coordinator's responsibilities include monitoring each VE study from initiation through the final report, reviewing the report, and assisting in the implementation of the findings. During the month of October, each year, the district VE coordinator sends the BDE VE coordinator a list, which itemizes the total number of VE studies conducted over the past year and the estimated cost savings for each study. BDE will summarize the information and forward it to the FHWA.

11-7.03(b) Constructability Reviews

Constructability reviews are useful tools for complex or unusual projects and are encouraged as a cost or time saving measure. These reviews may include the use of IDOT personnel unassociated with the project or consultant/contractor teams that would not be bidding on the project. These reviews would not typically be making complex design change recommendations as would be expected in a full VE study. The constructability review would focus upon staging issues, work staging areas, field expedient procedures or methods, and similar activities focused upon accelerating or enhancing the proposed design.

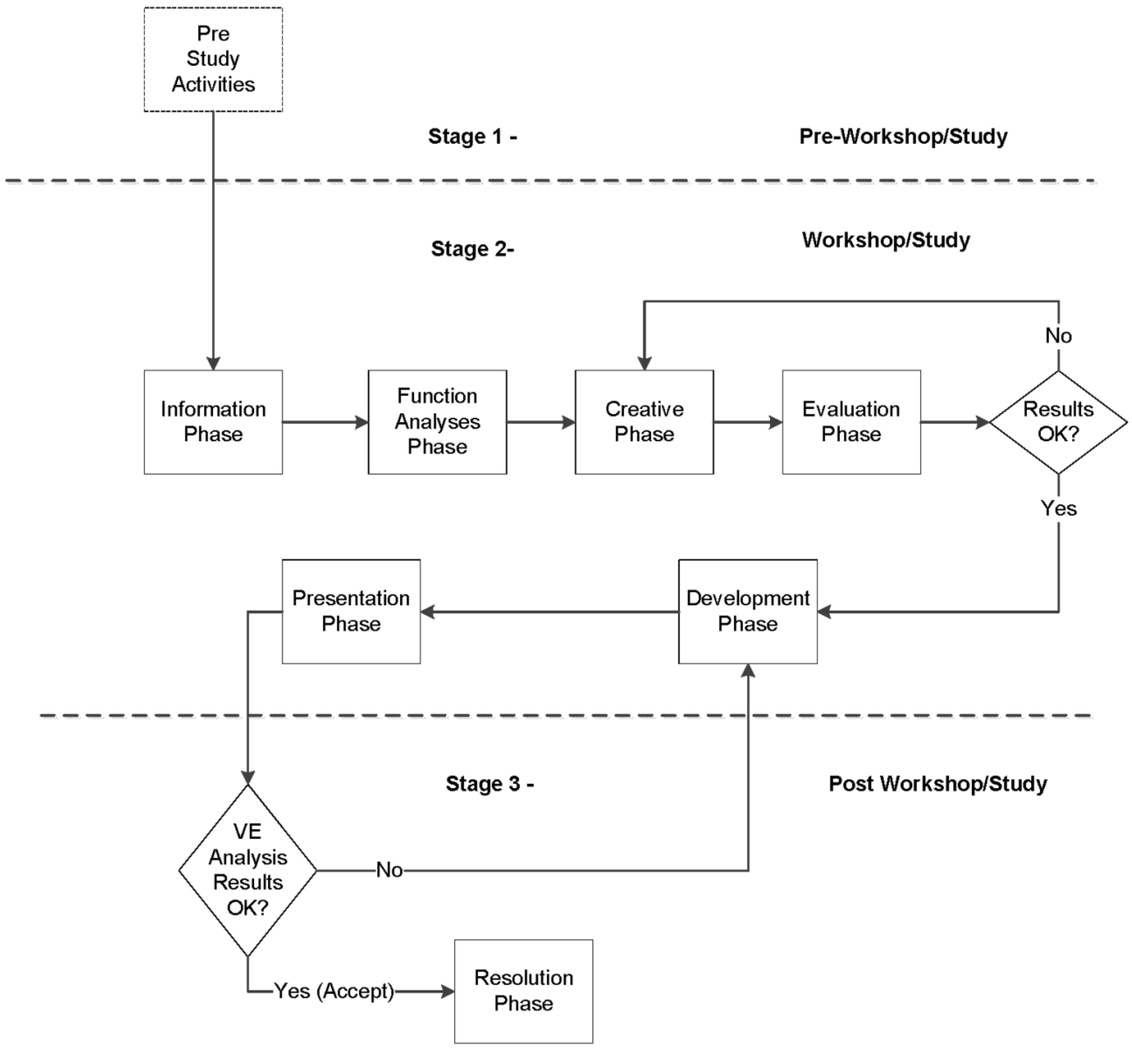

Figure 11-7.B

Value Engineering Flow Diagram

11-8 ENGINEERING COMPUTER PROGRAMS

11-8.01 General

IDOT uses various engineering programs for Phase I and Phase II work (e.g., hydraulic programs, traffic operations, highway capacity programs). These programs greatly increase the efficiency of providing solutions to the Department's engineering needs and should be used whenever possible. IDOT's major design software package is GEOPAK. GEOPAK is used for coordinating geometry, alignment and profile design, cross section designs, and 3-D modeling.

11-8.02 GEOPAK Roadway Design Software

The GEOPAK is a comprehensive, proprietary design software package that works as an interactive program within MicroStation. The Department presently is using this engineering program for its design work. GEOPAK is used to provide engineering solutions in Phase I work and to develop detailed plans in Phase II.

For Phase I studies, the following main features are available through GEOPAK.

11-8.02(a) Data Collection

The GEOPAK allows electronic field data to interface with the software program or on CADD.

11-8.02(b) Generation of Alignments via Interactive Graphics

The software provides for the dynamic placement of tangents and arcs on digitized mapping. These items may be modified as needed to determine a final design.

11-8.02(c) Coordinate Geometry

The GEOPAK provides a quick means to document and calculate the location of alignments in reference to State plane coordinates. In addition, it can station alignments, provide curve data, calculate profile elevations, store existing ground cross section survey data by station-off-set-elevation or reading-distance, provide areas of land parcels, and determine many more solutions to geometric type problems.

11-8.02(d) Aids to Label Plans

It automates the generation and placement of labels onto mapping plans.

11-8.02(e) Digital Terrain Modeling

It can create 2D and 3D triangulated models.

11-8.02(f) Existing Ground Profiles

Existing ground profiles can be generated from a wide range of sources.

11-8.02(g) Existing Ground Cross Sections

Existing ground cross sections can be generated from a wide range of sources.

11-8.02(h) Proposed Cross Sections

Proposed cross sections can be taken at any location and at any skew from digitized mapping or survey data. The software can recognize the presence of specified substrata (e.g., rock) and adjust side slopes accordingly. Special ditch designs can be accommodated. Many other commands are also available.

11-8.02(i) Earthwork Computations

Earthwork computations are made from the graphical representation of the cross sections. This feature affords the user maximum flexibility. The user can graphically modify the cross sections in the CADD file and those modifications are automatically reflected in earthwork computations. The following earthwork support features are available:

- multiple layers of proposed fill,
- multiple layers of existing sub-strata,
- unsuitable material subsoil excavation,
- topsoil and any other material removal,
- separate expansion/shrinkage factors for excavation and fill,
- mass-haul diagrams, and
- balance points.

11-8.02(j) Limits of Construction

These limits may be drawn on the plan view after earthwork computations are finalized. This assists the designer in laying out right-of-way limits.

11-8.02(k) 3D Models

Once the final alignment, profile, and cross sections are determined, the designer may request perspective views of the road from any location and elevation above the road. This analysis may cause a change in the proposed design.

Detailed information on the uses of GEOPAK is available in the *User Reference Manual* provided to each district. The *Manual* is also provided on-line and can be downloaded to the user's computer. The Engineering Systems Support Unit in the Bureau of Information Processing supports GEOPAK and assistance can be obtained by calling (217) 524-6532. Also in each district, the CADD supervisor or an Engineering Support Specialist may be available to provide assistance on the use of the GEOPAK software.

11-9 DISTRICT GEOMETRIC APPROVAL QUALIFICATION REQUIREMENTS

Geometric designs such as Intersection Design Studies and Interchange Design Studies represent some of the most critical parts of Phase I Engineering Reports with respect to the safety and operational quality of the highway facilities. These designs are some of the most complex and technically rigorous portions of the preliminary engineering process. Proficiency in geometric design takes years of experience, training, and hands-on work to achieve. Great care must be taken in choosing those individuals responsible for the development and approval of such designs, and the end products must be closely monitored for quality compliance. As such, only qualified individuals shall approve geometric designs for phase I of the project, or for any geometric modifications proposed in phase II or phase III of the project after initial phase I design approval. This section details the requirements and process necessary for the District Geometrics Engineer to approve geometric designs on federally funded roadway projects.

11-9.01(a) General

Districts are eligible to become qualified to approve all geometric designs they produce. The process involves the Regional Engineer of the appropriate district seeking district approval authority from the Central Office Bureau of Design and Environment (BDE). The prerequisite requirements for the District Geometrics Engineer, and hence the district, to be qualified for approval of geometric designs, are listed below in Section 11-9.01(d). Once qualified, districts can approve all geometric designs they produce. However, design exceptions included in any geometric design must be approved through the central office as outlined in Chapter 31.

As an ultimate goal, districts would fill the Geometrics Engineer position with able and experienced personnel. With budget constraints and staff turnover, it is understood that this process will be an evolving one, where responsibilities will shift periodically between the district offices and the central office. District coordination meetings and annual quality reviews will ensure proper and consistent application of policy and quality compliance.

The geometric designs of districts not qualified for geometric approval will be reviewed and approved by BDE. This would occur for districts where the Regional Engineer has not requested anyone to be qualified, where staffing changes have left the Geometric Engineer position vacant, as well as for those districts for which qualification has been rescinded. Although BDE review and approval are not required for qualified districts, these districts may request BDE assistance in the processing of any geometric design. The Regional Engineer is also responsible for requesting assistance from BDE should the district staff experience be insufficient for the required work.

The BDE is not precluded from reviewing any portion of the Phase I process at any time, especially when unique features or unusual circumstances are involved. If an annual quality review determines that a qualified district’s geometric designs are unsatisfactory, the Regional Engineer and the Director of the Office of Program Development will be notified immediately of the deficiencies, and corrective action up to and including rescission of the qualification may be pursued.

11-9.01(b) Items Exempt from Qualification

Design exceptions included in any geometric design must still be approved through the central office as outlined in Chapter 31. Access Justification Reports (AJR) and access control changes on interstates will continue to be coordinated with BDE. This is due to the complex nature of the designs and issues involved, and the need for statewide consistency. BDE will review and approve the AJR and access control changes for transmittal to the Federal Highway Administration (FHWA) for federal approval.

11-9.01(c) Removal of Qualification

Once approved, the District Geometrics Engineer is qualified to approve all geometric designs. The District Geometrics Engineer is the only position in the districts eligible to have geometric design approval authority.

Approval authority of the Geometrics Engineer can be withdrawn by the Bureau Chief of BDE in the event of failure to exhibit the requisite professional ability. Removal of approval authority would be based on unsatisfactory results of process reviews or other similar evidence.

Staffing changes within the Geometrics Unit may also nullify the district's approval authority. To continue to maintain approval authority, the Regional Engineer shall submit a list of staffing changes within the Geometrics Unit, including revised qualifications, to the Bureau Chief of BDE for approval. See Section 11-9.01(e).

11-9.01(d) Qualification Requirements

1. The candidate must have a degree in Civil Engineering, possess a Civil Engineer V technical classification or higher within the department (State of Illinois Professional Engineer License implied), and be the District Geometrics Engineer.

2. The candidate must have demonstrated the professional ability to produce designs which reflect genuine expertise in the field of geometrics as recognized by the Regional Engineer.

3. The candidate must have attended the following IDOT approved capacity and geometrics training classes:

    a. Basic Highway Capacity
    b. Advanced Highway Capacity
    c. Fundamentals of Geometric Design
    d. Advanced Geometric Design

11-9.01(e) Qualification Process

1. Upon fulfillment of the above requirements, the Regional Engineer will assess the capabilities of the Geometrics Engineer and, if deemed qualified, submit the candidate

to the Bureau Chief of the Bureau of Design and Environment for district approval authority. The submittal to BDE should include a cover memo requesting district qualification and a resume which details the professional experience of the candidate and lists the significant projects the candidate has previously worked on.

2. The Bureau Chief of the Bureau of Design and Environment will verify the qualifications of the candidate and determine whether the candidate Geometrics Engineer is qualified for approval authority.

3. The Bureau Chief of BDE is responsible for approving or denying the Geometrics Engineer as qualified for approval authority. The Bureau Chief of the Bureau of Design and Environment will notify the Regional Engineer via memo of the approval or denial of the request for geometric qualification.

11-10 REFERENCES

1. NCHRP Report 399, *Multimodal Corridor and Capacity Analysis Manual*, Transportation Research Board, 1998.

2. NCHRP Report 418, *Research on the Relationship Between Economic Development and Transportation Investment*, Transportation Research Board, 1998.