3.0 SURVEY AND DESIGN PROCEDURE

- **General**

The purpose of this chapter is to provide the designer with a general outline of the survey and roadside inventory procedure and the design procedure from the start of survey data collection to the production of plans, specifications, and estimates. This chapter is not all inclusive but intended to provide the designer with general knowledge on how projects are designed via the project development process.

3.1 GENERAL SURVEY PROCEDURES

Location surveys are performed to provide the designer with information about the project site. The products generated by the location survey depend upon the type and scope of the project. These products may include: Geodetic Control Monuments, Horizontal Control Network, Vertical Control Network, Planimetric Map, Digital Terrain Model (DTM), Property Monument Recovery Map, Existing Right of Way Centerline and Boundary Resolution Map, and a variety of other specific purpose maps, such as Utility, Airport Permit, Railroad Encroachment, etc.

For detailed ODOT survey procedures refer to the 1998 "Route Surveying – ODOT Procedures for Location, Design, and Monumentation" manual.

3.1.1 LAND SURVEY LAW

It is ODOT policy that licensed land surveyors, in appropriate positions, are responsible for land surveying practiced under their supervision including conformance to all state statutes pertaining to survey and land laws. This includes but is not limited to the following statutes:

ORS 92 Subdivisions and Partitions
ORS 93 Conveyancing and Recording
ORS 209 County Surveyors
ORS 672 Professional Engineers, Land Surveyors, Geologists

In addition to the requirements of state law, the State Highway Engineer has directed that:

1. The Project Manager, Region Survey Manager, or Technical Services Resource Manager shall contact the appropriate County Surveyor upon commencement of any field location

surveys. This will keep the County Surveyor informed of work within their jurisdiction. For government monuments in danger of being destroyed by construction activities, arrangements should be made with the appropriate County Surveyor for monument referencing or replacement. "Project Notification to County Surveyors" form # 734-2298 should be used and is located in the manual *"Route Surveying- ODOT Procedures for Location, Design, and Monumentation-1998"*.

2. Copies of field notes with references to found and/or set monuments will be furnished to County Surveyors upon request.

3.1.2 SURVEY TYPES

• Geodetic Control Survey

Geodetic Control Surveys cover a large area and take into account the curvature of the earth. They are executed to specified accuracies and standards and may be used to provide primary control for projects. These surveys provide monuments that are connected to the Oregon High Accuracy Network (HARN). Project Horizontal and Vertical Control Networks may be based on Geodetic control in the vicinity.

Information concerning the HARN is available from Geometronics in Salem. The Geometronics field crew will, upon request, establish Geodetic control points where none exist in the vicinity of the job.

• Cadastral Survey

Acquisition of land for highway right of way requires a Cadastral Survey to establish existing property lines and to establish and monument new boundaries. This work must be done in compliance with the laws of the State of Oregon and within the "Rules of Professional Conduct" for practicing land surveyors as defined by the State Board of Engineering Examiners. (See OAR 820.)

Location projects involving acquisition of additional right of way and easements will require a Cadastral Survey. All right of way monuments, property line corners, section or subdivided section corners, D.L.C. corners, etc. within the project limits shall be tied to the project control network.

• Topographic Survey

Topographic Surveys are made to determine the relative position of points on the surface of the earth so that maps showing a plan view of an area can be made. Topographic maps show natural

and manmade features and are used in the planning and design of highways, subdivisions, parks, etc. It is common practice to collect topographic data with an electronic theodolite and data collector. The survey crew records code information along with the measurements to instruct the computer in processing the data. The data is downloaded and processed into a 3D digital map. This digital map is stored in real world coordinates (1:1 scale) and can be plotted at any scale required.

The topographic map should generally include the following:

Fences: measurements to the fences should be taken at frequent intervals. All intersecting fences should be tied.

Approach Roads: Note the grade, type of surfacing, width, name, private approach or public, controlling agency, direction and distance to nearby towns.

Utilities: Locate all utility lines both above ground and underground, even though it may not be necessary to move them. Note the name of the owners, pole numbers, number of wires, pipe sizes, depths, and flow lines. Frequently the local utility company will assist in the location of their facilities. The Right of Way Liaison Agent may be of help in determining a property owner's independent source of water, underground pipes, septic tank, drain field and other important features which must also be shown on the map.

Improvements: Locate buildings, orchards, improved lands, etc., adjacent to the project. Field tie all buildings on properties that may have a R/W taking or potential for flooding.

Irrigation Facilities: Note irrigation ditches and show the direction of flow, the grade, typical section, size of structure, centerline station and angle of the crossing.

Bridges: Show stationing at both ends, width of roadway, type of bridge, type of rail, dimensions of walks, etc.

Railroads: Show centerline stationing of both highway and the railroad at their intersection and the angle of crossing. Tie in head blocks, switches, culverts, bridges, etc. Where the highway runs adjacent to a railroad, frequent ties should be made to the facility.

Terrain: Designate whether the area is cultivated, forested (note if recently logged), marsh, or rangeland. Also note the character of the ground such as clay, rocky, etc. Locate any significant grade breaks or changes in vegetation.

Hydraulics: Show the names and location of all streams in the area. Determine the high and low water stages. Note if the land is ever flooded by backwater. If there are other bridges in the vicinity, make a note of the location of the structure and the size of its opening. Refer to the “Topographic Data Required For Backwater Analysis” pamphlet from the Hydraulics Unit.

Permanent Monuments: A diligent search should be made for all recorded survey monuments. All found corners, both recorded and unrecorded, will be shown on the map.

DTM: A DTM is a representation of the surface of the earth utilizing a triangulated network of points. The DTM models the surface with a series of triangular planes. Each of the vertices of an individual triangle is a field-measured 3D coordinate point. DTMs are created by measuring data points that define breaklines and random spot elevations.

Cross sections, profiles, contours, and slope vectors can be developed from a DTM.

• Stationing

Stationing shall run from north to south and from west to east, corresponding with the highway route number (odd is north-south and even is west-east).

Stationing shall be in 100 foot increments with control points measured to 0.01 foot accuracy, i.e. 10+ 00.00.

Stationing should be continuous. Secondary and additional lines should have an equation at their point of beginning, with the stationing identical to the main line. Stationing equations will also be necessary at intersections of lines, bearing equations, and where new lines tie into previously established lines. The bearings, both back and ahead of any equation, shall be clearly shown. Secondary stationing lines should be differentiated from centerlines through labeling or naming the line (i.e. “SW” 10+00.00).

Where a new line crosses an existing road, centerline stationing for each road will be established at the point of intersection, recorded in the field notes, and shown on the map.

The construction centerline should be common with the right of way centerline. If not, one of the centerlines shall be designated for continuous stationing and will be used in preparing right of way descriptions. Equations shall be used for the other line to produce corresponding stationing for parallel tangents.

Preliminary and located lines shall be differentiated in the field, in the notes, and on the maps by using the prefix 'P' for preliminary lines and 'L' for located lines. If more than one preliminary line or located line is run, the additional lines shall be designated 'P^2, P^3, L^2, L^3,' etc. Lines run solely as a basis for taking topography shall be called 'T' lines.

3.2 PROJECT SURVEY

- **General**

This section provides general guidance in determining the appropriate level of survey data required for project development projects. The guidelines are broken down by the three main project types: maintenance projects, preservation projects (3-R), and modernization projects (4-R Reconstruction, New Construction). The project scoping team will determine the amount of survey work that will be required for individual projects.

3.2.1 MAINTENANCE PROJECTS

The amount of survey work for a maintenance project can vary depending on the project. Generally maintenance projects are small and require only roadside inventory (Appendix D) type of field data collection.

3.2.2 PRESERVATION PROJECTS

Preservation projects that don't include work outside the existing typical section generally only need roadside inventory (Appendix D) information collected prior to project design. During the design work phase, it may be necessary to obtain additional data such as superelevation information on curves in need of correction, or additional widening required for new guardrail flares. The amount of additional survey data will vary and is project dependent.

Preservation projects that include major shoulder widening, curve correction, intersection channelization, or other reconstruction type work, will require more initial survey work. This work will most likely include a DTM of the area.

3.2.3 MODERNIZATION PROJECTS

Modernization projects will almost always require a DTM, which could require a combination of extensive survey work and/or photogrammetry work. Survey work would include gathering topographic information on breaklines (edge of pavement, ditches, shoulders) and features (guardrail, barrier, poles, signs, utilities, etc.). One of the best ways to determine the limits of the survey work is for the designer to conduct a site visit with the survey crew chief.

3.3 ROADSIDE INVENTORY

- **General**

FHWA regulations require that, on 3-R/4-R classes of projects, an inventory shall be made of roadside features that do not conform to AASHTO's *"A Policy On Geometric Design Of Highways And Streets – 2001"* Geometric Design Standards or nongeometric design standards (such as structural strength, safety features and traffic control, etc.). This inventory shall be completed regardless of funding category. In addition to the inventory, a traffic study of crash locations shall be made. The Project Leader should use this data in the development and design of the project.

The level of detail of the roadside inventory will vary between projects. Preservation projects that are covered under the Safety Investment Program (SIP) Categories 1 and 2 will require less roadside inventory work than 4-R (New Construction or Reconstruction) projects. This section is broken down into two areas. Section 3.3.1 covers roadside inventory for 3-R and 4-R projects and preservation projects under SIP Categories 3, 4, and 5. Section 3.3.2 discusses the roadside inventory for preservation projects under SIP Categories 1 and 2. These sections should help the roadway designer in providing level of survey detail required to the Project Team. Chapter 13 outlines the steps responsible parties should take when dealing with design exceptions and the inventory/analysis of 3R/4R projects to comply with the FHWA requirements. To assist field teams in making the inventory, a form on which to record the features has been prepared. A copy of this form is included in Appendix D. The main purpose of the roadside inventory is to note substandard design features, but it can also be used to inventory existing features for mapping and bid item purposes.

- **Roadside Inventory Analysis and Design Concurrence Process**

The *2002 AASHTO "Roadside Design Guide"* provides information and operating practices related to roadside safety. A design concurrence process has been developed for those nonconforming roadside features that are identified in the roadside inventory. Any nonconforming roadside feature that will not be corrected as part of the project will require a design concurrence. The design concurrence process is located in Chapter 13-Design Exception Process, and is similar to the process used for justifying design exceptions.

3.3.1 ROADSIDE INVENTORY FOR 4R (NEW CONSTRUCTION & RECONSTRUCTION) AND 3R (SIP) Categories 3,4, & 5

• Purpose

The purpose of the inventory is to identify all objects and configurations that do not conform to the *2002 AASHTO "Roadside Design Guide"* and AASHTO's *"A Policy On Geometric Design Of Highways And Streets – 2001"* Geometric Design Standards and nongeometric standards (nongeometric standards relate to structural strength, safety features and traffic control). 4-R projects shall have a full roadside inventory completed and should be brought up to full standards, including sight distance, horizontal and vertical alignment, and ADA requirements. In addition, 3R SIP Categories 3, 4, and 5 shall have a full roadside inventory completed.

The clear zone concept is discussed in the *2002 AASHTO "Roadside Design Guide"*. This guide provides an excellent elaboration on the clear zone concept and is a valuable working tool.

• Guidelines

A simple form was developed to inventory the location and description of nonconforming objects. Rather than attempting to provide a box to check off or record every possible detail, the recorder is urged to use extra lines to write in appropriate details. A conventional camera, video camera, or other visual recording device should be used to produce a photographic record of the project. This information should be logically arranged and labeled.

All non-conforming items to be inventoried shall include, but should not be limited to the list of items below:

1. Trees
2. Rock Outcrops
3. Steep Cut or Fill Slopes
4. Barriers (Guardrail & Concrete "Safety Shape")
5. Impact Attenuators
6. Bridge Rails
7. Signs
8. Luminaires
9. Drainage Facilities
10. Other:
    - Utilities
    - Roadway Surfaces
    - Sight Distances
    - Driveways
    - Mailboxes

Structure Columns
Drop-offs at Pavement Edge
Cattle/Equipment Pass Headwalls

(1) Trees present some interesting problems. The easy recommendation is to remove them if they are within clear zone, but in many cases the public sentiment is to save them at almost any cost. Some trees may be entitled to specific protection because of historic or ecological significance. Reasonable protection, such as extending a barrier required for another obstacle, may be more expensive but also more acceptable to the public. Careful analysis of crash history at the site, evidence of the tree being hit, location (such as near outer edge of clear zone on inside of a curve), and public attitude (particularly in urban areas), may indicate an exception should be requested to allow the tree to remain.

(2) Rock outcrops in cut slopes can sometimes be removed, but large outcrops or solid rock cuts may need guardrail or barrier protection. These are easily overlooked as they have seldom been considered for protection. Decisions on the proper protection of slopes must be made only after considering the magnitude of the problem and the costs involved.

(3) Cut or fill slopes steeper than 1:3 require protection. While slope flattening is the desirable action, the preservation and 4-R projects seldom have adequate material available and R/W is frequently inadequate. Flattening may not be feasible due to streams or wetlands at the toe of the fill. Provision of barrier or guardrail is the usual solution. While vehicles can recover on a 1:3 fill slope, the large clear zone required (over 120 feet at 70 mph) frequently cannot be provided within the R/W.

Cut slopes steeper than 1:3 within the clear zone should be flattened or considered for protection. Provide a 1:3 or 1:4 "safety slope" area at the bottom of steeper cuts if possible. Decisions on the proper protection of slopes must be made only after considering the magnitude of the problem and the costs involved.

(4) Barriers include both guardrail and concrete "safety shape" barriers. Guardrail must be checked against current standards for type of rail, height, flare rates, anchors, bridge connectors, end pieces, lap direction, miscellaneous hardware, etc. If the leading end can be buried in the backslope it should be considered even though only a flare may be required. Sloped ends are allowable only when design speed is less than 45 mph and the sloped end is outside the clear zone.

Concrete barrier shall be of the current "safety shape". Consider the effect of overlays, past or present. At the base of the barrier the finished surface of the overlay must not be higher than the top of the vertical 3 inch portion of the barrier for proper functioning. Flare rates and terminal treatments (buried end, etc.) must agree with current standards. Narrow base barrier must be supported with embankment behind it.

Guardrail protecting fixed objects needs approximately 6.5 feet from face of rail to object and approximately 3 feet clear behind it to deflect. If deflection room cannot be provided, rigid barrier must be used.

Exposed guardrail and barrier ends that cannot be properly flared or buried, such as in exit ramp gores, should be protected with an impact attenuator.

(5) Existing impact attenuators must be properly maintained with no modifications that are not approved by the manufacturer. A careful inspection by experienced personnel using the manufacturer's specification book should be done. The District Manager, Bridge Engineering, or manufacturer's representative may be appropriate sources of expert assistance.

(6) There are five "acceptable" bridge rail shapes identified in the *2002 AASHTO "Roadside Design Guide"*. If in doubt as to acceptability of a particular rail consult Bridge Engineering. The concrete "safety shape" should be used on freeways. Guardrail connections to bridge rail are a critical area. Chapter 7 of the "*Roadside Design Guide"*, *Bridge Railings and Transitions* provides an excellent guidance.

(7) Signs must be mounted on breakaway posts if within the clear zone. The need for a multidirectional breakaway base should be considered. The slope on unidirectional single-support breakaway bases must be in the correct direction.

Breakaways must not be in the ditch and should be at or above the ground surface, but not over 4 inches above the surface. Proper bolts, washers, slip plates, etc., must be in place with no modifications, such as welding, that may alter the function of the breakaway.

The hinge mechanism must also have all hardware in place. No auxiliary sign panels should span the hinge in such a way as to alter its function. The hinge mechanism should be a minimum of 5 feet, and preferably 7 feet, above the ground. On fills the nearest sign post should be at least 20 feet outside the edge of the shoulder so the vehicle will not be airborne when it strikes the sign. Signs mounted on wood posts must not have concrete foundation collars or support plates. Wood post installations must comply with Standard Drawings TM100 and TM200, TM201, TM202.

(8) Luminaires must have frangible or slip bases if within the clear zone. Some older frangible bases may not function properly with the newer small cars. Consult Bridge Engineering for acceptability of specific frangible bases. If luminaires cannot be readily relocated or protected, a study of the need for them should be considered. Eliminating them may be less hazardous than retaining them.

(9) Drainage facilities should be studied carefully. Many cross culverts may need stabilization, rehabilitation, or replacement. The structural integrity of each drainage

facility should be evaluated prior to considering extending the culvert for widening a roadway. Contact the Highway Maintenance Supervisor for the project area or the Geo/Hydro Unit for information pertaining to the existing culvert when the structure is less than 6 feet in diameter. If the culvert is 6 feet in diameter or larger contact the Region Bridge Inspector or the Bridge Maintenance Unit for assistance. If inadequate information is available, a thorough culvert inspection should be performed.

Many cross culverts can be lengthened to eliminate open ends, outlet ditches, etc., within the clear zone. Even though paved end slopes exist, they may not provide a safe end, since many of the 1:3 paved ends are inletted into 1:4 or 1:6 slopes, creating a ditch across the clear zone. Paved end slope installations must be constructed as shown on Standard Drawing RD320, with particular attention to warping or contouring the slope as shown.

Metal end sections on culvert pipes require appropriate end treatments. Safety end sections should be considered on larger pipes (See Standard Drawings RD320, RD322, RD324). Recontouring around some existing paved end slopes must be considered if erosion and settlement have allowed the upper end of some paved end slopes to project more than 6 inches above the ground.

Longitudinal drainage ditches must be uniform and not eroded. It is desirable, but not mandatory, that pipes under driveways and crossroads have end slopes flatter than 1:6 so that vehicles hitting them are not stopped abruptly or launched into the air. Type "ME" or "MO" inlets or modifications of them, may be required to accomplish these flatter end slopes. Pay particular attention to crash history when evaluating these features.

(10) Most inventories for preservation and 4-R projects are in conjunction with overlay or paving projects so correction of poor pavement conditions is an integral part of the project. Drop-offs, roughness, raveling joints, etc., must be analyzed if repaving is not already part of the proposed project.

Certain design elements can best be analyzed in the office using "As Constructed" plans. These include horizontal and vertical alignment and typical sections. Elements such as sight distance for merges, lane drops, road approaches, and intersections should also be analyzed in the field so the interaction of all elements can be better evaluated.

A broad viewpoint must be maintained so that possible hazards that don't fit conveniently in the categories already mentioned are not overlooked. Utility (poles, valves, etc.) slope breaks that can launch a car or stop it as solidly as a barrier, cattle and equipment passes hidden by vegetation, erosion around culvert ends hidden by weed growth, etc., are easily overlooked. Shoulders on structures should be full width, according to current standards.

- **References**

The field crew should become familiar with the *2002 AASHTO "Roadside Design Guide"*. A good understanding of how the clear zone requirement is determined by considering design speed, side slope, ADT, and curvature is needed. All nonconforming items must be inventoried, even though it may appear to be difficult to bring them into conformance with the appropriate standard. Economics and practicality can be determined later in the office.

3.3.2 ROADSIDE INVENTORY FOR 3R (SIP) Categories 1 and 2

- **General**

The design process outlined below provides guidelines for developing a roadside inventory for 3R Category 1 and 2 (SIP) projects. **The scoping team should determine the level of effort that will be required by the survey crew.** Very definite parameters should be set as to which roadside obstacles need to be inventoried. The intent of the inventory for Category 1 and 2 projects is not to survey every fixed object or culvert throughout the project. Only those objects near the roadway that constitute a substantial hazard should be inventoried. Continuous runs of utility poles or trees at the R/W line generally don't need to be inventoried. However, if there is a location with a number of run-off-the-road crashes (outside of a curve), then the effort and the area covered in the inventory should be increased.

Other than roadside features, the field work on these projects should be limited to the amount needed for quantity calculations, in particular leveling for crown and super correction. By their nature, urban projects may require some additional work but every effort should be made to limit the survey work to the minimum needed for the particular project.

During scoping, the need for exceptions to design standards should be identified. Design exception requests shall be submitted as soon as the need is identified. This will minimize the need for redesign should the exception request be denied. For further information on design exceptions, see Chapter 13.

- **Roadside Inventory**

By their nature, preservation projects on sections of highway having low crash history place special emphasis on pavement preservation even while recognizing that certain cost effective safety improvements may be necessary and desirable. Due to good safety performance and limited scope, roadside inventories on these sections should be limited to the following areas:

1. Roadside Obstacles Within Clear Zone or R/W

Trees
Luminaires
Utility Poles
Misc. Fixed Objects

2. Existing Guardrail Including Bridge Rail Connections
3. Public Road Intersections With Stopping Sight Distance Less Than ODOT New Construction Standards
4. Horizontal Curves More Than 15 mph Below ODOT New Construction Standards
5. Vertical Curves More Than 20 mph Below ODOT New Construction Standards Hiding Intersections, Sharp Horizontal Curves, or Narrow Bridges
6. ADA Deficiencies

Following is a further explanation of the above inventory items and some thoughts on appropriate mitigation measures that may be incorporated on this type of project.

(1) **Roadside Obstacles -** With the emphasis on pavement preservation, the inventory of roadside obstacles is limited under most circumstances to R/W or clear zone, whichever is less. Inventories wider than clear zone are not considered a good expenditure of engineering budgets as only under unusual circumstances will substantial widening or realignment be included in the project. The survey crew should rely on the scoping report from the project team for guidance on the level of effort to be expended on the inventory of roadside obstacles.

(2) **Existing Guardrail -** All existing guardrail including bridge connections and end treatments should be inventoried. Bridge connections shall consist of positive bridge connection, standard transition Type 3 Guardrail, and current standard terminal. During the inventory/analysis process, the project team should also be looking for opportunities to modify existing installations that do not adequately protect obstacles either by extending or burying ends in cuts. Once any portion of the guardrail installation is modified, even for height, the entire run must be brought to new construction standards or concurrence must be obtained from the Roadway Engineering Manager.

(3) **Intersection Sight Distance -** Most of this analysis can be done in the office from As-Constructed Plans. Many times those intersections with deficient sight distance will also show up during the crash analysis. The SIP may consider those intersections with crash histories for improvement, but even those without a history have a potential. These intersections will probably have opportunities to incorporate low cost mitigation elements with the project to diminish crash potential. Deficient intersections should be reviewed on-site with the Region Traffic Engineer to aid in identifying mitigation measures.

(4) **Horizontal Alignment -** Horizontal curve deficiencies can best be identified by a review of As-Constructed plans, but superelevation rates need to be measured in the field. As a minimum, superelevation should be corrected as close as reasonably possible to the new construction standard with the project. Additional mitigation (delineation, signing, etc.) may also be appropriate due to site-specific conditions. Again, the Region Traffic Engineer should be consulted for input.

(5) **Vertical Alignment -** As-Constructed Plans should be used as a starting point for identifying vertical alignment deficiencies. Field verification is needed to determine if major driveways or intersections are hidden by the vertical curves. If a crash history exists at these locations or horizontal curve locations, it may be appropriate to include major safety improvements with the project funded from the SIP. This need should be identified early, during project scoping, so funding can be procured.

(6) **Americans with Disabilities Act -** ADA deficiencies are predominantly limited to urban preservation projects. ADA accommodation is more than a standard; it is a legal requirement. Intersection accommodation by installation of sidewalk ramps is an absolute minimum regardless of jurisdictional ownership of the sidewalks. Driveways and sidewalk obstacles should be carefully reviewed for candidate improvements and may provide good opportunities to partner with local jurisdictions for a better overall facility.

3.4 DESIGN PROCEDURES

- **General**

The purpose of this section is to provide the designer with a general outline of the design process from the point of obtaining survey data to the production of Plans, Specifications, and Estimates. This section is not all inclusive of all design features but will provide the designer with a general basis on how projects are designed through the project development process.

3.4.1 PRE-ROADWAY DESIGN PROJECT SCOPING

A project scoping report is developed as part of completing the project prospectus. Project scoping aids in delivering a product the meets the goals and objectives of the identified problem. Elements of a scoping effort include:

- Clear Problem Statement
- Outline of project elements

- Estimates of preliminary engineering, construction engineering, and right of way costs
- Anticipated design exceptions
- Required agreements
- Right of way requirements
- Environmental scope
- Utility conflicts
- Special elements

Project Scoping Teams normally consist of the following personnel:

Typical Members	**As Needed**
Project Leader	Region Traffic representative
Technical Services or Roadway Engineering representative	Local representative
	Region Utility specialist
Construction Project Manager	Bridge representative
Right of way representative	Transportation planning representative
ODOT Maintenance representative	Pavement representative
Environmental representative	
Designer	

The Project Leader, with the assistance of the scoping team members, completes the following activities:

- Obtains input on project prospectus from appropriate units.
- Prepares a draft schedule of the project for review by appropriate units.
- Prepare a preliminary budget for the project.
- Completes the project prospectus and obtains the appropriate signatures and approvals.

3.4.2 PROJECT FIELD DATA

Prior to beginning project design, the designer will obtain all available information pertinent to the project. The amount of information required will depend upon the scope of the project. Information that normally will be obtained includes:

- From Project Leader
  - Project Prospectus
  - Background Information
  - Scoping Notes and Information
  - Project Team Meeting Minutes, Memorandums

- From Field Survey
  - Complete Digital Terrain Model (DTM) (Depends on scope of project)
  - 3-R/4-R Roadside Inventory
  - Base Map
  - Confidence Point Report
  - Copy of Field Notes, Level Notes, Transit Notes
  - Report of Project Monuments
  - Photograph Log - Digital
  - Airport Permit Map
  - Survey Report, Narrative, and Transmittal
    - Required for projects that require additional right of way or easements.
      - County Assessors Plats and Ownership Map
      - County Surveys
      - Subdivision Plats
      - Government Land Office Plats and Notes
      - Road Dedication or Vacations
      - Vesting Deeds, Sales Agreements, Contracts, etc.

  - Environmental Information
    - Resource Maps – Wetlands, Historical/Cultural, Archeology

  - Miscellaneous Information collected by Designer or Others
    - As Constructed Plans
    - Utility Maps and Data
    - Right of Way Information
    - Interchange Layout Map

3.4.3 PROJECT DESIGN

- **General**

A designer is assigned to a Project Team early in the project development process. Outlined below is the general process that a designer undertakes in taking a project, after being assigned to a Project Team, to final Plans, Specifications, and Estimate.

- **Receipt/Review of Field Data and Project Team Meetings**

After being assigned to a Project Team, the designer should review all available field data listed in Section 3.4.2 for completeness and accuracy. An initial Project Team meeting is normally held to review the scope of the project, to introduce Team members to one another, to review the draft

project development schedule, and to draft project work tasks for the different team resources. The Project Team should request the appropriate information (See Section 3.4.2) to be gathered at the initial scoping meeting. Scoping trips are held to review the project in the field. Lack of information or detail should be discussed with the Project Leader and Project Team and additional survey information or needs requested if necessary. Critical items include review of the survey narrative, and all general project information.

- **Project Files**

The designer will establish and maintain a file for proper documentation. Project files consist of designer established files and files that are obtained from other units or resources. Below is a list of commonly used information obtained from other units that should be kept on file.

Designer Files

- Cost Estimates
- Correspondence
- Calculations
- Special Provision Data
- Basic CADD Files
    - Existing Topography
    - Design Details
    - Right of Way
    - Cross-Sections
    - Profiles

Other Unit Files

- Project Prospectus
- Scoping Information
- County and City Data
- Pavement Design
- Geology/Geotechnical Reports
- Bridge Vicinity Map
- Environmental Documents
- Interchange Layouts
- Permits
- Utility Mapping

In addition, ODOT has adopted a naming convention in order to maintain a statewide consistency and understanding of project names. This naming convention ensures consistency and continuity. It is critical for consistency and accuracy that the proper file naming convention be used.

- **Data Management**

It is important that the designer maintain project files, and archive files in the appropriate manner. Typically the drafter will archive final contract plans at the time of bid. The designer will archive other pertinent information such as narratives, estimates, correspondence, or archive a project that has been dropped or canceled from the STIP and needs to be stored until the project is brought back into the program. The designer should refer to the ODOT Engineering Archives concerning the archiving and restoring procedures.

- **Coordination with Other Units**

As the designer proceeds with the project development process and project design, there is correspondence and coordination with other units, both inside and outside of ODOT. The amount of time of interaction with other units is dependent on type of project and project schedule. Outlined below is a listing of some of the major units outside of Roadway Design that may be a part of the design process.

- Utilities: The Region Utility Specialist reviews the design maps, cross sections, and narrative provided by the designer and prepares a report on the estimated impacts to utilities by the different project design alternatives. Issues such as time and relocation needs, potential right of way impacts, and estimates are covered in the report. The designer should work with the utility specialists on issues such as determination of reimbursable utility costs, the different permit processes, when and where to pothole, and consideration of the use of Subsurface Utility Engineering (SUE). Other utility projects that the utility specialist can assist with include:
    - Gas Lines - major or minor
    - Water Lines - major or minor
    - Power Lines - clearances, type of lines
    - Communications - fiberoptic, cell towers, cable
    - Sanitary and Storm Sewer
    - Utility Vaults
    - Joint Trenches
    - Utility Adjustments

- Right of way: At different times in the project design process, the designer may work with Right of Way personnel to obtain scoping right of way impacts, determine right of way impacts on design alternatives, determine proper road approaches and access lists.

Refer to Chapter 4 (Right of Way) and Section 5.11 (Access Management) for additional information on the different right of way processes encountered during project development.

- Bridge Design: For those projects that include bridges or structures, the designer should work closely with the bridge designer to ensure proper alignments, bridge widths, and identifying impacts. See Section 10.8 for additional detail.

- Geo/Hydro Design: The designer should work closely with the Geo/Hydro Section when drainage and geotechnical issues are involved. Items such as location of water quality and detention facilities should be discussed. The proper design of culverts for fish passage is critical to design as well as the geotechnical elements of a project. This Section furnishes the design, using different geology/geotechnical reports for assistance in large culvert design. Discussion should include kinds of earthwork materials encountered, foundation problems, erosion control problems, and substantial cuts and fills. See Sections 10.1 and 10.4 for additional detail on Hydraulics and Geotechnical issues.

- Traffic Control: Maintenance of traffic during construction must be included in all highway projects. The roadway design should work with the Traffic Control Plans designer to ensure that proper Traffic Control Plans are developed and submitted for projects. See Section 5.6 for additional information.

- Environmental: The Environmental Section provides the designer and Project Team with environmental information that allows the designer and Project Team to make project decisions which balance transportation needs, safety, and economics, and protects the environment. See Section 10.5 for additional information.

The following areas described in other sections of this manual are also involved in project design and typically involved in most projects.

- Pavements (Section 10.3)
- Transportation Analysis (Section 10.6)
- Traffic Management (Section 10.7)
- Bicycle and Pedestrian (Chapter 11)
- Preliminary Design (Section 9.1)
- Permits (Section 10.9)
- Roadside Development (Section 10.10)
- Specifications and Standards (Chapter 14)
- Rail (Section 10.12)
- Aeronautics (Section 10.13)

- **Project Design (Project Design Alternative Selection) and Project Design (Project Delivery)**

Upon receiving and reviewing project information from the Project Team and other sources, the designer can begin the design of the different project alternatives. During the design process, the designer will continuously be working with the different project team members in obtaining and distributing project design information. Outlined below is the general design process. This process will vary depending on the type of project (3-R/4-R) and the project schedule established by the Project Team. After the project design alternatives have been developed through the environmental and public involvement process, a recommended project alternative is selected. As with the project design alternative process, the designer continues to work with the different project team members in the refinement of the selected project alternative design. The final product from a designer's perspective is a complete set of contract plans and specifications.

- Roadway Design Standards: The designer shall use the following references in the design of roadway projects.

  - *ODOT Highway Design Manual* (2002)
  - AASHTO's *"A Policy on Geometric Design of Highway and Streets - 2001"*
  - *"Oregon Standard Drawings"*, ODOT
  - AASHTO's *"A Policy on Design Standards - Interstate System"* (July, 1991),

  Using the above standards, the designer will complete the following design processes and procedures:

  - Typical Section - Lane, shoulder, sidewalk, median, and bridge widths, side slopes, rock slopes, clearances.

  - Horizontal and Vertical Alignment - Design speed, grades, spiral lengths, horizontal and vertical curves, superelevation rates, vertical clearance, and stopping sight distance.

  - Guardrail/Barrier - Use the ""*Roadside Design Guide*"" (AASHTO) to provide appropriate use of barriers, offsets, flare rates, clear zone features, etc.

  - Standard Drawings/Detail - Select appropriate standard drawings and include standard details in plans.

  - Materials and Earthwork - Discussion of the kinds of materials encountered, deficiency or excess of material, disposal of excess or acquisition of borrow, and foundation problems.

  - Quantity and Cost Estimate - Maintain current quantity and cost estimate.

- **Design Work with Other Sections/Units**

    - Pavement Design - Check with pavement design for most current pavement design. This includes the pavement design for stage construction, detours, and frontage roads.

    - Bicycle and Pedestrian Facilities - Check with the bicycle and pedestrian unit to confirm the appropriate bicycle and pedestrian features.

    - Development Plans for Prospective and Mandatory Sites - Work with the Region Geologist to assure that essential data is shown on the material source plan, borrow source plan, and disposal site plan.

    - Temporary Protection and Direction of Traffic- Stage construction review of the traffic control plans to see if traffic will operate and has sufficient widths and clearances.

    - Right of Way - Review the design to see that all right of way needs have been addressed. Make sure there is adequate right of way or easements for slopes, state construction, utilities, permanent signs, illumination, traffic signals, detours, drainage facilities, and road approaches or driveways.

    - Drainage - Review drainage and make note of any floodplains, bridges, erosion or scour, large culverts, large storm sewers, structurally failing pipes, fish passages, net new impervious surface area (water quality), and other drainage problems. Work with the Geo/Hydro Section for evaluation of drainage design and review of drainage plans. Work with the Standards Engineer for evaluation and approval of the Pipe Data Sheet.

    - Erosion Control - Review grading and drainage and make note of project timing, surrounding vegetation, long or steep slopes, concentrated flows, off-site flows, swales or streams, inlets, construction staging, and other items that may affect surface erosion. Work with the Hydraulics Unit for evaluation of erosion control design and review of erosion control plans.

    - Geotechnical - Work with the geologist and geotechnical engineer according to Section 10.4.

    - Bridge - Review the following with the bridge designer: stationing, horizontal and vertical alignments, typical section, superelevation rate, roadway width, length, stage construction, overlays, bridge end panels, rails, inlets, seismic retrofit, construction duration, abutment protection plans, and cost.

- Traffic Management - Review travel and shoulder widths, sidewalk widths, turning radii, pedestrian ramps, etc. on any planned signals with the signal designer. Review the need for any signing or illumination with Traffic Management.

- Roadside Design - Work with Roadside Development designer to determine seeding, mulching, planting, wetland mitigation, and roadside development designs.

- Permits - Work with permits units and Project Leader to determine appropriate permitting issues for the project (See Section 10.9).

- Railroad and Utilities - Provide the necessary maps and data to Right of Way Engineering for railroad encroachment. Work with the Region Utility Specialist to determine utility impacts such as gas, water, power, communications, storm and sanitary sewer, utility adjustments, and trenching.

- Specifications - Work with specifications writer to achieve consistent plans and specifications. The specification writer is normally involved at the preliminary plans stage.

- Environmental - Continual work with the environmental project manager in order to follow guidelines established for project development. Designer will provide informational maps, roadway alignments, and other design information for project team meetings and public involvement processes at different stages of the project development process.

- **Plan Preparation**

The designer, with the assistance of the drafter, will produce a set of plans arranged in the order listed below. The *Contract Plans Development Guide* provides procedures for the proper development of contract plans.

- Title
- Typical Sections
- Details
- Traffic Control (Details, Detour, Traffic Control Plans)
- Erosion Control
- Water Quality and Detention Facilities
- Material Source (Stockpile Site, Disposal Site)
- Pipe Data

- Plan and Profile
- Roadside Development (Wetland, Irrigation, Plantings, Contour Grading)
- Bridge (Details, Noise Mitigation Wall/Barriers)
- Traffic (Markings, Signing, Illumination, Signals)

- **Location Plans (Planning Level)**

Plans developed for the different planning projects such as corridor level planning projects, Transportation System Plans (TSP), Refinement Plans, and Location Environmental Impact Statements. The plans at this stage are approximately at the 10% level consisting of mainly single line horizontal alignments.

- **Approved Design/Preliminary Plans/Advanced Plans/Final Plans**

Chapter 14 provides detail on the different stages of contract plans. From a design standpoint, the further along in project development, the more detailed a design becomes. Early on in the design process the different design alternatives are developed with rough horizontal and vertical alignment. As the project development process proceeds, the design alternatives are refined to a point where one design alternative becomes the design for the project. At this point the project design becomes more detailed and refined.

- Approved design is the tangible culmination of all activities that are needed to begin the drafting of contract plans for construction. It consists of a complete set of Plans for Approved Design. Plans for approved design are supported by a design narrative and consists of all substantial features of a project that allows the project team to proceed with the preparation of contract plans. Plans for approved design are at the stage where the project team has a high degree of confidence that the scope of the project will not change and that right of way and environmental permits can be acquired in time to meet the scheduled project letting date.

  Approved plans will generally require a title sheet, typical section, detail sheets, and layout sheets. Additional information on Plans for Approved Design can be found in the Highway Division Project Delivery Leadership Team Operational Notice PD-02. The designer should review PD-02 to determine the requirements needed for Plans for Approved Design.

- Preliminary Plans (70%) – Assimilating comments received from the Concept Plans, the designer continues to develop the roadway design for the project. Interaction with the different units continues towards Preliminary Plans, which

are typically 70% complete. At the Preliminary Plan phase, a complete set of plans, outlined in plan preparation above, are produced and distributed for review and comment. Prior to distribution the Design Team Supervisor (Technical Services Resource Manager) reviews the plans.

- Advance Plans (95%) - At this stage in design, minor changes in the project design are being made. The Special Provisions accompany the Advance Plans and are sent out for review and comment.

- Plans-In-Hand - Prior to the letting date, a plans-in-hand review is conducted in the field (if necessary) with all involved parties attending. This is the last opportunity to discuss and resolve anticipated problems or issues relating to the plans and specifications prior to the contract letting. The Project Leader makes all meeting arrangements while the designer provides the necessary copies of the plans.

- Specifications - The designer shall furnish the specification writer with a quantity estimate, drawing number list, list of unusual items, and the most recent set of plans. All changes made to the plans are furnished to the specification writer.

- Final Plans - The quantity check is conducted by another designer prior to final plan review. The final plans are reviewed by the following:
    - Design Team Leader and/or Senior Designer
    - Technical Service Resource Manager (TSRM)
    - Lead Drafter
    - Traffic Control Plans Engineer

- Returning Field Data - Prior to the project being advertised, the design data should be returned to the Construction Project Manager in a transmittal letter. A project file index should be developed to assist the construction office with the identification of the CADD files. Index folders may include a calculations folder, design folder, documents folder, photos folder, reports folder, and other needed project design folders. This will help the transition from the design of the project to construction in the field.

- **Designer Check List**

The Designer CheckList (Appendix E) should assist the designer in the developing a complete set of contract plans. The checklist, although not inclusive, provides the designer with a list of the major steps incurred during the normal project design process.