Part 1200 Other Technical Disciplines

Section 1201 Bridge

1201.1 General

It is important to contact the Bridge Engineering Section when a project involves some type of structural element, whether it is a retaining wall, culvert, bridge, cantilever sign support, etc. The designer should stay in contact with the bridge designer as a project develops to ensure that the roadway and bridge elements of a project fit together.

1201.2 Bridge Definition

A bridge is defined as a structure spanning and providing passage over a river, chasm, road, or the like, having a length of 20 feet or more from face to face of abutments or end bents, measured along the roadway centerline.

1201.3 Structure Types

Structure types include culverts, slabs, box beams, and various types of deck girders, box girders, arches, and trusses. The selection of structure type is determined by the site, economic, environmental (in-water work windows, etc.) and esthetic considerations.

For small streams, a culvert might be used instead of a bridge. However, for locations with low deck-to-streambed clearances, a culvert may not be proposed because it could not provide enough waterway area. Fish passage issues may also influence the type of structure selected.

Concrete structures may either be pre-cast or cast-in-place. Pre-cast members offer the advantage of off-site fabrication (especially important in remote locations), speed of construction and minimal falsework. Precast members can play a key role in accelerated bridge construction, where it is important to minimize the impact of a construction zone on road users and interested parties. However, it may be difficult to accommodate horizontal curves, and changes in grade lines or superelevation with precast members. Cast-in-place structures can more easily accommodate the geometrics but require falsework, which can create a traffic hazard at grade crossings and potentially cause problems at stream crossings.

The roadway designer needs to be aware that there are many types of structures with features that can complement the specific site conditions. It is very important that the roadway designer and the structure designer communicate all of the site conditions to facilitate appropriate structure type selection.

1201.4 Structure Lengths

1201.4.1 Roadway Crossings

For bridges on county roads and less traveled highways, provide the required roadway horizontal clearance plus 1:1.5 end slopes. For all other highways use 1:2 end slopes. When using end slopes steeper than 1:2 a geotechnical review shall be completed to ensure stability.

1201.4.2 Stream Crossings

Provide the required waterway opening to pass the specified design flood. The hydraulics report will provide a required waterway area, the stream bed elevation and the design flood high water elevation. Normally, a minimum bottom-of-beam clearance of 12 inches is provided above the design flood high water elevation. If drift or debris is a concern, the bottom of beam clearance will be increased.

Normally, overtopping is not desirable, but may be required to accommodate regulated hydraulic considerations.

Provide the required waterway opening to meet fish passage requirements.

See also Section 1211 Hydraulics.

1201.5 Structure Clearances

See Part 300 for additional information on all clearances.

1201.5.1 Vertical Clearance for Highway Traffic

Proposed new construction that reduces vertical clearance shall require consultation with the Statewide Mobility Program to ensure understanding of the impact of the proposed decrease to the user. All other projects, which result in final vertical clearances at or above the minimum vertical clearance, require notification of MCTD to ensure all vertical clearance inventories are current and updated for the appropriate routing of permit vehicles.

For projects other than new construction, no reduction of the existing vertical clearance below the minimum vertical clearance is allowed.

1. All High Routes the Vertical Clearance Standard is 17 feet-4 inches.
2. All non-High Routes on the NHS the Vertical Clearance " Standard is 17 feet.
3. All non-High Routes and non-NHS the Vertical Clearance Standard is 16 feet
4. Vertical clearances during construction below the minimums requires consultation with the ODOT Statewide Mobility Program.

More information, standards, and guidance on vertical clearance is available in Highway Directive TRA 07-15 and Tech Bulletin RD17-02(B).

1201.5.2 Horizontal Clearances for Highway Traffic

Normally the bridge roadway width will equal the approach roadway width plus 4 feet for bridge rail shy distance.

1201.5.3 Vertical Clearances for Railroad Traffic

Coordinate with the Railroad Liaison to determine required vertical clearances for railroad traffic. In general, the following minimum vertical clearances apply, however, the Railroad Liaison may determine that project-specific clearances are required.

1. All new structures are to be designed with a minimum of 23 feet 6 inches vertical clearance.
2. A minimum vertical clearance of 21 feet (UPRR) or 21 feet-6 inches (BNSF) is required during construction.

1201.5.4 Horizontal Clearances for Railroad Traffic

Coordinate with the Railroad Liaison to determine required horizontal clearances for railroad traffic. In general, the following minimum horizontal clearances apply, however, the Railroad Liaison may determine that project-specific clearances are required.

1. The minimum clear distance from the center line of the track to a column face is 25 feet. This distance can be reduced to 18 feet if crash walls are installed.
2. A minimum horizontal clearance of 12 feet (UPRR) or 15 feet (BNSF) is required during construction.

1201.5.5 Horizontal Clearance during Construction

Coordinate with the Statewide Mobility Program to determine required horizontal clearances during construction. In general, the following minimum horizontal clearances apply, however, the Mobility Services Team may determine that project-specific clearances are required.

1. On Interstate Freeways the minimum width of 19 feet between face of rail for one-way/one lane traffic, plus additional clearance to falsework behind rails. Above 8 feet vertical on each side an additional 2 feet horizontal is required.
2. On non-Interstate highways the minimum width of 16 feet between face of rail for one-way traffic, plus additional clearance to falsework behind rails.
3. Minimum width of 28 feet between face of rail for two-way traffic, plus additional clearance to falsework behind rails.

1201.6 Curbs and Sidewalks

For a particular crash tested bridge rail, the curb or sidewalk height should be used as shown on the appropriate standard drawing.

1201.7 Deck Drains

Some form of drainage system is normally needed on or off structures that have curb or concrete parapet rails. The Roadway Plans drainage details should be carefully reviewed. If drains are required, the project hydraulics engineer will do the design and determine the size and spacing. Bridge length, deck grades, cross slope, typical section, and deck surface type will be needed to determine the deck drain layout. See also Section 1211.

1201.8 Structure Superelevations

The structure superelevation should match the roadway superelevation criteria. Structures are more susceptible to surface icing therefore superelevation rates may need to be limited to 8 percent or less in areas beyond the traditional snow/ice limits of the roadway superelevation criteria.

1201.9 Traffic Control during Construction

There are four basic methods of handling traffic for replacing a bridge:

1. Close the highway while removing and rebuilding the bridge.
2. Use the existing roadway and bridge while constructing a parallel bridge on new alignment.
3. Construct a temporary detour bridge around the existing bridge and replace the bridge on the existing alignment.
4. Use stage construction with existing or new lanes carrying traffic while other portions of the existing bridge are being removed and rebuilt.

In addition, accommodations need to be made for pedestrians (including the disabled) and bicycles passing through the work site, especially in urban areas.

1201.10 Bridge Rail End and Barrier Treatments

The proper type of bridge rail end and barrier treatment is dependent upon the location of treatment. Below is a listing of ways of treating bridge ends and barriers. Engineering judgment is still required when areas of treatment are nonstandard.

1. Rural conditions, bridge rail end treatment: Use standard approach guardrail to bridge rail transitions. Apply at all rail ends inside the clear zone.
2. Urban conditions, bridge rail end treatment: Normally no approach rail is used when the design speed is 40 mph and below. In these cases, the end of the bridge rail will be protected by a tapered down concrete transition, even if the rail is at the back of a raised sidewalk and is outside the clear zone.
3. Ditch rider roads, bridge rail end treatments: When ditch rider roads are closer to the end of the bridge than standard transitions will allow, a crash-tested treatment shall be used. There is a minimum distance from transition to ditch rider road that allows this system to work, so judgment shall be used in those situations.

1201.11 Bridge Design Deviations

The bridge discipline uses a design deviation process to document design details that do not meet ODOT Bridge design standards. The ODOT Bridge Design Manual (BDM) provides guidance for when a Bridge Design Deviation is required and the process to complete one.

Section 1202 Geotechnical Design

1202.1 General

Two of the many questions faced by the roadway designer include:

1. What are geotechnical project elements; and
2. How should they be dealt with?

Geotechnical project elements include all issues of design and construction involving soil and rock. How to deal with geotechnical project elements is a more complicated question. Since almost every highway project uses either earth or rock as a construction material and relies on earth support, subsurface information and geotechnical data is essential for project planning, design, and construction. Any geologic feature or material that affects the design and construction phase of a project or has a bearing on site or corridor selection in terms of hazards or economics must be investigated and analyzed. Of equal importance is the clear and accurate portrayal of these conditions in a format that is accessible and understandable by all users.

The purpose of this section is to make the roadway designer aware of the broad range of geotechnical issues that may need to be addressed, and their potential effects on any project regardless of size or apparent complexity. There are common project elements that typically require site-specific geotechnical investigation and design such as bridge foundations and landslide mitigations. Some project elements, depending on the site history and underlying geology, may or may not need a site-specific geotechnical investigation and design, or may require different levels of effort. The geotechnical designers will be able to determine the level of effort based on their own or other's knowledge and experience of the site to make these judgments. Because of the underlying site conditions, elements that generally don't warrant geotechnical design for most sites may require it at others. Conversely, investigation and design efforts may be scaled back or eliminated at other sites due to known favorable conditions, and the significance of the project feature. It is the geotechnical designer's responsibility to make these decisions.

The guidance provided in this section is not exhaustive as every project is unique. The ODOT Geotechnical Design Manual (GDM) must be consulted for all geotechnical design elements.

1202.2 Common Geotechnical Design Issues

Due to the variability of soil and rock, the design and construction of embankments and cut slopes require investigation, laboratory testing, and geotechnical analyses. The following is a short list of common geotechnical issues encountered during project delivery. Since every

project is unique, the list is not exhaustive, and the GDM must be consulted for all geotechnical design elements.

1202.2.1 Selecting and Designing Stable Slopes for Cuts and Embankments

This far ranging issue must consider the materials available or required for construction, the space available to make the slopes, erosion from the slope, picking slopes to minimize maintenance, how the slopes will be constructed, surface drainage over the slope, and quality control to ensure good performance. The subject also includes designing steeper than usual slopes to accommodate right of way limitations, avoid environmental features, or simply save money. Many options can be used to build steep slopes ranging from specially placed select materials to geosynthetic reinforcement.

1202.2.2 Designing Inclinations for Cut Slopes and Embankments

Inclinations for cut slopes and embankments under 10 feet in height can be designed by the roadway engineer with an inclination no steeper than 1V:2H. Inclinations outside of this criteria may be recommended by the Geotechnical Engineer. Many projects are space constrained (right-of-way, environmental avoidance, etc.) which require steeper, and/or higher slopes. Early identification and communication of these locations with the geotechnical staff is critical so subsurface investigations, laboratory testing, and analyses can be performed, and recommendations can be made for the project design.

1202.2.3 Unstable Slopes

This deals with the broad subject of building on or around landslides or not creating landslides with earthwork construction. Both cuts and fills may be involved. The subject also includes the possibility of destabilizing an existing fill by making changes to it including widening or slope steepening. Special design is usually necessary to recognize and deal with this issue.

1202.2.4 Embankments over Soft Foundations

An embankment on soft ground often settles dramatically and may slide, slump, or sink during construction if not designed properly. It is important to know how much settlement will occur

and how long it will take to finish. Often, measures must be taken to accelerate settlement or improve foundation strength. Options include flat slopes, berms, stage construction, surcharging, wick drainage, foundation reinforcement, ground improvement and lightweight embankment materials.

1202.2.5 Materials for Construction

On-site soils must generally be used for economy, but they may be poorly suited for embankment construction. Soil type and excess moisture are often problems. Wet soils and strategies for dealing with them must be recognized. Finding suitable sources for borrow can be important. Also under this heading are design strategies for getting embankment built over wet, soft subgrade, or building embankment in wet weather. Other issues may include the presence of boulders, rock, or other obstructions in excavation and the proper placement and compaction of soil, soil rock mixtures, and rock fills. Special density testing and compaction requirements will often be required for special cases including embankments with steep slopes, high embankments, or fills in critical locations.

Materials used for embankment construction must be available in the required quantity, suitable for the time period when construction is anticipated, and suitable for placement and compaction at the design inclination. Use of on-site "selected" soil varies across the state and not all materials are suitable for winter construction. ODOT material sources should be explored for use, through coordination with the project Engineering Geologist or the ODOT Materials Source Manager.

Stone embankment is frequently used as an "all-weather" material, but it is significantly more expensive than other materials. Consider that if embankment construction work is scheduled to occurs between November and May, the plan details may need to account for use of stone embankment and the project should anticipate higher costs for the materials.

1202.2.6 Roadway Widening

Projects involving widening must be carefully considered to assure that cuts and fills will perform well and can actually be constructed. Sliver cuts and fills can be and often are severe construction problems. There are also issues around the type of fill used in a widening and whether certain material may actually destabilize an existing embankment by causing water to backup in the old fill.

For roadway widening projects requiring fill, use DET2101 Sliver Fill Benching Detail, with benching dimension recommended by the geotechnical engineer. The sliver fill is the engineered prism, and any additional soil placed on top of the sliver fill, such as landscaping,

must not reduce or change the slope inclination or dimensions. The geotechnical engineer should specify materials for use as fill in widening projects.

1202.2.7 Earthwork Balance Analysis

On moderate to large projects, estimating the volume shrinkage or swell of earth and rock material from borrow to embankment can be a major source of error in balancing the earthwork. A careful consideration of the volumes of material along with evaluation of the earth density can be used to refine shrink/swell estimates.

1202.2.8 Surface and Groundwater Control

Water control is necessary for stable slopes.

1202.2.9 Seismic Site Response and Mitigation Design

Consideration will be increasingly given to the seismic stability of embankments and slopes. Coordinate with the geotechnical engineer to determine if seismic analysis is needed on the project.

1202.2.10 Rock Slopes

In designing new alignments or widening in rock, the issue is the appropriate slope and its configuration to minimize rockfall. Some projects may require improvements in existing rock slopes to minimize the impacts of rockfall. Design guidance is provided later in this document.

1202.2.11 Pavement Subgrade

The Pavement Unit deals with this issue to determine if wet soils will make pavement construction difficult. When significant quantities of subgrade stabilization are proposed for a project, the roadway designer should coordinate discussions between the Pavement Unit and the geotechnical engineer. The geotechnical engineer may need time to investigate and work with Pavements Unit to establish limits the of stabilization.

1202.3 Geotechnical Design Deviations

All State of Oregon projects are required to meet ODOT design standards. Design deviation requests must be submitted for all STIP projects that do not meet standards. A request for a deviation from design standards is appropriate when the request benefits the project and is supported by rational engineering principles. Deviations to design standards should be discussed early in the design process with the assigned technical resource. The ODOT Geotechnical Design Manual provides the process for completing a Geotechnical Design Deviation.

Section 1203 Environmental Studies

1203.1 Project Classification

Per FHWA regulations, ODOT is required to document National Environmental Policy Act (NEPA) compliance for federal proposed actions with an FHWA connection (funding or approval). The NEPA document serves a federal purpose and therefore focuses primarily on compliance with federal statutes, regulations, and policies. FHWA also requires compliance with state and local laws as applicable, and state policies require that transportation projects are compatible with state and local transportation plans and policies.

When a project is identified in the Statewide Transportation Improvement Program (STIP), the responsible Region initiates scoping and project development. For NEPA classification and approval documentation, the Region Environmental Coordinator (REC) prepares an Environmental Prospectus to document scoping and to recommend a preliminary NEPA classification to cover the project's proposed actions.

The Environmental Prospectus is required as an attachment for further required NEPA documentation as follows depending on the applicable NEPA classification. For PS&E submittal, only the final NEPA document is required (not the Environmental Prospectus or any other environmental attachment). For NEPA Class 2: Programmatic Categorical Exclusions (PCE) - the PCE Approval (signed by ODOT); for NEPA Class 2: CEs - the CE[1] Closeout (signed

[1] Categorical Exclusion (CE) for Class 2 projects

by FHWA); for NEPA Class 3: EAs - the Finding of No Significant Impact (FONSI)[2] (signed by FHWA); and for NEPA Class 1: EISs - the Record of Decision (ROD)[3] (signed by FHWA).

Most projects are Class 2 projects, which do not require an Environmental Assessment or Environmental Impact Statement but may require specific environmental reports and/or mitigation and do require specific permits, approval and/or clearance documents which are attached to the PCE Approval (signed by ODOT) or CE Closeout (signed by FHWA). Class 1 projects will have a significant impact on the natural or human environment and require a draft and final Environmental Impact Statement (DEIS/FEIS) and the issuance of a Record of Decision (ROD). Class 3 projects that may have significant impacts to the natural or human environment require an Environmental Assessment/Revised Environmental Assessment (EA/REA) and a Finding of No Significant Impact (FONSI).

Approving the PCE Approval, CE Closeout, FONSI, or ROD by FHWA prior to PS&E allows the project to advance to the final design phase and to undertake right of way acquisition.

1203.2 Environmental Studies

PCE and CE (NEPA Class 2) projects must be evaluated for several of the same elements as NEPA Class 1 and 2 projects are, depending on the type and severity of impact. All impacts, including if there are no or minor impacts, are summarized in the specified locations of the PCE Approval and CE Closeout. Public involvement and community/EJ/equity engagement, environmental commitments, and Tribal consultation summaries are also included in all PCEs and CEs. Projects that are classified as Categorical Exclusions are evaluated to determine that there are minimal impacts, if any, and documented in the Environmental Prospectus. The required level of detail, supporting environmental studies, and documentation are driven by the nature of the impacts, not necessarily the NEPA class of the project.

The purpose of the environmental evaluation is to give information to the project team, the public, and the regulating agencies so that project decisions can be made by decision makers who are informed of all the consequences of the decisions they are making. It is hoped that this

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[2] Finding of No Significant Impact (FONSI) for Class 3 projects. A FONSI is attached to the Environmental Assessment or the Revised Environmental Assessment if revisions are called for.

[3] Record of Decision (ROD) for Class 1 projects. The ROD is the final NEPA approval document for a project that has significant impacts and is therefore required to be analyzed in an Environmental Impact Statement (EIS)—consisting of a Draft EIS (DEIS), a Final EIS (FEIS), and a ROD which captures the decision made and the rationale for making the decision. FHWA is the decision-maker for all NEPA documents.

will lead to the solution that best balances transportation needs, safety, economics, and minimizes harm to the greatest extent feasible, to the natural habitat and human environment.

Environmental Policy requires avoidance, minimization, and compensatory mitigation, in that order. All ODOT and LPA sponsored transportation projects require a standard list of regulatory approvals, clearances, and/or permits as applicable to the project's environmental impacts. The ODOT NEPA Program website contains all the FHWA-approved NEPA forms, templates, and procedures for complying with CEs, EAs, and EISs. Individual ODOT environmental discipline program websites contain forms, templates, and procedures for those disciplines – including any specific qualifications required for the preparation and/or completion of any environmental documents that support the NEPA decisions for CEs, EAs, and EISs. Further, ODOT's NEPA Manual can be found at the external website:

https://www.oregon.gov/odot/GeoEnvironmental/Pages/NEPA-Manual.aspx

If federally-protected Parks or Recreation Areas are impacted, those clearances and/or approvals would be required as well, and there can be several other environmental clearances, approvals, and/or permits that are also required either before NEPA is approved or after—during final design and prior to bid let.

Designers should work very closely and as early in the project as possible with the Region Environmental Coordinator (REC) or EPM (Environmental Project Manager) for any questions or issues they may have with a particular design especially if the project is a federal-aid highway program (FHWA-funded) or other federalized modernization, bridge, culvert, or safety project. These types of projects can be much more complex in addressing all the various aspects of environmental constraints and requirements if impacts cannot be entirely avoided. The REC or EPM coordinates with the region or Technical Services Environmental Section and is responsible to carry any messages related to design scope, schedule, or budget changes from environmental requirements to the TPM / RE-CP and Project Development Team (PDT) for further discussion if needed.

ODOT has certain time-saving programmatic permits and agreements with various state and federal regulatory agencies that are intended to satisfy regulatory compliance for projects that fall under certain criteria without needing an individual permit or approval directly from the regulatory agency. It is crucial to coordinate with the Region REC or EPM along with the other environmental specialists on the PDT to ensure the correct 'environmental performance standard' or 'best management practice' is being applied to the design in order to meet the relevant environmental standards as well as all the terms and conditions contained within individual permits if those are required. Environmental performance standards include specific design guidance that should be applied to projects that fit a certain category and criteria.

ODOT environmental staff capture environmental commitments made before, during, and after the NEPA process. Some commitments are captured in the various NEPA documents (i.e., CEs, EAs, and EISs) and some are captured in environmental permit terms and conditions.

Remaining environmental commitments are captured via the use of ODOT standard environmental specifications and "specials" as well as other relevant project documentation.

1203.3 Specific Impacts

Project impacts that affect the environment can be either direct or indirect as well as cumulative; occurring over time in addition to other similar impacts within a certain established area such as a watershed or ecosystem region. An example of a direct impact would be the removal of habitat by realigning the roadway prism. Indirect impacts often occur from changes in access. For example, providing an interchange where only an overcrossing existed may induce land use changes which, in turn, impact habitat. Other indirect impacts can occur from increasing development that can result from improvements made (i.e., the projects) to the transportation system. These are more difficult to predict with certainty but are often the more profound impacts. Either type of impact can influence the facility design as the project team attempts to avoid, minimize, or offset/mitigate the impacts. Some of the typical impact areas are:

1203.3.1 Noise

Noise barriers may be used to mitigate traffic noise on a project. The preliminary design (location, height, length) for these barriers is done by the noise analyst (consultant) conducting the technical work for the noise study. After the barrier has been determined to be feasible and reasonable, the affected residents and property owners must vote their approval before the wall can be built. The public involvement process may also be used to help determine the type and the surface features (if any) of the wall and desirability of a noise barrier.

The final decision as to the type of noise barrier to be constructed will be made during the final design process. The project structural designer will do the final design of the structural element of a noise wall often working with the noise analyst who did the preliminary design to ensure effectiveness of the final wall location and dimensions. The project roadway designer will do the final design of an earth berm.

It is essential to realize that additional right of way may be necessary to construct the footings for a wall. In addition, conflicts can arise between a noise barrier's location and utilities, signing or drainage facilities. Coordination during the final design process involving all the affected groups will help in avoiding conflicts with wall placement.

1203.3.2 Historic

Environmental laws that require that all buildings, objects, sites, structures (i.e., bridges/tunnels) or districts (i.e., historic roads, railroads) listed in or eligible for listing in the National Register of Historic Places, and publicly owned parks, recreation areas, and wildlife or waterfowl refuges, be avoided, or if part of the transportation system, are minimally affected.

1203.3.3 Archaeology

Archaeological sites are frequently identified on our projects and can influence engineering and design. The archaeological site type, depth, and location may require special protections and sometimes even warrant preservation in place. For example, archaeological sites are frequently found at stream crossings and confluences; they can be deeply buried or relatively shallow. Such sites may require special re-designs to avoid the locations. In addition, some Tribes continue to use certain site locations for ceremonial practices; in those cases, a project may require special engineering/design for access points. Designating no-work zone areas is also typical. Successful design alternatives can be reached by working closely with the project RECs and ODOT Archaeologists and through consultation with the Tribes. For some projects, an archaeological monitor might be required to be present during portions of construction. Always coordinate with the REC, EPM, and ODOT Archaeologist to determine if or when an archaeological monitor will need to be present on a project during construction. Archaeological monitoring requirements for any project will be contained in the project specifications (00290.51) and contract.

1203.3.4 Wetlands

All NEPA classes of projects frequently impact wetlands. It is critical to determine if there are alternatives that avoid the impact, and if not, how the impact can be minimized or mitigated, in that order, for all wetland areas. Different alignments, steeper slopes, retaining walls, and other techniques must be used to avoid or reduce impacts, if these techniques are feasible in the impact area.

1203.3.5 Water Quality

Designs that can avoid disturbance of water quality, including changes to an area's hydrology, are important to consider. Stormwater management for water quality is required for projects that:

1. Increase impervious surface area,
2. Change highway alignment and/or modify the storm drainage system including adding curbing to current uncurbed sections of roadway,
3. Replace or widen stream crossing structures (bridges, culverts, etc.), or
4. Do extensive reconstruction of the roadway by removing and replacing the pavement.

Water quality treatment is to be designed to treat all the runoff from the project's contributing impervious area (CIA) resulting from the water quality design storm[4]. Treatment techniques that incorporate infiltration, media filtration and filtration through vegetation are highly effective at removing highway pollutants thereby maintaining and/or improving water quality. Information on triggers for treatment of stormwater, the water quality design storm, and treatment techniques is available in the ODOT Hydraulics Design Manual.

Flow control is required for projects that increase discharges to a surface water by more than 0.5 cubic feet per second (cfs) from the 10-year 24-hour storm, and do not discharge into a large water body (river, lake, reservoir, estuary, ocean). The intent is to prevent adverse changes to stream stability and form by matching the post-project to the pre-project hydrology for the range of flows most responsible for stream channel processes and erosion. Detailed information on the range of flows is found in the ODOT Hydraulics Design Manual.

1203.3.6 Threatened and Endangered (T&E) Species

Many projects have the potential to impact wildlife in general, specifically T&E plant and animal species. In this case, design changes to avoid impacts are required. Conservation measures are often required as part of the construction contract to avoid impacts to protected species. Since these vary widely with the various species, it is important to work closely with the Region biologist and REC, and/or Local Agency consultant biologist, when designing the facility and work conditions near endangered and threatened species, particularly near fish bearing streams and wildlife groups.

Seasonal in-water work periods are designated for most Oregon waterways; stream classification and fisheries activity can also influence the design of most bridge and culvert replacements and larger transportation improvement projects. Due to the presence and/or likelihood of T&E species and/or critical habitat in many areas of the state, water quality requirements to protect species and in-water work timing prompt critical project discussions between designers and environmental specialists. Designs that can avoid in-water work or

4 The Water Quality Design Storm is 50% of the 2 year 24 hour storm for climate zones 1, 2, 3, 6, 7 and 8, 67% of the 2 year 24 hour storm for climate zones 4 and 9, and 75% of the 2 year 24 hour storm for climate zone 5.

disturbance of water quality, including changes to an area's hydrology, are important to consider.

1203.3.7 Migratory Bird Treaty Act

Many projects have potential to violate the Migratory Bird Treaty Act and should be reviewed by the REC or EMP assigned to the project. Activities which are most likely to impact and result in "take" (e.g., harm, harassment, or death) of migratory birds on highway projects include but are not limited to; clearing or grubbing of roadside and project area vegetation used by migratory birds for nesting habitat during the nesting season when eggs or young are likely to be present, bridge cleaning, painting, demolition, or reconstruction where bird nests are present.

Proper coordination with Region biologists, RECs, or EPMs will help prevent projects from being halted or delayed due to bird issues.

1203.3.8 Air Quality

Transportation plans, programs and projects within Oregon's air quality non-attainment and maintenance areas must conform with the intent of the State Implementation Plan (SIP) for air quality. Major projects in these areas requiring DEIS/FEIS or EA/REA environmental documentation must demonstrate conformity before FHWA can issue a ROD or FONSI. CE and PCE projects involving signalization, channelization, changes in vertical or horizontal alignment or bus terminals may also require a conformity determination. Coordinate with the Region Environmental Coordinator (REC) or an air quality specialist when questions arise regarding specific conformity requirements.

1203.3.9 Hazardous Materials

All projects need to be reviewed for potential impacts to hazardous material sites. There are many risks that can be created or aggravated even when working completely on ODOT right of way. When excavating or working along ditches the designer must be careful of disturbing contamination or causing lateral transport of that contamination, and the design must manage contaminated material, transport, and surface drainage.

All projects require a Pollution Control Plan. The plan will address the contractor's response in the event of an unforeseen spill, leak, or discovery.

New federal policies stress that the State needs to consider future land uses when deciding the location of facilities. It is not necessary to try to avoid all contamination. The contaminated site could be used for transportation, which could bring the site into greater productivity.

1203.3.10 Public Parks and Recreation Areas

Public parks, recreation areas, trails, scenic corridors, and other recreation resources could have received funding from state and/or federal grant programs that require that land to stay in recreation use "in perpetuity". If a transportation project needs to acquire any amount of property (including temporary and permanent easements or rights-of-entry) from those protected recreational properties, formal consultation with and approvals from state and federal parks agencies, FHWA, and the local park or recreation area "official with jurisdiction" may be needed to allow a use other than recreation to occur. Region RECs and EPMs will assist designers and project teams in determining those needs and will also lead the consultation and approval process along with the region ROW agents. In some cases, project re-design may be needed to avoid impacts to these state and/or federally protected recreation properties.

1203.3.11 Other Areas

Project impacts to floodplains, scenic resources, emergency services, neighborhoods, social and cultural interactions, businesses and other environmental subject areas can be of sufficient importance to influence the design. Land use and planning, particularly compatibility with comprehensive plans, Department of Land Conservation and Development Statewide Planning Goals, and requirements of the Transportation Planning Rule, are critical elements in determining the design of the facility.

Using an equitable approach for ensuring environmental justice compliance is critical in determining the location and type of transportation projects by considering previous impacts, as well as the new project's impacts, to historically underserved or excluded communities in the area. Both ODOT and FHWA have several requirements that must be met during the preparation of a draft STIP and during preliminary engineering of STIP projects.

1203.3.12 Permits

Many of the above areas will require individual environmental permits (see Section 1213), if the project cannot meet the available programmatic permit requirements that ODOT currently has in place with several regulatory agencies. The Region REC or EPM is the best source for designers to determine if and when individual environmental permits and other individual approvals are needed.

1203.4 Design Specifications

A summary of mitigation and conservation measures, known as 'environmental commitments', is included in the PCE Approval, CE Closeout, REA, or FEIS for the specific project. These environmental commitments are incorporated into the plans and specifications for the project. Although there are some standard conservation measures listed in the *"Oregon Standard Specifications for Construction"*, project specific items are identified in the PCE Approval, CE Closeout, REA, or FEIS.

As stated previously, the Region REC or EPM for a specific project should be consulted early in the project's design on questions regarding all environmental commitments.

1203.5 Plans, Specifications and Estimate (PS&E)

Approximately 7 weeks prior to bid letting, the PS&E package - which includes the required NEPA approval document and all environmental clearances, approvals, and permits - is delivered to the Project Controls Office (PCO) for final processing. All NEPA approvals and other environmental permitting work must be completed at this point.

Section 1204 Rail

1204.1 General

As with airports, rail crossings in the vicinity of projects cause the influence areas of the respective modes to overlap. Projects near railroads, light rail, and other rail system crossings need to be reviewed for potential impacts. Rail crossings may be at-grade or grade separated depending on elements such as type of facilities, conflict points, and safety requirements. It is desirable to avoid or reduce at-grade rail crossings. The project team should hold discussions with the ODOT Commerce and Compliance Division to determine the need to grade separate the crossing or leave it as an at-grade crossing.

Roadway projects in the vicinity of railroads need to accommodate the type of cargo and goods that are exchanged between rail and other transportation modes such as truck freight. Turning radii, travel lanes, or additional dedicated turn lanes need to be considered in the accommodation of vehicles moving such cargo and goods between roadway freight and rail lines. Review the existing Transportation System Plans to determine any related rail transportation needs.

ODOT Commerce and Compliance Division's jurisdiction for the regulation of the railroad-highway at grade crossings extends a distance equal to the stopping sight distance (SSD), for the posted or statutory speed, measured back from the location of the stop clearance line at the railroad crossing (OAR 741-100-0005).

Because ODOT Commerce and Compliance Division has jurisdiction within the SSD from the stop clearance line, it is important to include them in the scoping phase of project development so that there is enough time to obtain a Rail Crossing Order if needed. It is also important to include the State Railroad Liaison in the scoping as they will be developing an agreement with the Railroad Company. (See Right of Way Manual, Chapter 10.)

Failure to coordinate with ODOT Commerce and Compliance Division and the State Railroad Liaison will result in excessive delays to your project schedule.

1204.2 Field Diagnostic Review

The field Diagnostic Review is part of the requirements found in 23 CFR Part 646 – Railroads, Part 646.214 – Design. This will occur early in the design process, at project scoping or prior to DAP plans, and is coordinated by the State Railroad Liaison and the ODOT Commerce and Compliance Division. The review typically includes the following members:

- The State Railroad Liaison
- Road Authority
- Project Team Leader
- ODOT Commerce and Compliance Division representative
- Railroad Company representative
- Construction representative
- Designers (Signal, Roadway, and others as needed)

The field diagnostic review team will meet on-site to determine the required safety upgrades to the railroad crossing. The findings from the field diagnostic review will be the starting point for:

- Identifying design constraints and work to be completed;
- Completing the Railroad-Highway Public Safety Application (which is required to obtain the Rail Crossing Order for ODOT Commerce and Compliance Division; and
- Obtaining any necessary design exceptions.

1204.3 Rail Crossing Orders

The rail crossing order process involves strict procedures and timelines to ensure proper coordination with the affected railroad company and all other interested parties. Obtaining a rail crossing order typically takes 6 to 18 months, depending on the complexity of the proposed work.

Each public railroad crossing is required to have a Rail Crossing Order. Rail Crossing Orders are issued by the ODOT Commerce and Compliance Division and authorize the alterations to crossings, both at-grade and grade separated crossing types. Private crossings are not regulated by the ODOT Commerce and Compliance Division and therefore do not require a Rail Crossing Order. Most projects involving railroad crossings will require an Order to alter the subject crossing. New at-grade crossings are rarely approved by ODOT Commerce and Compliance Division because state law directs ODOT to eliminate at-grade railroad crossings wherever possible.

Rail Crossing Orders contain specific requirements related to the roadway geometry and roadway features. To obtain a Rail Crossing Order, complete and submit a Railroad-Highway Public Crossing Safety Application (Form 735-9202) to ODOT Commerce and Compliance Division early in the design phase. This application is typically submitted by the project team leader or designer, with assistance from the State Railroad Liaison. See OAR 741-200-0050 for information that must be included in the application. Contact ODOT Commerce and Compliance Division for questions related to the form.

1204.4 Railroad Roadway Plan Sheet

ODOT Commerce and Compliance Division requires a separate, sealed railroad roadway plan sheet(s) to be included with the Railroad-Highway Public Crossing Safety Application. This plan sheet will be completed early in the project (DAP or preliminary plans) and prior to completion of the other roadway plan sheets for the project. This is due to the design phase and the Rail Crossing Order process running concurrently, with the requirement that the Rail Crossing Order is complete prior to bid letting.

This plan sheet(s) must contain the roadway design features that will be shown in the final roadway contract plans, including:

- A plan view of the railroad crossing
- Vertical grade
- Length of roadway surface, gates and lights, gate arms type
- Location of guardrail, gates by station and offset

- Curb exposure
- Pedestrian and bicycle facility features (See Part 800 Part 900 for addition guidance.)

Send the final signed and stamped railroad roadway plan sheet(s) to the Technical Services Traffic-Roadway Section, who will then submit a copy to the ODOT Commerce and Compliance Division and the State Railroad Liaison and file the plan sheet(s) with the project plans in ProjectWise.

While the railroad plan sheet(s) is not part of the contract plan set, it is an important and required part of the Railroad-Highway Public Crossing Safety Application. (See also Part 800, Section 840 and Part 900, Section 921 for pedestrian and bicycle accommodation at rail crossings.)

1204.5 Design Elements

The intersection angle between the roadway and railroad should be as close to 90 degrees as possible. Right angle crossings maximize the driver's view of the rail crossing, location of tracks, and view of on-coming trains. A right-angle crossing is also preferred for bicyclists and pedestrians. Besides the same visual problems of such a crossing, angled crossings coupled with flange openings create problems for the thin tires of a bicycle. The flange opening width should be kept to a minimum through the entire rail crossing section.

Sight distance is a critical consideration at railroad crossings. Sufficient sight distance must be available to the driver to recognize the crossing, see and perceive the crossing device and the trains themselves, and come to a stop condition if necessary.

Horizontal and vertical alignments are very important at rail crossings. The vertical profile between the roadway and the rail crossing should be as level and consistent as possible for smooth transition between surface types, sight distance and visibility of the crossing, and ability to react to the specific situation. Rail crossings along horizontal curves are not preferred as they impact the visibility of the crossing and cause the driver to focus on the curvature of the roadway instead of looking for a train.

Some additional design elements involved with rail crossings include location of driveways, other accesses, and signals located at rail crossings. Vehicular storage queues in the vicinity of rail crossing intersections must be carefully reviewed and measures taken to prevent trapping vehicles on the rail crossing. Sign locations need to be thought out to maintain proper clearance between the roadway and the railroad tracks.

The minimum horizontal and vertical railroad clearance to be provided on crossings shall conform to ODOT regulations shown in Figure 300-25 Railroad Clearances in Part 300. Additional clearance may be required and should be determined individually for each crossing. Information regarding these clearances shall be obtained from the ODOT State Utility and Rail

Liaison. Contact the ODOT Commerce and Compliance Division when rail crossings are involved in a project.

1204.6 Crossing Types

The crossing type (signals, signals and gates, stop sign) is generally determined on a case-by-case situation, but typically the crossing will have both crossing gates and signal lights. The designer needs to consider the lead time needed for interaction with other divisions such as Rail when a crossing is involved. Contact the ODOT Commerce and Compliance Division to determine the appropriate crossing type and other rail requirements.

1204.7 Stopping Lanes at Railroad Crossings

Additional stopping lanes at railroad at-grade crossings were formerly added routinely. In some cases, stopping lanes are not justified. The ODOT Traffic Manual outlines the procedure for determining the need for additional stopping lanes at railroad at-grade crossings. Additional design guidance for railroad grade crossings can be found on Oregon Standard Drawings RD400 series, for use when stopping lanes have been justified.

1204.8 Curb Exposure

Curb exposure at railroad crossings is very important. Standard curb (barrier) is to be used. The roadway curb exposure at railroad protective devices shall be a minimum 7 inches for new construction and 6 inches for existing installations and for maintenance after initial installation. In overlay situations, the construction of a new curb should not be ruled out. Each situation should be looked at individually to determine the correct solution.

Section 1205 Utilities and Utility Relocation

[Placeholder for future section]

Section 1206 Transportation Analysis

1206.1 General

The Transportation Planning Analysis Unit (TPAU) and Region Traffic Sections, with assistance from region staff, cities, counties, and other state agencies, are responsible for providing highway design hour volumes, traffic analysis and performance measures such as volume/capacity ratios for projects and studies.

TPAU typically performs this work for large or complex systems and/or the Environmental Assessments (EA) and Environmental Impact Studies (EIS). Region Traffic staff typically does the analysis for operational, preservation, bridge and other small improvement projects as well as scoping and review of developer-submitted Traffic Impact Analysis (TIA).

ODOT traffic analysts' scope and review consultant analysis work. The analyst should work iteratively with design staff in the development of alternatives. The ODOT Analysis Procedures Manual (APM) available at https://www.oregon.gov/odot/Planning/Pages/APM.aspx guides the analysis process from scoping through the analysis and documentation for projects and studies. Any traffic analysis performed involving state highways must conform to the APM or be explicitly agreed to by ODOT.

1206.2 Projects

In project development, the traffic analyst should be involved beginning in the scoping phase and continuing throughout the life of the project. The transportation analysis for modernization projects includes developing air, noise, and energy traffic data for environmental studies. The analyst may also furnish volumes and vehicles classifications for pavement design.

The analyst will furnish traffic information for base and (appropriate) future year(s), such as hourly and daily volumes along with truck percentages as detailed in the APM. The analysis should report performance information including lane configurations, volume/capacity ratio (v/c) and any other operational performance measures, 95th percentile queues/storage lengths, signal progression, and preliminary signal warrants. The analysis process and results must be documented in either technical memoranda or a narrative report.

1206.3 Design Guidelines

Table 1200-1 shows the acceptable v/c ratios for project development/design. Table 1200-1 applies to all modernization projects and should be applied within other project categories

except for development review. A design exception should be processed if the volume/capacity ratios in Table 1200-1 cannot be met. If it is known early in the planning or project development process that the v/c measures cannot be met, the design exception should be sought at that time instead of later in the project design phase.

The volume/capacity ratios shown in Table 1200-1 are generally different than those shown in the Oregon Highway Plan (OHP). The v/c ratio values in the OHP are used to assist in the planning phase identifying future system deficiencies. The OHP v/c ratio values also allow flexibility for land use applications and Transportation System Plans by having at-capacity v/c ratios in urban areas. The HDM v/c ratio values are different as the expectation is to provide a mobility solution that corrects those previously identified deficiencies and provides the best investment for the State in establishing 20-year design life solution. The Table 1200-1 values, although v/c oriented, are based upon the *AASHTO's "A Policy on Geometric Design of Highways and Streets"*.

Issues may arise when a large difference occurs between the design and planning v/c ratios particularly when alternative mobility standards have been adopted. The issues occur due to different interpretations of which measure applies. Technical Services should be contacted if agreement between Region Planning and Design staff cannot be reached on the use of the design-life requirement.

Although traffic data is needed in the design of all highway improvements, preservation type projects are primarily focused on extending the service life of the pavement while looking at cost-effective safety enhancements. Traffic forecasts can assist in making decisions regarding needed safety improvements as part of the 3R project (adding turn lanes, signals) or as a future standalone project. Table 1200-1 v/c ratios should be used as guidance in making cost effective safety improvement decisions for 3R preservation projects.

Region Traffic Unit and Region Roadway Design Unit need to determine when a design-life design exception request is required for a new or modified traffic signal. Consensus on the proposed improvements needs to be reached prior to submitting design exception requests for design life to Technical Services.

Design Life exceptions are not required on the following project types:

1. Private approaches
2. Unsignalized public approaches that do not modify their capacity
3. Development review projects
4. Operation STIP projects
5. Maintenance projects not in the STIP
6. Transportation System Plans

7. Traffic Growth Management (TGM) projects that do not have design details and would not be considered a 4R project in the design phase, however, any future build scenarios for TGM projects are to use the v/c ratios in Table 1200-1.

Table 1200-1: 20 Year Design-Mobility Standards (Volume/Capacity [V/C]) Ratio

Highway Category	Land Use Type/Speed Limits					
	Inside Urban Growth Boundary				Outside Urban Growth Boundary	
	STAs	MPO	Non-MPO outside of STAs where non-freeway speed limit <45 mph	Non-MPO where non-freeway speed limit >= 45 mph	Unincorporated Communities	Rural Lands
Interstate Highways and Statewide (NHS) Expressways	N/A	0.75	0.70	0.65	0.60	0.60
Statewide (NHS) Freight Routes	0.85	0.75	0.70	0.70	0.60	0.60
Statewide (NHS) Non-Freight Routes and Regional or District Expressways	0.90	0.80	0.75	0.70	0.60	0.60
Regional Highways	0.95	0.85	0.75	0.75	0.70	0.65
District/Local Interest Roads	0.95	0.85	0.80	0.75	0.75	0.70

Notes:

- Interstates and Expressways shall not be identified as Special Transportation Areas (STAs).
- The peak hour is the 30th highest annual hour. This approximates weekday peak hour traffic in larger urban areas.
- MPO category includes areas within the planning boundaries of the Bend, Corvallis, Eugene/Springfield, Medford, Portland (METRO) and Salem/Keizer Metropolitan Planning Organizations, and any other MPO areas that are designated after the completion of this manual.

1206.3.1 Estimating Capacity for Highways

Since there are many variables that could affect the capacity of a highway, use the following process as a general guideline only. This process enables designers to estimate allowable daily traffic volumes. These volumes can be used to determine that the correct number of lanes on a state highway has been identified in a prospectus. The allowable daily traffic volumes are not intended for detailed design purposes. The assigned traffic analyst will provide design level traffic data. If there is a discrepancy between the prospectus and the results from this analysis, a designer should contact the TPAU for a more detailed evaluation.

1206.3.2 Capacity Estimation Process Outline

1. Determine the "Highway Category" and "Land Use Type/Speed" for the facility that you are working with.
2. Determine the acceptable Volume/Capacity Ratio
3. Determine the average daily capacity
4. Determine the allowable average daily traffic volume (ADT)
5. Compare the allowable ADT to the 20-year future ADT projected for the facility.

Note: This estimation process uses two of the most critical adjustments when determining the capacity of a roadway (signals and truck traffic impacts). There are several other factors used by a traffic analyst when determining the actual capacity of a facility.

1. **Determine Highway Category and Land Use Area Type:** Refer to Appendix D of the Oregon Highway Plan.
2. **Determine Highway acceptable Volume/Capacity Ratio:** The maximum allowable volume/capacity ratios for state highways can be found in Table 1200-7.
3. **Determine the Average Daily Capacity:** This process will allow you to estimate the average daily capacity for the highway under study/investigation. Note that this is only an estimation of the capacity, the Transportation Planning Analysis Unit should be contacted to determine the capacity of a roadway for design purposes.

Average Daily Capacity = Ideal Daily Capacity x FS x FT

- **Ideal Daily Capacity** – unadjusted capacity of a roadway (Table 1200-2).
- **FS** – a factor to account for the presence of signals (Table 1200-3).
- **FT** – a factor to account for the presence of truck traffic and the type of terrain (Table 1200-4).

Table 1200-2: Ideal Daily Capacity

Highway Category	Land Use Type/Speed Limits				
	Inside Urban Growth Boundary			Outside Urban Growth Boundary	
	MPO	Non-MPO outside of STAs where non-freeway speed limit <45 mph	Non-MPO where non-freeway speed limit >= 45 mph	Unincorporated Communities	Rural Lands
Interstate/ Expressways					
4 Lanes*	74,500	NA	68,000	63,000	63,000
6 Lanes	117,500	NA	107,500	94,500	99,500
Statewide					
2 Lane Undivided**	31,500	30,000	30,000	26,000	21,000
2 Lane Divided	39,000	37,500	37,500	32,500	26,000
4 Lane Undivided	51,000	48,000	48,000	45,000	42,000
4 Lane Divided	68,000	64,000	64,000	60,000	56,000
6 Lane Divided	102,000	96,000	96,000	90,000	84,000
Regional Highways					
2 Lane Undivided	30,500	29,500	29,500	25,500	20,500
2 Lane Divided	38,000	37,000	37,000	31,500	25,500
4 Lane Undivided	49,500	47,000	47,000	45,000	41,500
4 Lane Divided	66,000	63,000	63,000	59,500	55,500
6 Lane Divided	99,500	94,500	94,500	89,500	83,500
District/Local Interest Roads					
2 Lane Undivided	28,000	28,500	28,500	25,000	20,000
2 Lane Divided	35,000	35,500	35,500	31,000	25,000
4 Lane Undivided	48,500	46,000	46,000	44,500	41,000
4 Lane Divided	64,500	61,500	61,500	59,000	55,000
6 Lane Divided	96,500	92,000	92,000	88,500	82,500

* The number of lanes refers to the total number of through lanes on the facility.

** For the purpose of this computation, a divided roadway has a raised median to prevent mid-block left turns or it allows mid-block left turning vehicles to exit from the through traffic lanes.

If the facility is in an urban area that has signalized intersections, the signalized intersection adjustment factor (FS) needs to be applied to the ideal capacity. FS is the same for all the land use types/speed limits.

Table 1200-3: Signalized Intersection Adjustment Factor (FS)
(applied to ideal daily capacity if there are signalized intersections)

Highway Category	FS
Interstate	NA
Statewide	0.51
Regional	0.46
District	0.45

If the facility has truck traffic, the slower moving trucks will take up more capacity than a passenger vehicle, especially if they are traveling on grades. Table 1200-4 shows the adjustment factors (FT) for truck traffic on Level (1-2%), Rolling (3-4%), and Mountainous (5% or greater) terrain that are one-quarter mile or longer.

Table 1200-4: Reduction Factor for Presence of Trucks (FT)

Number of Lanes	Percent Trucks											
	0-5%			6-10%			11-15%			>15%		
	L*	R**	M***	L	R	M	L	R	M	L	R	M
2	.97	.91	.80	.95	.83	.67	.93	.77	.60	.91	.71	.50
4-6	.95	.85	.69	.90	.73	.53	.86	.65	.43	.82	.58	.36

* L - level terrain, which has a grade of 1-2%

** R - rolling Terrain, which has a grade of 3-4%

*** M - mountainous terrain, which has a grade of 5% or more

4. **Determine the Approximate Allowable Average Daily Traffic:** To determine the allowable average daily capacity for a facility, carry out the following computation:

Allowable Average Daily Traffic = Average Daily Capacity x (v/c from Table 1200-1)

5. **Compare the Approximate Allowable ADT to the 20-year future ADT projected for the facility:** If the forecasted ADT, found on the prospectus, is greater than the calculated allowable ADT, contact the Transportation Planning Analysis Unit for clarification.

Section 1207 Traffic Engineering

1207.1 General

The design of a project will include traffic management elements such as the location and function of traffic control devices (signals, signing, pavement marking, etc.). The Technical Services Traffic-Roadway Section (TRS) provides traffic support during all phases of project development and construction. TRS provides standards for preparing project plans, specifications and estimates for traffic signals, ramp meters, variable message signs, permanent signing, and illumination. In addition, the Traffic-Roadway Section provides statewide policies and guidelines for all traffic control devices, administers ODOT's Project Safety Management System and provides technical assistance for traffic operation improvements on state highways. TRS also manages traffic signal approvals, manages speed zone designations for all public roads, monitors traffic speeds, tests electrical equipment, and coordinates development of design standards. The designer should be aware of these traffic functions and the support which is available from TRS during the design phase of projects. The designer should provide adequate notification to TRS staff through the assigned traffic designer or designated representative to ensure timely input consistent with the project schedule. In addition to the traffic design aspects of projects, the designer should consider future maintenance access and right of way need for electronic traffic equipment.

For further discussion of the roles and responsibilities of TRS, as well as information regarding the use of traffic control devices, see the ODOT Traffic Manual. This manual contains information regarding policies, procedures, warrants, and design considerations for traffic related items.

1207.2 Authorities of the State Traffic-Roadway Engineer

The designer should be aware that State Traffic-Roadway Engineer approval is required for the installation or modification of traffic signals as well as other traffic control devices and applications. Other examples of applications requiring the approval of the State Traffic-Roadway Engineer include: provision of multiple turn lanes, emergency vehicle preemption capability, U-turns at signalized intersections, turn prohibitions, flashing beacons, marked crosswalks at uncontrolled intersections or mid-block locations, crosswalk closures, designation of one-way operation, speed zones, parking prohibitions, restriction of lane use by type of vehicle, variable message signs (and other ITS devices), and the approval of roundabout locations. (See the ODOT Traffic Manual for more detail.) Many of these authorities are

designated by Oregon Administrative Rule or come through a letter of authority from the Chief Engineer.

Typically, all requests for approval of traffic control changes or applications come from Region Traffic. Region traffic staff are familiar with the requirements for documentation and investigation of traffic control applications. The Region Traffic Manager or Engineer should concur with all requests before forwarding them to the State Traffic-Roadway Engineer.

Early participation of traffic representatives in project scoping and identification can identify items requiring approval of the State Traffic-Roadway Engineer as well as related traffic concerns with safety, operation, and application of traffic control devices.

1207.3 Signals

When a project involves signals the roadway designer should contact the region technical center signal designer. Information that the signal design will require includes: roadway features such as elevation profiles; guardrail requirements; truck turning radius requirements; curb ramp designs; utility locations (particularly poles, above ground wires and possible underground conflicts with infrastructure such as fiber optic lines); storm drain locations; lane use width; curb ramp locations; proposed curb and corner radii alignments; or other features that will have a bearing on the placement of traffic signal equipment. It is very important that items such as signal cabinets, power service cabinets and signal poles be located where they are not obstructions to pedestrians, bicyclists, or vehicles. Overhead utility lines such as power and communications should be reviewed to determine any conflicts with signal poles and signal heads. Typically, this field information is in electronic file format.

The signal designer will provide the projected layout of signal equipment (poles and controller cabinet) and cost estimates. The signal designer will also provide technical expertise regarding the signal equipment such as signal pole foundation size, ramp metering, lane usage, and vehicle detection type and locations. In the case of retrofit projects, the signal designer can provide information on existing signal equipment locations, lane configuration, vehicle detection replacement, and signal phasing. Crosswalk locations are normally determined through communication between the roadway and signal designers.

One of the most essential items the signal designer can provide the roadway designer is locations where the purchase of right of way or easements is needed. This item is sometimes overlooked but is critical in keeping the right of way purchase process on track. It is essential that the roadway designer notify the signal designer in advance so that proper right of way needs are determined and submitted, enabling the purchase of all right of way to occur in one phase of the project.

In some projects, multiple signals are involved and are part of an interconnected traffic signal system. Safe and efficient traffic signal timing along state highways depends on optimal

intersection spacing. It is difficult to predetermine where such locations should exist, although one-half mile intersection spacing for Statewide and Regional highways is often desirable. Items that are involved in interconnect systems include highway capacity, lane balance, cycle lengths, vehicle storage and progression speed. When a project involves multiple signals, the roadway designer should contact the region technical center traffic operations staff to determine the need for a signal interconnect system.

Temporary signals may be needed for traffic staging or in temporary locations during project construction. As with permanent signals, the designer should contact and communicate with the Region Technical Center Signal Designer in the early project stages to ensure that adequate time is allowed for temporary signal design.

1207.4 Signs

The designer should contact the Region Technical Center Sign Designer when a project involves signing. Typical information that the sign design will require includes a detailed sign inventory with dated photographs and accompanying highway milepost or station. Typically, a roadside inventory or detail map (electronic version) is provided that identifies sign locations. The sign designer should be provided with project limits and the scope of work. Projects that involve sign bridges or cantilevered signs will require communication between the sign designer, roadway designer and structure designer.

As with traffic signals, right of way or easement needs are critical for sign designs. Accurate right of way or easement acquisitions will lead to proper location of signs. The road designer should contact the Region Technical Center Sign Designer early on in project development to determine if signing will or should be included in the project. When notified early in the process the sign designer will be able to provide signing plans, special provisions, and right of way needs in an efficient manner.

1207.5 Signal and Sign Supports in Islands

Designers need to carefully weigh the benefits of constructing islands for the accommodation of sign and signal support. It may be preferred to look at other alternatives such as location of the supports on the other side of the roadway. If installation cannot be avoided and a raised island is considered necessary, consider the following priorities:

1. Clear islands with mountable curb are most desirable.
2. Where pedestrian or other small devices are necessary, they will be on breakaway supports.

3. Where a fixed object cannot be avoided, a brief, written justification should be attached to the preliminary plan review transmittal letter.

Standard barrier curb on islands will be considered inappropriate for use on any arterial or rural facility unless supported in the justification document noted in the list above.

1207.6 Illumination

Prior to illumination design for a project, it must first be determined if illumination is warranted for the project. Region Traffic identifies locations for illumination and forwards the information to the Technical Services Traffic-Roadway Section for determination of policy agreements and statewide consistency before proceeding with project illumination design. If there are agreements between ODOT and local governments, the designer, Transportation Project Manager (TPM), or Resident Engineer – Consultant Projects (RE-CP) should forward them to the illumination designer.

When it has been determined that illumination will be part of the project, the roadway designer will need to provide the illumination designer with final roadway alignment and detailed project information relating to illumination needs. Typically, 30 percent roadway plans that include centerline profiles, cross sections, existing roadside features, roadway alignment, and right of way line information will be sufficient for the illumination designer. Communication between roadway designer, the illumination designer, bridge designer, and traffic signal designer is critical in providing proper illumination designs for a project.

1207.7 Striping

Technical Services Traffic-Roadway Section is responsible for the policies and guidelines regarding striping and pavement marking. The striping guidelines provide statewide consistency. The responsibility for completion of the striping plans on state highway designs rests with the Roadway Designer. Striping should conform to the Traffic Line Manual, Pavement Marking Design Guidelines, and the MUTCD.

1207.8 Intelligent Transportation Systems (ITS)

Intelligent transportation systems goal is to improve safety and reduce congestion on the roadway infrastructure through the use of technology. Some of the ITS applications include ice sensors (road and weather information systems); speed monitoring sites, variable message signs, traffic cameras, communication lines, and ramp meters. ITS projects can be stand-alone,

but it is important for the designer to consider ITS improvements as part of highway modernization/reconstruction project work.

As with other types of traffic projects, early identification of right of way needs is important. Items such as variable message signs, speed monitoring cabinets, and traffic cameras may require additional right of way or need to be protected by guardrail or barrier. Traffic cameras may require special right of way locations to allow proper orientation and field of view.

1207.9 Crash Analysis

There are several tools available to the designer to assist with the crash analyses. The Motor Vehicle Traffic Crash Database, compiled and maintained by the Crash Data Unit, covers state, county, and city road systems. The SPIS (Safety Priority Index System) Reports and the Crash Summary Database is compiled and maintained by Traffic-Roadway Section. Other tools such as the crash graphing tools help identify patterns of crashes and are available via the intranet. Contact the region Traffic investigator for more information.

These reports and others allow the designer to summarize data by different characteristics, such as weather conditions, types of crashes and types of vehicles. Preparing collision diagrams to identify patterns is helpful. Familiarization with the volumes, speeds, physical features and geometry also assists in the process. Crash and fatality rates should be compared to the statewide average for similar facilities. After analyzing the specific site or segment the designer can better determine the appropriate actions for correction. Region Traffic personnel routinely perform crash analyses and can help with specific sites or trends and have the latest investigation on SPIS top 10 percent sites. Contact Region Traffic for assistance.

1207.10 Project Safety Management System

Traffic-Roadway Section, in cooperation with other ODOT sections, has developed and is maintaining ODOT's Project Safety Management System (PSMS). The PSMS consists of the Highway Safety Program and the Safety Priority Index System (SPIS). In addition, the Traffic Engineering Unit has developed plans around specific Safety Emphasis Areas (i.e., Roadway Departure and Intersections). See Traffic-Roadway Section's Highway Safety Website for more information.

These elements consist of evaluation tools, plans and funding options. These tools will assist TPMs / RE-CPs and designers to evaluate and improve safety on Oregon highways.

1207.10.1 Highway Safety Program

The Traffic-Roadway Section administers the Highway Safety Program to encourage engineering improvements that address identified safety needs (i.e., SPIS locations). The funds are primarily federal funds from the Highway Safety Improvement Program (HSIP). The mission of the Safety Program at ODOT is to carry out safety improvement projects to achieve a significant reduction in traffic fatalities and serious injuries.

In addition, the department receives 164 penalty funds from Transportation Safety Division Grants. These funds are allocated towards Safety Emphasis Areas (i.e., Roadway Departure).

For up-to-date information on the Highway Safety Program see the Traffic-Roadway Section Highway Safety web site. Also contact region traffic staff for more information.

1207.10.2 Safety Priority Index System (SPIS)

SPIS is a methodology developed by ODOT to identify potential safety problems on state highways. Essentially, SPIS is a tool for comparing and prioritizing crash histories of state highway locations. Each year regional reports of the top ten percent ranked SPIS sites are generated for review by Region Traffic. Region Traffic evaluates these sites for correctable safety problems and possible solutions. If a correctable problem is identified, a cost/benefit analysis may be performed. If viable options are identified, funding may be pursued.

1207.10.3 Safety Emphasis Areas

Data analysis of crash data is combined with cost effective strategies to identify locations for the most effective uses of funds to achieve a 20 percent reduction in targeted fatal and serious injuries. This approach involves deploying large numbers of cost effective countermeasures on targeted segments of roadways with a history of specific crashes.

1207.11 Work Zone Analysis and Constructability

Work Zone Traffic Analysis is used to determine lane closure restrictions and delay estimates for highway construction projects. Lane closure restrictions are used to determine times when road work is less likely to adversely impact traffic. Lane closures restrictions are determined by comparing actual or forecasted traffic volumes to a free flow threshold. Delay estimates are used to manage mobility throughout the highway system. An estimate of delay is the average additional travel time a construction project will add to a segment of highway.

The Region work zone traffic analysts determine both the lane closure restrictions and delay estimates for projects. The work zone traffic analyst should coordinate with the Region traffic control plan designer when developing the lane closure restrictions and delay estimates. The traffic analyst should send a formalized report recommending lane closure restrictions and delay estimates to the TPM/RE-CP and Region mobility liaison.

Several tools are available to determine lane closure restrictions and delay estimates. For segment analysis, the ODOT work zone traffic analysis methodology should be used. For work zones that are near convenient alternate routes or contain various types of traffic control (i.e., signals), the Highway Capacity Manual and recognized traffic simulation software should be used. For more complicated analyses, the Transportation Planning Analysis Unit (TPAU) is available to help determine both lane closure restrictions and delay estimates.

The Traffic Control Plan can change based upon the lane closure restrictions and delay estimates. Determine both the lane closure restrictions and delay estimates early in the project development process and refine as the project progresses to PS&E. Document the lane closure restrictions and delay estimates and any supporting information in the project Transportation Management Plan (TMP).

For further information regarding ODOT's Work Zone Traffic Analysis, refer to the ODOT Work Zone Traffic Analysis Manual and the ODOT Traffic Control Plan Design Manual.

Section 1208 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 on 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 contact the ODOT Geometronics Unit.

1208.1 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 Chief Engineer has directed that:

1. The Project Manager, Region Survey Manager, or Region Technical Center 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. (Use "*Project Notification to County Surveyors*" form # 734-2298)
2. Copies of field notes with references to found and/or set monuments will be furnished to County Surveyors upon request.

1208.2 Survey Types

1208.2.1 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 the ODOT Geometronics Unit. The Geometronics field crew will, upon request, establish geodetic control points where none exist in the vicinity of the job.

1208.2.2 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 Examiners for Engineers and Land Surveyors. (See OAR 820-020-0005.)

1208.2.3 Topographic Survey

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

1. Fences: measurements to the fences should be taken at frequent intervals. All intersecting fences should be tied.
2. Approach Roads: Note the grade, type of surfacing, width, name, private approach or public, controlling agency, direction and distance to nearby towns.
3. 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.
4. 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.
5. 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.
6. Bridges: Show stationing at both ends, width of roadway, type of bridge, type of rail, dimensions of walks, etc.
7. 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.
8. 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.

9. 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.
10. Permanent Monuments: A diligent search should be made for all recorded survey monuments. All found evidence, both recorded and unrecorded, will be shown on the map
11. 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.

1208.3 Stationing

Stationing will 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). If the existing stationing does not follow this rule, the existing stationing direction will be followed.

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

When the existing alignment is in SI units (Metric), the beginning of that Metric alignment will be equated to an earlier alignment that used US customary units (English). Stationing will be recalculated from that point using English units. The radius of the Metric curve will be converted to English units to the nearest 0.01 foot and the radius will be used to define the curve.

There are different types of projects that affect how the features will be located on the construction plans. These can be shown on the construction plans as either stations or milepoints as outlined below. In all cases, the construction plans will identify the right of way map number(s) used in establishing a link to the record data.

For projects that require a change in the right of way and a retracement survey has been completed, the construction alignment and stationing will be based on the retracement survey information. Further the retracement survey will be based on the alignment and stationing of the latest published right of way map in the Map Center in FileNet. It is a best practice for the construction alignment and the right of way alignment to be the same.

For projects where the construction alignment deviates from the right of way alignment, the construction alignment will begin and end the deviation on the same tangent bearing as the right of way alignment. An offset to the right of way alignment must be 2 foot or greater to

avoid confusion of the two alignments. If the deviation occurs on an arc section of a curve, the local tangent of the two alignments will be the same bearing at that point. No deviation will occur on the spiral portion of the curve. The deviation will be shown on the construction plans as an equation at both ends of the construction alignment. The stationing used on the construction alignment will be significantly different from the right of way alignment stationing. In no case will the construction alignment create an angle point with the right of way alignment without prior approval from the State Traffic-Roadway Engineer.

For projects that do not require a right of way centerline retracement survey, the stations will be derived from the current published right of way center line. A disclaimer will be placed on the project plans stating that the center line is for construction purposes only and should not be used for determining existing right of way.

For very simple projects, such as resurfacing projects, milepoints can be used in lieu of engineer stations to define the construction limits. The milepoint must be taken from an existing data source. ODOT TransGIS is an appropriate source for current milepoint data. The photo log milepoints are not recognized as existing data sources for determining accurate milepoints for a project. The point that is used to determine an accurate project milepoint will be equated to the engineer station from the current right of way map and shown on the construction plans. Typical locations used to equate stations and milepoints are bridges, intersections, box culverts, and in very rural areas a milepoint marker. Two equation points need to be shown on the plans. If the construction sheets are a part of the project special provisions, the milepoint and right of way station equation will be shown with the typical sections.

Projects that use milepoints in lieu of engineer stations are less accurate than a surveyed retracement of the alignment for calculating a station for any given feature but are generally close enough to cross check with existing data. In these cases, the record station would be considered the accurate station and not a calculated station from a milepoint.

Stationing should be continuous. Station equations are required at intersections of lines, bearing equations, and where new lines tie into previously established lines. Secondary alignments will be differentiated from the main centerline through labeling or naming the line (i.e., “SW” 10+00.00). Stationing will not begin below 10+00.00 for any alignment.

1208.4 Project Survey

1208.4.1 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 following project types: maintenance projects, 1R projects, preservation projects (3R), and modernization

projects (4R Reconstruction, New Construction). The project scoping team will determine the amount of survey work that will be required for individual projects.

1208.4.2 Maintenance and 1R Projects

The amount of survey work for maintenance and 1R projects can vary depending on the project. Generally, maintenance projects are small and typically require only roadside inventory type of field data collection. Roadside safety hardware requirements for 1R Projects are discussed in Part 100.

1208.4.3 Preservation Projects

Preservation projects that don't include work outside the existing typical section generally only need roadside inventory 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.

1208.4.4 Modernization Projects

Modernization projects will almost always require a DTM, which could require a combination of extensive survey work and/or alternative mapping methodologies such as photogrammetry, LiDAR, and laser scanning. 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.

Section 1209 Right of Way

1209.1 General

The Right of Way Section of the Technical Services Branch is responsible for the following project development functions:

1. Estimates of right of way costs and impacts for development of the project prospectus.
2. Estimates of right of way costs and impacts for different alternatives because of environmental assessments.
3. Collaboration with the Regions in developing project access lists.
4. Cost estimates for justification of proposed land service design features.
5. Acquisition of additional real property and real property rights needed to support the project design. This includes the relocation of all people and personal property displaced by the project.

1209.2 Acquisition Process

Of particular importance for project location and design staff is an awareness of the time requirements necessary for the acquisition of real property and real property rights. The right of way phase in project development begins after applicable environmental document clearance with the preparation of the right of way drawings and legal descriptions of the proposed right of way takings by the Region Survey Group. When the Region Right of Way office receives the completed right of way drawings and legal descriptions, the right of way acquisition process can begin. This process includes the appraisal of property values, offers to property owners, relocation of tenants, and demolition of property improvements. The right of way acquisition phase ends when the Region Right of Way office has acquired all the right of way, and it is certified for the project bid letting.

Design decisions that are delayed until after the start of the right of way acquisition process result in revisions to legal descriptions and right of way drawings. This may result in negotiations with property owners being restarted; appraisals being redone; and/or relocation work being significantly changed. This also occurs when design parameters change after starting the right of way acquisition process.

1209.3 Time Allowances

The time required for the Region Survey Group to complete the right of way drawings and legal descriptions varies due to the complexity and number of properties involved. It can be as little as one week for a simple, one-file project with an exhibit map showing a temporary easement to several months for large, urban projects with dozens of multi-parcel files. The acquisition of the right of way and the relocation of displaced people and property are governed by state and federal laws. These laws guarantee all property owners certain time periods during the acquisition phase. Property owners have a minimum of about four months, from the start of the right of way acquisition process for their own property, before the State can demand possession

of the right of way. Additional time is normally required for completing property appraisals and doing any required relocation studies. Because of the statutory allowances for time, as well as the complexities surrounding many properties, typical right of way acquisition projects require eight months to several years for completion. Projects cannot be constructed until the State has legal possession of the right of way and the right of way has been certified.

Design changes with minor right of way impacts will delay completion of an ongoing right of way acquisition process from one to four months. Design changes with major right of way impacts will delay the right of way acquisition process from four to seven months (or more). Contract letting dates can and do slip because of these delays. All project design decisions and work in areas having potential right of way impacts must be addressed as early as possible. Design changes after the start of the right of way acquisition process must consider the impact to the scheduled contract letting date.

1209.4 Property Rights

The State secures the property right to enter upon land to construct and maintain facilities by acquiring either fee title or various types of easements. The following describes these different property rights.

1209.5 Fee Title

This covers all property rights with full title being conveyed to the State. The property owner retains no rights to the property being acquired. The State can acquire the entire property or just a portion of the property. The minimum widths for freeways, expressways, and major streets in urban areas are based on sound engineering judgment and local government policies. The standard margin for rural locations is 10 feet to 15 feet outside the average cut (including slope rounding, see Part 300, Section 322) or fill slope to provide an adequate area to construct the project, maintain drainage facilities, locate utilities, etc. Fee title for city streets or urban highways is normally 1 foot outside the sidewalk but may be at the outside edge of the sidewalk if it greatly reduces property expenses or impacts to buildings. The project team makes these decisions.

1209.6 Easements

An easement is the right to use an exact piece of property for a specified need for a certain period of time. It may be necessary to acquire easements for slopes, drainage facilities, utilities, detours, irrigation facilities, riprap, road approaches, illumination facilities, signs, wetland mitigation, work areas, etc. All the different uses must be specified and cited in the conveyance

document. The State's future use of the easement area will be limited to only those uses declared in the deed. The underlying fee title to the easement area remains with the property owner. The property owner's use of the easement area is limited to only those activities that do not interfere with or affect any of the State's easement rights. Easements are never within a fee title acquisition. Easements usually adjoin property acquired as fee title. Easements not adjoining the right of way need to include a designated path for ingress and egress.

By state and federal law, fee title and easements must be valued and negotiated in exactly the same manner. The time allowances for the property owner are the same. The TPM/RE-CP and all staff working on the project should not be misled into thinking that projects requiring mostly easements rather than fee title are simpler or can be done more quickly. The exact same considerations must be observed so that sufficient time is provided for any property acquisition. The necessary location data and technical design information needs to be delivered to the Region Survey Group in a timely manner.

The following outline provides information about two categories of easements that may be needed:

1209.6.1 Permanent Easements

This provides the permanent right to use a certain piece of property for a specified need. The deed or conveyance document will be recorded in the public records of the County and thus the easement will show as an encumbrance on a title report for the property. There are two categories of permanent easements:

1. To accommodate the transportation facility. Examples would include permanent easements for slopes, drainage facilities, riprap, illumination facilities, signs, wetland mitigation, etc.
2. To accommodate utility companies, irrigation districts, government agencies, and other commercial or private facilities. Occasionally, utility easements are purchased in the name of the appropriate utility company. The Region Utility Specialist provides information about what, when, and where utility easements are necessary.

1209.6.2 Temporary Easements

This provides the right to use an exact piece of property for a specified need for a limited period of time. For the State, this is almost always for an activity that is necessary only during the time of project construction. The time period for a temporary easement is either the estimated time for project construction or the actual duration of project construction, whichever is sooner. If the project is completed ahead of the estimated schedule, then the temporary easement expires at that time. If project construction exceeds the estimated schedule, then the State will need to re-

negotiate with the property owner for a new temporary easement. Examples would include temporary easements for detours, work areas, road approaches, etc. If the State is acquiring only a temporary easement from a property owner, then the deed or conveyance document will not be recorded in the public records of the County.

1209.7 Conditional Entry onto Private Property

1209.7.1 Right of Entry

A Right of Entry gives the State temporary permission to enter certain private property to perform a specific task. During project development, a Right of Entry can be used to evaluate properties for potential transportation needs by performing geological tests, archeological studies, environmental studies, land surveys, etc. During project construction, a Right of Entry can be used to perform a presumed benefit to the property such as rebuilding road approaches, slopes, drainage operations, etc. It is not intended or expected that a Right of Entry will be followed by a formal right of way acquisition.

A Right of Entry is not a deed. The format may be as simple as a hand-written document with a sketch map attached. A written property description is not required; the map alone defines the area where permission is being granted. The map need not be an official survey; it can be very simple and basic. The Right of Entry only needs to clearly explain when and exactly where the State will be performing a certain task. The property owner usually receives no compensation and can revoke a Right of Entry at any time.

1209.7.2 Permit of Entry

A Permit of Entry gives the State temporary permission to enter certain private property to perform a specific task. During project construction, a Permit of Entry is used in emergency situations where access to private property is necessary. This type of permit is to be used sparingly; it is not to be used to circumvent the standard right of way acquisition process. The Permit of Entry should clearly explain when and exactly where the State will be performing a certain task. The permit should also declare the State's intention to soon enter into negotiations with the property owner. It is expected that a Permit of Entry will be followed by a formal right of way acquisition. The property owner can revoke a Permit of Entry at any time.

1209.8 Property Conveyance Documents

The Region Survey Group develops the legal descriptions for right of way acquisition which are forwarded to the Right of Way Section in Salem to be used in the conveyance documents. The preparation of legal descriptions by the Region Survey Group and conveyance documents by the Right of Way Section ensures the proper transfer of real property and property rights. Property needed for right of way cannot be appraised and purchased until the legal descriptions are written and the right of way drawings are completed. The proposed right of way design relies on the project design and delays in receiving this information or subsequent changes to this information result in delaying the right of way acquisition process.
TPMs / RE-CPs must ensure that the Region Survey Group receive the necessary design information in a timely manner, as agreed to in the project schedule.

1209.8.1 Special Rights of Way

Separate legal descriptions and right of way drawings must be developed for parcels of land that are not part of the regular right of way, such as: stockpile sites, quarry sites, scale sites, etc. The data required for acquisition of such parcels is the same as that needed for regular right of way. All stockpile sites are to be purchased, not leased.

1209.8.2 Railroad Encroachments

A specific drawing is developed and submitted with the legal description when the State's construction needs encroach upon a railroad right of way. The explicit relationship between the centerline of the railroad track (not the centerline of railroad right of way) and the highway centerline must be shown. Due to the additional time required to develop railroad encroachment drawings, the TPM/RE-CP should work closely with the Region Survey Group to assure that the project is kept on schedule.

1209.9 Access Rights

Access is a complex issue that requires careful deliberation and decisions by the project team. OAR 734 Division 51 forms the basis for access decisions during project development. Information to be considered includes the designation of the highway, ODOT policies and rules regarding access, design standards, safety of the travelling public, and a list of the existing road approach permits and/or access control measures. There are very specific policies and regulations regarding access, which include state and federal laws, Oregon Highway Plan, and

agency access management manuals. The project team will use this information to determine the access control measures needed on a project. The TPM/RE-CP may decide to form a sub-team to consider access management issues to be addressed as part of the project. (See Project Delivery Leadership Team Operational Notice PD-03 for more information about these sub-teams). Detailed guidance and structure for those required to make and carry out appropriate access management decisions in the development of highway projects can be found in the Access Management Manual.

The status of highway access rights for a certain property can be as follows:

1. Access completely restricted. The State has acquired all rights of access between the highway and an abutting property. No highway access is allowed. This can cover the property's entire frontage or just a portion of the frontage. The deed or conveyance document is recorded in the public records of the County and thus the access restrictions show as an encumbrance on a title report for the property.
2. Access controlled to reserved locations. The State has acquired all rights of access between the highway and an abutting property but provided the property owner a "reservation" of access rights at a specified location. Highway access is allowed only at the specified location. This can cover the property's entire frontage or just a portion of the frontage. The deed or conveyance document identifies the access location (reservation) by Engineer's Station and is recorded in the public records of the County. The access restrictions show as an encumbrance on a title report for the property. Prior to construction of an approach, the property owner must obtain from the State both a Permit to Construct a State Highway Approach and then a Permit to Operate, Maintain and Use a State Highway Approach.
3. Access not controlled. The State has acquired no rights of access between the highway and an abutting property. Only the State's permitting process controls the location of a highway approach. Prior to construction of an approach, the property owner must obtain from the State both a Permit to Construct a State Highway Approach and then a Permit to Operate, Maintain and Use a State Highway Approach. If an approach connects to a local street system, then the property owner must also obtain a permit from the County or City.

Access rights are property rights. Where access rights are to be restricted or controlled, the Right of Way Section will use the standard acquisition process. Whether access control is acquired or not, the district maintenance office is responsible for all approach permits. If the State is acquiring property for the project, the region right of way office can obtain needed signatures from the property owners for the permits.

A grant of access is required to provide new or additional access rights for property that has its access rights controlled with reservations or for property that has no access rights to the highway. A grant is also required to remove a use restriction for a farm crossing or farm access on an access reservation. A grant of access is very difficult to justify, but if it is approved, the

property owner must pay the market value for the access right. The Right of Way Section will order a property appraisal, prepare the conveyance document, and record the fully executed document in the public records of the county.

An Indenture of Access is required to change the location, width, or use of an existing access reservation. (Except the removal of a farm crossing or farm access restriction, which requires a grant). Any changes must comply with current laws and policies regarding access management. The Right of Way Section will prepare the conveyance document and record the fully executed document in the public records of the County.

Some projects require the acquisition of additional access rights or changes to the existing access rights. This is usually done to eliminate or modify existing reservations of access. This can be accomplished through the standard right of way acquisition process.

Oregon law automatically restricts access rights in certain circumstances. ORS 374.405 prescribes that there is no abutter's right of access along a completely new highway alignment constructed after May 12, 1951, unless the State identifies such access rights at the time of right of way acquisition. If highway approaches are to be allowed to a new alignment, it is important to coordinate this with the Right of Way Section. The right of access will need to be declared in the conveyance document. Providing new or additional access rights to a highway alignment established after 1951 may require a Grant of Access. Consult with the Right of Way Section in such circumstances.

1209.9.1 Location of Highway Approaches

On projects where highway approaches will be provided, the Access Management sub-team will establish the Official Access List. This list identifies existing approaches that will remain unchanged, existing approaches that will be rebuilt, new approaches that will be constructed as a part of the project, and existing approaches that will be removed. The list will identify the location (by Engineer's Station) and width of all highway approaches that will be allowed after completion of the project. This information may be declared in the conveyance documents for right of way acquisition. The Official Access List must be approved by the Area Manager. Any changes to the list must be approved by the Access Management Sub-Team core members and the Area Manager.

Access reservations are identified in the deed or conveyance document from the property owner. All decisions must be finalized regarding the allowable location of access reservations prior to the start of the right of way acquisition process. These decisions should be based upon the State's current Access Management policies as well as any unique project conditions or needs.

If any existing legally permitted driveways are to be closed as part of the project, the Access Management Sub-team, and subsequently the Area Manager, will make that decision based on

the access management strategy for the project. Oregon Administrative Rules provide for certain remedies that may be administered by the Right of Way Section. Such remedies may consider the financial cost associated with restoring access to the property, if necessary. If the closure of an approach is at an access reservation or grant of access location, it is elevated to the taking of a property right. In both situations, the Right of Way Section will set up a file and work with the property owner accordingly.

Often the right to enter upon private land to construct or reconnect a highway approach is handled during negotiations with the property owner and generally becomes part of the State's obligations. In such cases, a temporary easement for constructing an approach is not needed. However, if the approach involves major construction such as a fill section, a temporary easement may be needed. The Right of Way Section should be consulted to determine what is necessary.

1209.10 Miscellaneous Right of Way Issues

1209.10.1 Right of Way Estimates

An accurate right of way estimate is needed to establish a workable right of way budget and to apply for Federal Highway approval to use allocated funds. The right of way estimate is based upon the market value of the real property that is needed. This involves researching the highest and best use of each property, zoning, existing use of the property, available utilities, etc.

1209.10.2 Encumbrances and Liens

All encumbrances on real property that is needed for right of way need to be discovered. Encumbrances can be easements or permits to others for roadways, waterlines, power lines, etc.

Liens, such as mortgages, trust deeds and contracts, which encumber the necessary right of way must also be discovered. Such liens may need to be cleared which could delay the State's taking possession of the property.

1209.10.3 Utilities

The TPM/RE-CP, with the aid of the Region Utility Specialist, shall determine the location and ownership of all existing utilities. Careful attention needs to be paid to the difference between "Utility facilities" and "Private lines." The Region Utility Specialist handles utility facility relocations while private line relocations are generally handled as a part of the right of way

negotiations. Utility relocation often affects the amount of right of way needed. It is critical to identify utility needs early in the project development.

1209.10.4 Railroads

The Right of Way Section's Project Administration Unit should be contacted. Whether or not the State is obligated to reimburse for railroad moves needs to be established. The ODOT State Utility and Rail Liaison works directly with the railroad companies regarding their concerns and completes the needed paperwork.

1209.10.5 Land Services Justifications

The Right of Way Section may be asked to provide cost estimates to justify land service design options such as frontage roads, cattle or equipment passes, major installations for irrigation or for restoration of water supplies, etc. The estimated costs are a necessary component of the design option decision process when:

1. The amount of right of way plus potential damages varies greatly between design options. The cost of building a facility plus the required right of way impact for that facility should be compared to the cost of the right of way impact if the facility were not part of the design. The latter may result in larger takings and increased damages to the adjacent properties.
2. When the facility is at least partially for the public's benefit. Examples include situations when the facility would provide highway safety, access to recreation areas, fire protection, preservation or enhancement of the area economy or equitable treatment of property owners.

1209.10.6 Livestock and Equipment Underpasses

Livestock and equipment underpasses may be provided when:

1. The full cost of the underpass structure is less than the additional right of way costs for eliminating such access.
2. The underpass structure is partially for the State's benefit by eliminating any at-grade crossings. Investigation must show a continuing benefit. This must have the approval of the State Traffic-Roadway Engineer.

1209.10.7 Sound Walls

Sound walls usually prevent direct physical access to the highway right of way. Normally the right of way is delineated so that the entire sound wall (including its footing) is within the State's fee title right of way. However, the fee title line may be at the back face of the wall with a permanent easement covering any portion of the footing lying beyond that.

Section 1210 Aeronautics

1210.1 General

Transportation modes often link to each other enabling goods and services to be transferred from one mode to another. The influence areas of the individual modes often overlap each other. Airports that are near a project must be reviewed for impacts to the project and the airport.

1210.2 Design Elements

Projects within the vicinity of an airport must be carefully examined to determine any potential conflict between the two transportation modes. Airport master plans should be reviewed to determine potential impacts to projects. When a project requires an airport clearance study for structures and other potential obstructions to air navigation, comply with Federal Aviation Regulations – Part 77, *"Objects Affecting Navigable Airspace,"* and Oregon Administrative Rules, Chapter 738, Division 70. The Regional Technical Centers are responsible for completing airport clearance studies when required.

Projects that are near airports should be reviewed for obstructions or elements that may impact the air space. Roadway elements such as bridges, signals, illumination poles, or equipment that is used on these types of roadway projects may have an impact on air space. Even a proposed roadway with only the height of the vehicles as the only vertical impact may penetrate the imaginary flight surfaces. Location of drainage ditches and retention ponds can have an impact on airports by potentially attracting waterfowl to the area. The type and pattern of illumination located near an airport should be reviewed for lighting conflict between the project and the airport. Glare shields may be needed to prevent signal light glare to the pilot.

Roadway projects in the vicinity of airports need to accommodate the type of cargo and goods that travel through airports. Turning radii, travel lanes, or additional dedicated turn lanes need to be considered in the accommodation of vehicles moving such cargo and goods. Appropriate

signing for airports must be addressed in project design. Projects that add lanes should consider adding the lane away from the airport for clearance purposes. Potential for rail, light rail, bicycle and pedestrian, and transit needs should be examined for projects near airports, providing the necessary links between the different transportation modes. Coordinate with the Regional Transit Coordinator and review the existing Transportation System Plans to determine any related airport transportation needs.

1210.3 Contacts

The Oregon Department of Aviation should be contacted for assistance when any proposed project is within 20,000 feet horizontally of an airport; to assist in determining compliance needs with federal regulations; and to ensure proper coordination between the two divisions.

Section 1211 Hydraulics

1211.1 General

Various types of drainage facilities are required to convey both subsurface and surface water under, along, or away from the highway. These facilities must be economical and efficient, and they must convey the discharge without damaging the highway or endangering the public.

This section of the Highway Design Manual (HDM) provides guidance on hydraulic procedures for most situations encountered in highway design (with references indicating where details can be obtained). Users should always keep in mind the legal and ethical obligations of the facility owner concerning hydraulic issues.

A hydraulic engineer in the Region Technical Center should be contacted for assistance about project-specific drainage issues. The State Hydraulic Engineer and senior hydraulic engineering staff are resources available to assist Region Technical Center hydraulic engineering staff. Refer to the ODOT Hydraulics Design Manual for more detail on policy and design guidance.

1211.2 Hydraulic Engineering Design Risks

One of the first steps in project delivery is the identification and characterization of project elements and the associated disciplines required to evaluate and design the project. When hydraulic engineering is necessary on a project, there are a variety of hydraulic engineering tasks and associated risks that should be evaluated. These risks can be easily mitigated by

assigning professionals with the appropriate level of expertise to deliver the hydraulic engineering tasks, eliminating the need to identify these risks in the project risk register.

The following factors must be considered when evaluating the appropriate level of risk associated with project-specific hydraulic engineering features and tasks.

1211.2.1 Primary Risk Factors:

1. Safety to travelling public
2. Infrastructure replacement and life cycle cost
3. Environmental and regulatory requirements
4. Potential property damage and other liabilities
5. Design complexity

Site conditions and geography may also be considered. Consulting with a senior hydraulic engineer is recommended to determine the applicable project-specific risk factors.

After the level of risk has been evaluated, the risk is then mitigated by assigning professionals with the appropriate level of expertise to deliver the hydraulic engineering tasks. The five primary risk factors listed above were used to develop the contents of the matrix provided in Table 1200-5. This table should be used as a tool to quickly evaluate the appropriate level of expertise necessary to complete hydraulic engineering project tasks.

This approach replaces the past practice of using pipe diameter to determine the risk threshold.

Table 1200-5: Hydraulic Design Level of Risk

Hydraulic Engineering Task	Low Risk	Med Risk	High Risk
CHANNELS			
Channel - Roadside or Median drainage and Slope 5% or flatter	X		
Channel - Roadside or Median drainage and Slope steeper than 5%		X	
Channel – Stream Conveyance (All locations)			X
Channel - All Others			X
CULVERTS[5]			
Culvert, Non-Cross (public approach crossings, access roads, side drains, etc.)	X		
Culvert, Cross (State Highway) - Roadside or Median drainage only	X		
Culvert, Stream Conveyance (All locations)			X
Culvert extensions		X	
Culvert, Cross (State Highway) – All Others			X
STORMWATER[5]			
Inlet Capacity, Spacing, and Location	X		
Pavement / Pedestrian Facility Drainage	X		
New storm drain systems with 5 or less catch basins/manholes that do not discharge into a treatment or flow control facility	X		
New storm drain systems with 6 to 10 catch basins/manholes that do not discharge into a treatment or flow control facility		X	
New storm drain systems with more than 10 catch basins/manholes that do not discharge into a treatment or flow control facility			X
Modification of existing inlets or storm drain piping system without collecting additional contributing area	X		
Modification of existing inlets or storm drain piping system that collects additional contributing area		X	
Storm drain systems with stream conveyance			X
Storm drain systems that discharge into a treatment or flow control facility		X	

[5] Pipe materials and outlet protection are considered an element of the primary Hydraulic Engineering Task.

Table 1200-5: (Continued) Hydraulic Design Level of Risk

Hydraulic Engineering Task	Low Risk	Med Risk	High Risk
STORMWATER (Cont'd)			
Modification or removal of any existing treatment or flow control facility		X	
Offsite Drainage Contribution		X	
Combined flows from multiple jurisdictions			X
Flow control and associated features (detention, gates, valves, weirs, etc.)			X
Stormwater Treatment			X
Infiltration Facilities			X
Underground Injection Control Systems (UICs)			X
Stormwater Temporary Water Management		X	
OTHER			
Bank Protection (Rivers, Natural Channels)			X
Bridge Hydraulics / Scour Analysis /Abutment Protection			X
Scour Mitigation Plan of Action		X	
Downstream impacts and hydraulic connectivity zones			X
Facility Markers	X		
Fish Passage (All Locations)			X
Floodplains / Floodways			X
Minor structures (headwalls, wingwalls, vaults, special manholes, cutoff walls, etc.)			X[6]
Pump Station			X
Siphon			X
Temporary Water Management			X
Tide Gates			X
Trenchless Pipe Rehabilitation			X
Trenchless Pipe Replacement			X[7]
Waterway Enhancement			X
Anything not in the Hydraulic Design Manual			X

[6] Collaboration with a structural engineer may be required

[7] Collaboration with a geotechnical engineer is required

Table 1200-6: Professional Expertise Requirements

Risk Level	Design	Quality Control
Low	Professional Engineer	Professional Engineer
Medium	Professional Engineer	Hydraulic Engineer
High	Hydraulic Engineer	Hydraulic Engineer

Professional Engineer: a licensed engineer as described in ORS 672 and OAR 820 and regulated by the Oregon State Board of Examiners for Engineers and Land Surveyors.

ODOT Hydraulic Engineer: a professional engineer who specializes in the hydraulic components related to the repair and replacement of bridges, culverts, and roadway embankments. These projects occur in the river environment and adjacent to other large bodies of water such as lakes and coastal environments. These professionals also work with stormwater and help design projects that are related to the movement, control, and treatment of water. Hydraulic engineers must have a strong understanding of hydrology and fluid mechanics relating to the design and protection of the transportation system.

ODOT Hydraulic engineers also assist with water resources, flood control planning, and adhere to federal, state, and local environmental regulations and standards. They must have a strong understanding of how Oregon drainage law has been established by case history. They also create designs for flood control and waterway enhancement and communicate with governing bodies to address their concerns about stormwater, stream stability, and scour. Hydraulic Engineering falls under the broader career category of the Civil Engineering branch of Professional Engineering. Several indications that a Civil Engineer may have expertise in hydraulic engineering include:

- Work environment (team members primarily design hydraulic features or conduct hydraulic studies)
- Mentorship received from a senior hydraulic engineer
- Number and complexity of hydraulic engineering designs completed
- Number and quality of hydraulic engineering training classes completed
- Working Title (ODOT Only) of “Hydraulic Designer/Engineer”

1211.3 Policy

General policies pertaining to hydraulic and drainage design are governed by several factors discussed in this section. The ODOT Hydraulics Design Manual is the primary document that provides the guidelines and state-specific policies and procedures for the design of highway hydraulic facilities within ODOT right-of-way. The ODOT Hydraulics Design Manual must be used to design highway drainage features to convey both subsurface and surface water under,

along, or away from the highway. These facilities must be economical and efficient, and they must convey the discharge without damaging the highway or endangering the public. All engineering designs must comply with the Oregon Drainage Law, Federal Clean Water Act, Endangered Species Act, applicable state and local jurisdiction regulations, and other applicable environmental regulations.

A hydraulic and/or a stormwater report is also required to document engineering of Medium and High risk hydraulic and stormwater features as outlined in Table 1200-5. These reports are prepared by the project professional of record. See Section 1211.4 and the ODOT Hydraulics Design Manual documentation chapter for documentation guidelines.

1211.3.1 Oregon Drainage Law

Oregon drainage law, which originates from common law or court-made law, has developed without legislative action, and it is embodied in the decisions of the courts. Therefore, there are no Oregon Revised Statues to cite pertaining to Oregon drainage law.

Oregon has adopted the civil law doctrine of drainage. Under this doctrine, adjoining landowners are entitled to have the normal course of natural drainage maintained. The lower owner must accept water that naturally comes to his land from above, but he is entitled not to have the normal drainage changed or substantially increased. The lower landowner may not obstruct the runoff from the upper land if the upper landowner is properly discharging the water.

For a landowner to drain water onto lands of another in the State of Oregon, one of two conditions must be satisfied initially:

1. The lands must contain a natural drainage course; or
2. The landowner must have acquired the right of drainage supported by consideration (i.e., a purchased drainage easement).

In addition, because Oregon has adopted the civil law doctrine of drainage, the following three basic elements must be followed:

1. A landowner may not divert water onto adjoining land that would not otherwise have flowed there. "Divert water" includes, but is not necessarily limited, to:
    a. Water diverted from one drainage area to another; and
    b. Water collected and discharged which normally would infiltrate into the ground, pond, and/or evaporate.
2. The upper landowner may not change the place where the water flows onto the lower owner's land. Most of the diversions not in compliance with this element result from grading and paving work and/or improvements to water collection systems.

3. The upper landowner may not accumulate a large quantity of water, then release it, greatly accelerating the flow onto the lower owner's land. This does not mean that the upper landowner cannot accelerate the flow of water at all. Experience has found the drainage to be improper only when the acceleration and concentration of water were substantially increased.

Subsurface waters which percolate to the surface can be intercepted and diverted for the protection of the highway without regard for the loss of these waters to the adjacent landowners. In those cases where wells and springs are involved, the right-of-way agent should contact the affected owner(s) to prevent any misunderstanding over damage that could be claimed. Drainage designs should satisfy Oregon drainage law to avoid claims or litigation resulting from improper drainage design. When it is apparent that the drainage design will not satisfy the law, then drainage easements should be obtained from the affected property owners. Legal staff should be consulted in those situations that appear to be unique and could result in litigation.

Where certain drainage patterns have been established over long periods of time (i.e., in excess of at least 10 years), that are not the original natural drainage, there may be legal rights acquired which allow the continuance of the altered drainage pattern. Again, legal staff should be consulted in such situations.

1211.3.2 Design Deviations

Deviations from standards in the ODOT Hydraulics Design Manual require justification and approval by the State Hydraulic Engineer. Requests for a hydraulic design deviation are prepared by the project professional of record and submitted to the Region Technical Center for initial review.

If a proposed hydraulic design cannot meet requirements as defined in the ODOT Hydraulics Design Manual, then a design deviation will be required. A few common items that would require a design deviation include:

1. Design Flood Interval Period (ODOT Hydraulics Design Manual Policy Chapter)
2. Design Spread (ODOT Hydraulics Design Manual Storm Drainage Chapter)
3. Culvert Allowable Headwater (ODOT Hydraulics Design Manual Culverts Chapter)

See ODOT Hydraulics Design Manual, Policy Chapter for the hydraulic design deviation process and Appendix A for the deviation request form.

1211.3.3 Cooperative Projects

Participation in cooperative projects for flood control, flood protection mitigation, or stormwater control facilities must be approved by the Regional Technical Center with the extent of participation being restricted to the amount of benefit accruing to ODOT. No commitments should be made prior to approval by the Regional Technical Center and the amount of participation shall be documented by formal agreement. Actual work performed by ODOT under such agreements will be limited to highway right-of-way, unless otherwise approved in advance by the Regional Technical Center. Projects should consider opportunities for regional stormwater management facilities as appropriate in conjunction with local agency projects.

1211.4 Documentation

Hydraulic and Stormwater reports are essential to document engineering recommendations for projects and to provide information required for planning, environmental, the subsequent design phase, and quality control. These reports are intended to serve as a complete documented record containing the engineering justification for all drainage and stormwater installations and modifications that occur as a result of the project. See the ODOT Hydraulics Design Manual and the Hydraulic Engineering Quality Control/Quality Assurance Work Plan for more guidance on documentation.

1211.4.1 Hydraulic Report

Design of channels, culverts, and other hydraulic elements that are considered a high risk must be documented in a hydraulic report. These types of projects include complex hydraulic design, potential of property damage, and regulatory requirements such as FEMA floodplain permits or required fish passage conditions.

The hydraulic report is prepared by the project hydraulic engineer. This is the final report that provides detailed information for many tasks, such as structure design, roadway design, environmental documents, and permit applications. A hydraulic report is required for risk levels of medium and high for the Other, Culvert, and Channel sections in Table 1200-5. For more detailed information on the hydraulic report or additional reports, see the ODOT Hydraulics Design Manual documentation chapter.

1211.4.2 Stormwater Report

The ODOT Hydraulics Design Manual documentation chapter provides guidance for standard stormwater designs. Standard stormwater designs include roadway inlets, small storm drains, and small channels or ditches. This information is part of the drainage design provided to the roadway designer who incorporates the drainage features into the roadway design. The design information also may be part of the work done by the roadway designer if the drainage and roadway designs are done concurrently.

A drainage plan with design calculations and documentation is part of the design data that must be prepared on all projects. The drainage plan must address the location, size, and alignment of inlets, storm drains, small culverts, utilities, pipe materials, outlet protection for pipes, roadside ditches, and cutoff ditches. The drainage plan must be reviewed by another professional engineer, or the project hydraulic engineer as outlined in Table 1200-5 and Table 1200-6, prior to finalizing the drainage plan.

A stormwater report is required to document High risk storm drain, water quality and flow control facilities as detailed in Table 1200-5. The documentation for these projects is greater than the standard stormwater design documentation. These reports are prepared by the project professional of record. See the ODOT Hydraulics Design Manual documentation chapter for documentation guidelines. The facility design(s) incorporated in the final plans should comply with the information in the stormwater report.

1211.4.3 Stormwater Operational & Maintenance Manuals

ODOT requires preparing an Operation and Maintenance (O&M) manual for every stormwater control facility during the project development stage. An O&M manual describes the type of facility and how it operates, includes the drainage facility identification number (DFI number), outlines an inspection schedule, and summarizes maintenance actions for the facility. The purpose of O&M manuals is to support maintenance, protect water quality, and ensure compliance with permit requirements. Refer to Technical Bulletins GE16-01(B), GE16-02(B), and the documentation chapter of the ODOT Hydraulics Design Manual for guidance on the O&M manual process.

1211.5 Design Features

1211.5.1 Drainage Facility Identification

ODOT owns, operates, and maintains stormwater control facilities, underground injection control systems, and culverts across the state of Oregon. Assigning a DFI number and placing field markers assists in the accurate identification of facilities and supports data collection for asset management purposes. DFI numbers are asset numbers used to uniquely identify culverts and stormwater control facilities within ODOT's highway system. DFIs and field markers are required for all culverts and stormwater control facilities. For more information on DFIs, guidelines on field markers, and the DFI number request process, refer to the field marker chapter in the ODOT Hydraulics Design Manual.

1211.5.2 Floodplains

The National Flood Insurance Program has established floodways and floodplains on many rivers and streams in Oregon. A floodway is the regulated portion of the stream channel plus portions of the adjacent floodplain where encroachment is prohibited or limited. The remaining portion of the floodplain that is not included within the floodway boundaries, known as the floodway fringe, is often suitable for encroachment. Federal Emergency Management Agency (FEMA) regulations require the areas within the regulated floodway to be kept free of encroachment for the 100-year flood to be carried without substantial increases in flood stage or elevation. Minimum standards of FEMA limit such increases in flood stage within the floodway to no more than 1 foot, provided hazardous velocities do not result. In several jurisdictions in Oregon, community officials have adopted a floodway or floodplain that allows less than a one foot rise or, in some instances, a no rise of water elevations.

Highways adjacent to or crossing floodplains should be designed to maintain the existing water elevations and velocities for the 100-year flood event, if practicable. Floodplain boundaries can be determined by consulting the appropriate Flood Insurance Study or the project hydraulic engineer. The project hydraulic engineer should be contacted for assistance as soon as it has been determined that a floodplain or floodway exists within the project limits, and before any work in the floodway or floodplain is considered.

In some cases, constructing a project without modifying the existing floodway boundary may not be practicable. A floodway boundary revision request or other documentation must then be submitted to and approved by FEMA. This process may require up to 12 months to complete. FEMA approval of requests for floodway revisions are normally obtained by the local jurisdiction, either the City or County. In other cases, temporary construction (such as work bridges, cofferdams, etc.) is needed to construct the project within the floodway. The project

hydraulic engineer provides the engineering analysis necessary for projects to conform to the local floodplain regulations. Additional information on the National Flood Insurance Program and floodways can be found in the ODOT Hydraulics Design Manual Legal Aspects and Bridges Chapters.

1211.5.3 Bridge Hydraulics

Design elements, including the roadway horizontal and vertical alignment relative to the water crossing (skew of the bridge), floodplain, channel geometry, aggradation and degradation, channel migration, and sediment and debris transport, are some of the important considerations in bridge hydraulic design. The project hydraulic engineer provides the hydraulic engineering analysis for bridge replacements over waterways. Information and design guidance on bridge hydraulics can be found in the ODOT Hydraulics Design Manual Bridges Chapter.

1211.5.4 Scour Protection

Scour can occur around bridges and along roadway embankments in the river environment, coastal areas, adjacent to large bodies of water, such as lakes, and can lead to catastrophic failure of structures, embankments, and roadbeds. When scour becomes critical, designing mitigation measures becomes necessary to correct the eroded areas and provide protection from future scour. The project hydraulic engineer prepares and/or reviews all proposed solutions for scour mitigation. Information on scour and bank protection can be found in the ODOT Hydraulics Design Manual Bridges Chapter and Bank Protection Chapter.

1211.5.5 Channels

Roadside Ditches

Roadside ditches should be provided to convey roadway runoff where storm drain systems are not appropriate. Roadside ditches should also be designed to prevent saturation of the roadway base material. This can be accomplished by designing the water surface elevation in the ditch to not exceed the elevation of the bottom of the base material. A typical roadside ditch should be sized for capacity and stability. Project teams should also evaluate and consider existing ditches within the project limits during scoping for opportunities to modify or retrofit ditches to provide water quality benefits to nearby surface water bodies.

The peak discharge, longitudinal slope, and ground cover affect the ditch capacity. Ditches on steep slopes, as outlined in Table 1200-5, are of higher risk due to increased shear stresses on the ditch bottom and should be evaluated to assure the ditch does not erode. The discharge

contributing to ditches from areas within the right-of-way is often small compared to runoff from outside the right-of-way. Evaluate each ditch for significant flows from off-site contributing areas. The standard 6-inch deep ditch should be used on all projects unless the calculated peak flows indicate insufficient capacity or instability.

Shear stresses may be less in ditches not flowing full. The information on stability for cohesive and non-cohesive soils include a range of values because soil properties such as plasticity and gradation vary considerably and can significantly affect how the soils react to shear stresses in the bottom of the ditch. For more information, refer to the ODOT Hydraulics Design Manual Channels Chapter.

Cut-off Ditches

Cut-off ditches should be provided above high erodible cuts to convey drainage of surface water away from the face of the cut. They should be set back about 10 feet from the point where the slope rounding meets original ground slope (see Section 323 Rounding Cutbanks).

1211.5.6 Roadway Drainage

Roadway drainage systems typically include curbs, gutters, inlets, manholes, ditches, and a network of storm drain pipes that convey surface runoff collected by the system to an outlet location. The system should adequately drain the roadway runoff to the discharge point without surcharging inlets and minimize the potential for surface flooding and erosion of properties adjacent to the right-of-way.

Inlets

Storm drain inlets are used to collect surface runoff and discharge the flow to an underground storm drainage system. Inlets are typically located in gutter sections, paved medians, roadside ditches, and median channels. Each inlet should be checked for efficiency, flow capacity, and spacing (on continuous grades and at sag locations). Inlets used for the drainage of highway surfaces can be divided into six classes:

1. Grate inlets
2. Curb-opening inlets
3. Slotted drain inlets
4. Combination inlets
5. Trench drain inlets
6. Bridge deck drains

Inlet design considerations include, but are not limited to, the location of the inlet (on-grade vs. sag), selecting the storm event, limiting the allowable spread (extent of water on the road

surface), inlet and grate type, inlet clogging factors (to account for debris), and compatibility with pedestrian/ADA/bicycle facilities. For bridge deck drain applications, the design is complicated by the structural and architectural requirements of bridges and coordination with the bridge designer is critical. Information on inlet selection and design is provided in the ODOT Hydraulics Design Manual Storm Drainage Chapter.

Storm Drains

Storm drain pipes are used to convey water from inlets to a desired outlet location such as a channel, waterbody, or other pipe system. Storm drain systems should be designed to protect the highway from flooding at the appropriate recurrence interval (design event). Each storm drain pipe should be evaluated for structural integrity, capacity, and outlet protection. Design of inlets and storm drain pipes included in the drainage plan is usually prepared by the project professional of record. For more complex storm drain systems, the design is performed by the project hydraulic engineer. The drainage plan must be reviewed by another roadway designer or the project hydraulic engineer prior to finalizing. The professional expertise requirements and levels of risks associated with storm drain system designs are outlined in Table 1200-5 and Table 1200-6. Storm drain design guidance and documentation requirements are provided in the ODOT Hydraulics Design Manual Storm Drainage Chapter and Documentation Chapter.

1211.5.7 Culverts

All culverts should be evaluated for capacity, allowable headwater, outlet velocities, and protection. An existing culvert should not be extended, replaced, or undergo rehabilitation without first conducting a thorough evaluation of the pipe's existing capacity and structural integrity. Whenever possible, culvert extensions shall be designed using the same pipe material and size and match the existing slope. Pipe rehabilitation or replacement may be required if the culvert has exceeded the service life.

The project hydraulic engineer provides the engineering analysis for all culvert design with a level of risk of High as outlined in Table 1200-5. FHWA's HY-8 software is the approved application for performing hydraulic culvert analysis. For all hand calculations, refer to HDS-5 for calculation forms, charts, and nomographs for culvert design.

Refer to the culvert and pipe rehabilitation chapters in the ODOT Hydraulics Design Manual for design policy and procedures.

1211.5.8 Fish and Wildlife Passage

Check with the ODOT Region Environmental Coordinator to determine if fish or wildlife passage will be required at all proposed highway-stream crossing projects, regardless of stream

or drainage size. If fish or wildlife passage is required, the project hydraulic engineer will provide the engineering analysis as outlined in Table 1200-5.

1211.5.9 Pipe Materials

Concrete, metal, and thermoplastic pipe are available for use on projects. The site conditions and design criteria will determine which materials are viable options. Selecting the appropriate type of pipe material for a project is dependent on several factors including: size and strength, fill height, service life, corrosion and abrasion potential, and debris. Alternate materials must satisfy the requirements in the preceding list. The use of metal and concrete pipes is an excellent structural and longevity choice if care is taken regarding the pipe bedding and pipe zone backfill material. In situ soil, pipe zone backfill, and water samples must be taken at each site to measure soil and water pH and resistivity. Lack of design consideration in the determination of gauge size and/or coating of metal pipe can ultimately result in failure of the roadway. Refer to the Pipe Material chapter in the ODOT Hydraulics Design Manual for design policy and procedures to extend pipe service life, and Chapter 3 of the Geotechnical Design Manual, Section 3.5.5.5, for guidance on sampling.

Thermoplastic pipe is an excellent economical alternate material. Corrugated High Density Polyethylene (HDPE) is ideal for median drains, roadway approach culverts, and systems adjacent to the highway. Corrugated HDPE is not recommended for cross culverts under the highway system due to a thin wall profile, lack of strength, and the propensity to have misalignment of joints. Solid wall HDPE has a thicker wall profile and is a great option for cross culverts under the highway. The solid wall HDPE is joined by a fusion process which eliminates joint issues. However, care must be taken during pipe bedding and compaction to eliminate pipe sag.

Care must be given to the end treatment(s) used in culvert applications. Sloped ends of all HDPE pipe require additional end treatments to prevent the folding up of end sections during normal and high storm events. Removing the top section of the pipe to make the sloped end reduces the strength of the material to resist the upward buoyancy force. Solutions to this problem are to use a paved end slope for smaller pipes or a reinforced concrete collar for larger pipes. Refer to the Culvert Chapter in the ODOT Hydraulics Design Manual for more information on end treatments.

1211.5.10 Stormwater Control Facilities

Water Quality Treatment

Projects that trigger stormwater management mitigation for water quality are required to provide treatment of the stormwater runoff from the project's contributing impervious area

(CIA). Stormwater water quality triggers (including exemption activities) and the CIA definition are detailed in the Water Quality Chapter of the ODOT Hydraulics Design Manual. The delineation of the CIA may be done by the project hydraulic engineer or water quality specialist. This information is used to determine the extent of the treatment area, to design/size treatment facilities, and support permitting and environmental documents. Various local jurisdictions have special requirements that must also be addressed.

Water Quality Best Management Practices (BMPs), including engineered treatment facilities and non-engineered techniques, can be used to provide water quality mitigation for the project. The stormwater designer should evaluate treatment approaches and techniques in the following order:

1. Use of the adjacent unaltered right-of-way as a treatment area
2. Modification of the right-of-way (slopes, soils and/or vegetation) to provide treatment
3. Use of small, distributed treatment facilities along the length of the project
4. Use of large, consolidated treatment facilities
5. Off-site project mitigation

All water quality facilities must be reviewed or designed by the project hydraulic engineer. Refer to PDLT Notice 05 (PD-05), the Water Resources Specialist Manual, and the Water Quality Chapter of the ODOT Hydraulics Design Manual for project requirements and design guidance.

Flow Control

Detention or flow control may be necessary to limit peak runoff if existing drainage facilities used for stormwater conveyance are not sized adequately for estimated peak flows, if the project increases peak flows to a quantity-limited waterway, or in accordance with an approved drainage master plan. ODOT's goal is to reduce runoff generated from transportation-related projects first before using engineered stormwater facilities to meet water quantity standards. All flow control facilities must be reviewed or designed by the project hydraulic engineer. Refer to the Storage Facilities Chapter of the ODOT Hydraulics Design Manual for project requirements, including actions that trigger the need for flow control mitigation, and design guidance.

Underground Injection Control Systems (UICs)

Underground injection control systems (UICs) are a stormwater management tool that can be installed and used within the limits prescribed by ODOT's UIC Permit. A UIC is a system, structure, or activity that is created to place fluid below the ground or subsurface. Dry wells and systems that use perforated pipes to infiltrate stormwater into the subsurface are considered UICs. Other common stormwater UICs include, but are not limited to sumps, infiltration galleries (i.e., infiltration trenches with underdrain pipes), trench drains, and drill holes. Design of UICs requires determining the soil infiltration rates and ground water levels at the facility site. Techniques for establishing soil infiltration rates, including laboratory, field-testing, and groundwater monitoring methods, are provided in the Geotechnical Design

Manual. Refer to Technical Bulletin GE07-03(B) and the Water Quality Chapter of the ODOT Hydraulics Design Manual for guidance on UIC requirements.

Facility Maintenance Considerations

All stormwater control facility designs must include recommendations for appropriate preventative maintenance to ensure the facility operates properly. Project stormwater control facility designs must include features that will minimize and facilitate maintenance operations. Stormwater control facilities that require extensive or specialized maintenance activities or equipment are discouraged. The responsible Maintenance District should be consulted early and throughout the design process to obtain maintenance review and concurrence. Include documentation from maintenance in the project stormwater report.

Cost Considerations

The construction and maintenance costs for different stormwater mitigation options vary. The project hydraulic engineer must ensure maintenance is a consideration in design and in determination of long-term operation and maintenance costs. The goal is to select a stormwater control facility that minimizes lifecycle costs while achieving regulatory stormwater requirements, overcoming site constraints, and ensuring public safety. Cost-effective stormwater control facilities should be selected based on lowest overall costs, including maintenance, construction costs, and right-of-way costs for the life of the facility.

Geotechnical Investigation for Stormwater Facility Design

Stormwater control facility design includes understanding the soils, geology, geologic hazards, and groundwater conditions at the project site. This typically involves conducting a geotechnical investigation to evaluate the site's suitability for infiltration, to establish the infiltration rate for design, to evaluate slope stability, and obtain other geotechnical design information needed to design and assess the constructability of the facility. Project engineering geology staff should be consulted as early as possible in the scoping phase to identify the adequacy and available geotechnical data/information in support of stormwater and drainage facilities. Project engineering geology staff will need to include stormwater facility investigation in their project SOW when existing data is insufficient. Guidance on geotechnical investigation can be found in the Geotechnical Design Manual and in the ODOT Hydraulics Design Manual Water Quality Chapter and Storage Facilities Chapter.

1211.5.11 Outlet Protection

Protection should be provided at pipe outlets to minimize local scour caused by concentrated flows and high flow velocities. Typical outlet protection utilizes a riprap pad sized sufficiently to dissipate the energy from the end of the pipe into sheet flow. Environmentally sensitive locations may require larger transition areas and planting. The outlet protection should be

designed by the appropriate level of expertise as outlined in Table 1200-5 and in accordance with the ODOT Hydraulics Design Manual.

Section 1212 Pavement

1212.1 General

The pavement design for each project will be determined by the Pavement Design Group. Because the depth of surfacing is a major factor in the project design and cost, the pavement design is needed early in the project development process. If the Pavement Design Group is to complete their design work on time, keeping them informed of any changes in the project scope and schedule is very important. For preservation projects, contact pavement services so that they can schedule testing, complete testing, and complete Preliminary Design work prior to formal project kick off.

The primary function of the Pavement Design Group is to provide the most practical and cost-effective pavement/base/subgrade design for the conditions and criteria for a specific project. Development of the design is accomplished through a combination of field investigation, data analysis, and application of appropriate design procedures. Pavement design procedures and ODOT Policies are outlined in the ODOT Pavement Design Guide. The surfacing type selection, such as PCC versus AC, will be the responsibility of the Pavement Design Group and will not be left to the competitive bidding process.

1212.2 Project Scope

Before the pavement design process can be started, the project scope must be established. Once the project scope is established, the Pavement Designer can begin the field investigation. Because of the limited availability of the Pavement Design Field Crew and other factors, scheduling fieldwork several months prior to the date when a complete design is necessary is important. For pavement preservation projects, the Pavement Designer needs to validate final scope through testing and analysis prior to formal project kick off. Any changes in the project scope could require additional fieldwork and should be brought to the attention of the Pavement Designer as soon as possible.

Field work for most projects will involve deflection testing of the existing road surface. This work cannot be performed when the existing pavement or subgrade is frozen. For this reason, field work for projects in frost susceptible areas needs to be completed during the summer prior to the time a design is required. This may in some instances (particularly for regions 4 and 5 and projects at the higher elevations in the Cascades) require the scope and project schedule to be

finalized eight to nine months in advance of the time a pavement design is required. Typically, if a pavement design for a project in the above areas is needed prior to July of a given year, a work request needs to be provided by August of the previous year.

1212.3 Design Considerations

Additional information important in the selection of the most appropriate pavement design for a particular project is listed below.

1. The availability of materials
2. Source of embankment materials
3. Traffic staging details*
4. Amount of grade change required or tolerated (curbs, cross-slope, R/W, stream or cut encroachment, etc.)*
5. Location and extent of widening
6. Location and extent of alignment changes*
7. Extent of current or future planned projects on the same section of highway
8. Unusual traffic patterns on a project*
9. Areas where soft subgrade may be encountered
10. Age, condition and upgrade plans for utilities under the pavement*
11. Type of drainage facilities in place or to be placed*
12. Actual type of curb present*
13. Change in traffic pattern use on existing pavement*
14. Extent and frequency of chain usage
15. Extent and frequency of snow plow damage
16. Grade constraints at bridges

* Important for urban area projects

1212.4 Urban Pavement Rehabilitation Projects (in town, curbed sections)

This type of project requires a very detailed review of several of the items listed above before field work should be conducted for development of the pavement design. The items are

designated with an asterisk above. Many of these sections have very little curb exposure left or have unacceptable cross-slopes and/or other geometric features. This type of information is very important in determining the options available and the type of fieldwork necessary to develop the design. For more information regarding field work and pavement design for urban projects refer to the ODOT Pavement Design Guide.

1212.5 Pavement Preservation Minimum Design Life

All pavement designs must meet the minimum design life requirements outlined in the ODOT Pavement Design Guide (see Section 7.1 of the ODOT Pavement Design Guide). A design exception may be requested through the process described in Part 1000. Typical acceptable reasons for getting a design exception are as follows:

1. A life cycle cost analysis shows that the proposed maintenance/rehabilitation strategy is more cost effective than what would be required to meet the minimum design life.
2. The proposed short term fix keeps the road passable until a project can be put in the STIP to provide a long term solution. A commitment should be made at the time of the agreement of the exception to get the project into the next STIP.

1212.6 Project Scoping and Design Estimates

The Pavement Design Group is also available to assist in the project scoping process. In most cases the Pavement Design Group can develop a preliminary design estimate that will be fairly close to the requirements of the final design. By using the Pavement Design Groups' expertise in the early stages of a project, the risk of significant cost overruns due to changes in the pavement design may be minimized.

For projects with liquid asphaltic quantities in excess of 150 tons, the designer should include a separate bid item for the liquid asphalt. Any request to not have a separate bid item should obtain the approval of the pavement designer. In addition, the standard liquid asphalt quantity is equal to 6.0 percent of the mix for 1/2-inch ACP and 6.3 percent of the mix for 3/8-inch ACP. Any deviation to the standard liquid asphalt quantity requires the approval of the pavement designer.

Section 1213 Roadside Development

1213.1 General

Roadside development is work occurring on a transportation facility right of way that doesn't fall into other categories such as illumination, utilities, or access control. The purpose of roadside development is to help integrate the transportation facility into the surrounding environment, which includes the larger transportation corridor. The purpose may be environmental, cultural, aesthetic, functional, or combination of these. The work may be mitigation (avoidance or minimizing impacts), compensation (replacing functions that are impacted), or enhancement (creating or improving something desirable in the landscape). Roadside land outside the operational right of way can be used to provide a range of environmental services, including providing pollinator habitat, sequestering carbon, providing shade that can reduce urban heat islands, or providing cool aquatic habitats. Also included in this category of work is comment and advice for the modification of the work of other technical specialties that is related to the effect on the natural or cultural landscape of the transportation facility. Roadside development work is most often a part of road projects, but it can be the sole purpose of a contracted project.

Because roadside development usually deals with multiple overlapping large and small systems, it is not easy to precisely describe the term, just as there is no exact definition of the term “landscape.” The normal ODOT practice is to have specialists participate in scoping roadside development work on significant projects.

For the reasons cited above, specific roadside development requirements can have a variety of origins. One critical source is the environmental document whose legal purpose is to determine project impacts and state the actions intended to deal with those impacts. Other typical sources of requirements are various kinds of permits, agreements with county or city governments, the operating policies of various authorities such as the U.S. Forest Service, and ODOT’s mission concerning the environment or quality of life for residents and visitors to Oregon. Some needs of a project are discovered as the project evolves because they relate to project impacts that come to light or are finalized during later stages of development. Final roadbed slope lines are one example.

It is important to note that the roadside development work done for projects is almost always required, rather than optional. For questions about the sources of requirements that are not referred to in this section, contact the Roadside Development Program Coordinator in the Environmental Section in Engineering and Technical Services Branch. One primary source of actions on federal participation projects is the National Environmental Policy Act (NEPA). For Roadside Development on complex projects, it is often necessary to conduct an inventory and

analysis of visual resources along the project, determine the level of impact and identify measures to ameliorate or mitigate those impacts.

1213.2 Project Development Phases

1213.2.1 Planning

The ODOT Transportation Planning Unit usually looks at the "big picture" to develop initiatives like the corridor program and develop policies which integrate local land use policies with statewide transportation systems. Many of these policies condition what actions are to be taken later on in projects and in these cases, Transportation Planning Unit or region planners as well as published documents such as the Oregon Transportation Plan or Transportation Corridor Plans can be important resources.

Local government or transportation-related planning also must be considered for a comprehensive project. Some sources of information or requirements include local and regional Transportation System Plans (TSPs), local comprehensive plans, transit plans, and impacts to or from other planned projects in local capital improvement programs. Also included in the planning phase is consideration of other known major factors such as proximity to parks, funding options, access management, or other critical features.

1213.3 Programming and Scoping

Timely anticipation of the need for roadside development work will help establish a realistic design schedule and budget. Any project may have roadside development, but the rule of thumb is that the greater the disturbance to the natural or built landscape, the greater will be the need for work. Key flags are sensitive environments or populated urban areas where extensive work is being proposed. A brief review of the sources of work in the first section may help in scoping, but specific development of needs with the appropriate specialists may be required. In spite of best efforts, there will be times that the total work is not determined until late in the project design phase.

1213.4 Design

Field data collection that enables design work to begin is important to the success of roadside development. Data needs vary for the kind of work anticipated and ideally will be determined during project scoping. Data must be requested as the need becomes clear in the design process. Examples of data are a survey of existing trees, analysis of native plant communities, existing

and proposed topography, soil types and depths where planting is proposed, existing wetlands or other water features, available potable water supply information, existing noxious weed populations, or similar data. Also falling into the category of field information are government regulations, policies, or initiatives external to ODOT. Examples of these could be master plans for local improvement districts, zoning or development requirements, scenic waterway or byway requirements, and other similar kinds of information that must be known for the design to be completed. Primary resources to research this kind of information are the Region Permit Specialist, Local Government Coordinator, or Region Environmental Coordinator. Often, agencies with jurisdiction will have to be surveyed for relevant requirements, and project needs are sometimes determined through such forums as meetings with neighborhood groups or other interested parties.

Roadside development design in ODOT often focuses on the proposed contract document or design products as one way to scope the design process. The following is a list of the most familiar contract document and design products:

1. Roadside development conceptual mapping
2. Sketches or renderings to illustrate concepts.
3. Planting, Irrigation, and Contour Grading Plans
4. Various environmental mitigation plans - whether specifically identified by name, such as Wetland Mitigation, or not
5. Site Development Plan
6. Typical or unique project details
7. Cost Estimate with Bid Items
8. Specification Special Provisions
9. Special advice for project construction
10. Post-construction Maintenance Plan

1213.4.1 Construction

Design work of any type must be “biddable and buildable,” and also anticipate potential construction problems. This is critical for roadside development work because it usually deals with living systems that are subject to natural elements such as weather, and business elements such as supply of plant materials in a timely fashion. A few considerations are waterway high and low periods, planting seasons versus contract periods, problems caused by erodible soils, restrictions on work such as in-stream periods, the ability to water new plants where no irrigation system exists, length of the plant establishment period, and many other such issues. Good communication between the various parties involved in the origination and design of the

work is required for successful construction, especially because "adjustment" of all types of project elements as construction progresses is the rule, rather than the exception.

1213.4.2 Post-Construction

A critical concept in roadside development is, that in meeting legal and other requirements, ODOT is responsible for establishing permanent functions. Some examples of functions include modifying topography or establishing vegetation for specific purposes such as habitat mitigation, water quality enhancement, creation of new wetlands, neighborhood screening, sound wall mitigation, or existing planting replacement. If state or federal permits are involved, then the permit often requires monitoring after completion. For example, regulatory agencies require ODOT to monitor wetlands for five years to correct problems. Some cities require the replanting of newer street trees that fail to thrive after the plant establishment period ends. Federal funding participation brings with it the need to protect the federal investment. In the post-construction period, roadside maintenance is the most critical element in maintaining the designed function. However, there are other activities that affect roadside functions such as utility work, permit activities like plant collection, or other causes of disturbance.

ODOT regions are responsible for post-construction activities, and the system works best if the maintenance needs of new work are understood as the project is being developed. Transportation facilities such as roads are designed and built according to established needs, and then appropriate maintenance is programmed to keep the facility safe and functioning. In the same way, the best practice in planning for roadside maintenance is a clear understanding of the functions to be maintained and then working to ensure the ongoing maintenance capability.

1213.5 Roadside Development Responsibilities

Roadside Development is currently housed within the Environmental Section in each Region, although not every Region has a Landscape Architect on staff. The role of the Region Landscape Architect is to develop projects and provide design and contract document development support to other environmental disciplines as needed. The Statewide Roadside Development Coordinator is based in Salem in the Environmental Section of Engineering and Technical Services Branch. The Statewide Coordinator is responsible for related program and policy development, and also provides project support to Regions as needed and requested. Several other units have major responsibilities including the Environmental Section, Project Design Teams, and Region Environmental Specialists, among others. Private consultant landscape architects and environmental specialists may also have important design roles on projects.

Project teams are now responsible for overseeing the development of projects. Ownership of roadside development work generally follows the same path as other kinds of work; the specialists are responsible for their work, but the project team determines how the work is conducted and coordinated on a given project. Whenever there are roadside design contract documents, the individual responsible for the design needs to be identified on the plan sheet. The Professional of Record will be a Registered Landscape Architect.

Roadside development offers a focal point to assess the whole project site at any point in development, and assess, mitigate, and compensate for project impacts. Every design specialty can participate in how their project work affects the quality of the roadside as well as how roadside environments impact the quality of the project. One example of this is how traffic signing designers now routinely call for painting the backs of signs on certain highways to reduce their visual contrast in scenic areas.

Projects are transferred to maintenance after construction, so they assume the ongoing responsibility. It is important for Maintenance to understand and support roadside development designs, which allows the designer's intent to mature as intended. Their participation in project design and construction is critical for long term success. Roadside maintenance is one of the legs to the "three-legged stool" of planning, design/construction, and maintenance. The ability to provide long-term care for constructed designs allows ODOT to be able to continue to practice partnership with regulatory agencies such as FHWA, the Army Corps of Engineers, and many others. The advantage of this regulatory partnering to ODOT's ability to conduct project development cannot be overstated.

1213.6 Roadside Development Tools and References

Some references for roadside development projects have already been mentioned, such as the project environmental document, permits, agreements, relevant policies or regulations of various agencies and governments, and project documents such as the Prospectus and Narrative. Some useful internal references are the Roadside Development Manual, Right of Way Development and Control part of the Oregon Standard Specifications for Construction; and the Integrated Vegetation Management Guidelines. External references include A Guide for Transportation Landscape and Environmental Design by the American Association of State Highway Transportation Officials (AASHTO) and the American Standard for Nursery Stock from the American Association of Nurserymen (AAN).

Roadside Development requires the development of Specifications. It is important that landscape architects are familiar with the Oregon Standard Specifications for Construction, and with the process of editing special provisions. The ODOT Specifications Manual provides guidance on special provisions, the function and organization of the Standard Specifications, and general clarity in written communication.

Another important tool is the terrain modeling capability of Bentley InRoads and OpenRoads Designer software. The use of terrain modeling for contour grading design will become a standard on road projects as it applies to landscape, wetland, and riparian restoration or enhancement. This allows accurate cross sections to be developed for testing alternate design concepts and for use during project construction. Project terrain modeling works best when anticipated in project scoping and scheduling. Other tools in use and expected to see greater use are photo image editing and three-dimensional rendering of site designs using Microstation.

1213.7 Specific Project Considerations

It should be noted that every project which disturbs ground will need at least a minimal roadside development consideration, such as temporary and permanent seeding for site stabilization.

Conservation and protection of existing resources should be considered wherever possible and practical. This includes retention of existing vegetation or other habitat features, and salvaging project topsoil, stockpiling, and re-using on finished slopes wherever practical.

As we meet the basic design and construction needs of roadways and structures, existing native plant communities must be saved and protected wherever practicable. They can never be re-created exactly as they were before disturbance and attempts to re-create native plantings still meet with mixed success. Additionally, existing vegetation provides significant site stabilization, reducing the requirement for erosion control in those areas.

Roadside development requirements need to be identified during the location survey to assure that enough right of way is available for compliance. Sufficient right of way should be included to provide smooth finish grade transitions between existing landforms and the facility. Flattening steep slopes, slope rounding at the top and bottom of cuts and fills, and parabolic ditch sections are methods for developing a more compatible transition.

Additional right of way may be appropriate where issues exist such as endangered species or habitat preservation, wildlife corridors required to be protected, water quality facility locations, or transportation corridor visual quality. Roadside Development coordination with terrestrial biologists or Fish & Wildlife Service can identify locations where grade separated wildlife crossings can be developed to reduce animal/vehicle conflicts and increase safety.

High visibility areas and urban roadside areas almost always require some degree of ongoing maintenance. Slopes 1:3 or steeper cannot be maintained by normal roadside mowing, so reducing slopes to less than 1:3 can reduce future maintenance efforts where mowing is acceptable. Planted shrubs and trees are an alternative to mowing on steep slopes and they have many other kinds of benefits. Even these planted areas, however, are not maintenance free and must receive maintenance, supporting roadside development design, as needed.

Interchanges, except in special circumstances, require roadside development. The degree of treatment is determined by the amount of landform change, urban/rural nature of the site, local interests and participation, local ordinances, and other factors. A basic level of roadside development, such as permanent seeding for site stabilization, is expected for all projects which disturb the ground surface. Since interchange areas are highly visible to many travelers every day, they often receive a higher level of treatment than other areas.

Sound berm designs should allow sufficient area (10 – 12 feet) between the toe of berm and the Right of Way for maintenance access.

Sound walls should be set back from the edge of curb a minimum of 1.5 times the height of the wall. This achieves a better visual balance between the vertical mass of the wall and the horizontal plane of the roadway. It also helps address clear zone issues. Sound wall ends should be stepped down or wrapped around corners where streets intersect the highway. Sound walls are a large vertical element on the land and treatment of their surface is important, as is the issue of graffiti on walls. The Roadside Development specialist should be involved when considering treatments (color, texture, or vegetative cover) for sound wall designs. Climbing vines can deter graffiti vandalism, and vegetative screening or foundation planting can soften the gray concrete corridor and poor aesthetics created by sound walls.

Areas that require landscape screening, such as residential areas or undesirable views visible from the highway, need sufficient Right of Way for plantings while maintaining clear zone requirements and access to the areas.

Utility pole location signage placements and street tree plantings needs to be coordinated during design. This is often difficult because utility companies may not determine pole locations until very late in the design process.

Any area that is planted in any way must be able to be safely accessed for maintenance.

On federal participation projects, law requires that an amount equal to 1/4 of 1 percent (.0025) of the roadside development estimated cost must be used to plant native wildflowers. Maintenance treatment of these areas must accommodate the requirements of native wildflowers to support the federal regulation. (Erosion control and some other costs are excluded.)

1213.8 Roadside Development Initial Project Checklist

1. **ODOT Information** - Include or check roadside development items in project prospectus, scoping, environmental documents, schedule, City-State Agreement, key contacts list, special needs such as riparian revegetation, state commitments, Scenic Byways or Scenic Rivers, and other critical policies or programs such as Transportation Corridors or Forest Highways.

2. **External Information** - Relevant city and county permit requirements, external review authorities, key contacts list, critical laws and policies of local, state or federal agencies, working partners, initial project objectives, water supplier, et cetera.
3. **Design and Construction** – Includes performing or coordinating roadside development scoping and preliminary budget, participation on project development team, research, preliminary concepts, designs, contract document preparation, plan sheet drafting, consultant oversight, expert plan review, construction observation, and consultation on change orders. A variety of professionals perform these functions.
4. **Roadside Maintenance** - Name of maintenance authority (ODOT or other), name of responsible contact, inclusion of maintenance in project development review, inspections, maintenance standards, maintenance agreement or contract, maintenance plan for designed areas, approximate resources needed, maintenance ability to meet needs added by project

Section 1214 Temporary and Permanent Erosion and Sediment Control

The ODOT Erosion Control Manual is the basis for design of Erosion and Sediment Control Plans (ESCP) and is used to assist the practitioner to prepare both temporary and permanent Erosion and Sediment Controls (ESC) on all ODOT projects. The Environmental section should be consulted about problems involving ESC design.

The purpose of erosion and sediment control measures are to prevent erosion, to limit the transport of sediment-laden water from construction sites and prevent discharge of sediment into receiving waters. Erosion and sediment control is environmental stewardship, good Project "housekeeping" and a cornerstone of the Federal Aid Highway Programmatic which ties federal funding to the protection of the Endangered Chinook and Coho salmon.

Erosion and Sediment and Sediment Control Plans (ESCP) are both one of the construction document series included in contract plans and a Permit document, submitted to the regulatory agency (Oregon Department of Environmental Quality) prior to beginning of construction, on all projects that disturb 1 acre or more of soil. Engineers provide the areas of soil disturbance to erosion control Professionals of Record. Staging areas, even contractor provided staging areas not on Agency land, must be included in the area-of-disturbance calculation. The ESCP is a living/dynamic document that needs to be modified during construction when site conditions change, when erosion and sediment control measures change, and to comply with regulatory requirements. The ESCP contains Best Management Practices (BMP) to minimize erosion and control sediment movement on the construction project. The BMP will have to be modified or upgraded (if necessary) to reflect the site conditions from project inception to completion.

The Oregon Department of Environmental Quality (DEQ), acting under Section 402 of the EPA's Clean Water Act, requires that all construction activity disturbing 1 acre or more, of soil have an ESCP developed to comply with the 1200-CA permit. Each region has a 1200-CA permit to cover work done within that region. Contact a Region Environmental Coordinator for a copy of the permit. Small projects that do not require 1200-CA coverage must still provide appropriate erosion and sediment control and comply with the 00280 and 00290 Sections of the Specifications.

The Federal Highway Administration is required by Section 1057 of the Intermodal Surface Transportation Efficiency Act of 1991 (ISTEA) to develop erosion and sediment control guidelines for states to follow when constructing highways using federal funds. In order to fulfill this requirement, on July 26, 1994, FHWA adopted the guidelines presented in Volume III of AASHTO Highway Drainage Guidelines.

As part of The Oregon Plan for Salmon and Watersheds, the Oregon Department of Transportation now assures erosion control plans are provided on all projects that disturb soil and use federal funding. Local jurisdictions may also have soil erosion and stormwater quality control requirements, and these should be considered on a location-by-location basis.

Temporary and permanent ESC measures need to be considered during the project planning. The topography, drainage patterns, hydrology, and developed condition in the vicinity of the project site must be researched and used during the development of ESCP. The ESCPs consist of drawings, details, and specifications that are included in the contract documents and in the designer's narrative. An Environmental Management Plan (as described in 1200-CA, Appendix A) must be included in the ESCP on projects where pollutants or contamination are known or discovered during the course of construction. The ESCP must contain all of the necessary elements to accomplish the goals and meet the limitations of permits. Contract documents include specifications in Sections 00280 and Section 170 to address contractors' compliance with this permit.

Section 1215 Permits & Documents

1215.1 Permit Responsibilities

A number of permits and/or documents may be required from various agencies during the advance of a project from design to construction. Table 1200-7 is a list of permits and the units responsible for obtaining them.

Table 1200-7: List of Permits and the Units Responsible

Permit	Issuing Agency	Responsible Party
Airport Clearance	Federal Aviation Administration (FAA)	Region Tech Center / Engineering Services / through Aviation Department
Railroad Crossing (New and Alteration)	ODOT	ODOT Commerce and Compliance Division
Section 401 of Clean Water Act (Water Quality Certification)	Department of Environmental Quality (DEQ)	Environmental Permits Coordinator
Land Use Plan (Conditional Use; Flood Department Plain, etc.)	County/City Planning Department	Region Office
Building Permit	County/City	Region (Project Mgr.)
Other Local Permits	Irrigation/Diking Districts, etc.	Region Office
Right of Entry/Use Permits (through USFS/BLM Lands)	U.S. Forest Service/Bureau of Land Management (BLM)	Region Office / R/W
Material Site	Oregon Department of Geology & Mineral Industries (DOGAMI)	Region Geologist Resources*
Coastal Zone Management	Oregon Dept. of Land Conservation & Development (DLCD)	Environmental Permits Coordinator
Water Use (Water Impoundment)	Water Resources Division	Watermaster
Fill/Removal Permit	Oregon Division of State Lands	Environmental Permits Coordinator
Section 10 of Rivers and Harbors Act	U. S. Army Corps of Engineers	Environmental Permits Coordinator
Scenic Waterway Permit	Oregon State Parks & Recreation and/or Bureau of Land Management	Environmental Permits Coordinator
Waterway Permits	U.S. Coast Guard	Environmental Permits Coordinator

Table 1200-7 (Continued): List of Permits and the Units Responsible

Permit	Issuing Agency	Responsible Party
Section 404 of Clean- Water Act Permits	U.S. Army Corps of Engineers	Environmental Permits Coordinator
Water Well	Oregon Water Resources Department	Operations (Building Manager)
Construction Permit	Property Owner	Right of Way
Environmental Documents		Environmental Services
Wetlands Report	See Note	See Note
Cultural Resources Report	See Note	See Note
DEQ Indirect Source Permit	See Note	See Note
Noise Study Report	See Note	See Note

* For Commercial and other Contractor Option sites, the permit is obtained by the Contractor, Site Operator, or Landowner.

Note: 1200-CA permits are issued to Regions and are effective for 5 years.

The Project Prospectus (Part 2 and Part 3) will, in most cases, identify those permits and documents required for each project, and who is responsible for obtaining them.

Permits for some local agency and off-system projects are to be obtained by the agency or the consulting engineer as stipulated in the Oregon Department of Transportation/Agency agreement for the project.

An Air Quality report is required for all projects that increase capacity in Portland, Salem, Eugene, Medford, Grants Pass, and Klamath Falls, La Grande, Oakridge, Lakeview.

FHWA also requires a Hazardous Materials report or other documentation.

1215.2 Permit Types

1215.2.1 Airports

In compliance with Federal Aviation Regulations (PART 77), "Objects Affecting Navigable Airspace," highway projects within 20,000 feet of an airport will be carefully examined by Project Support and/or Roadway Engineering prior to the public hearing stage to determine if there is a possibility of conflict.

When it is determined that a notice is required, the Engineering Services Unit will complete FAA Form 7460-1 and submit it to the Federal Aviation Administrator as prescribed in FAA Reg. 77.17 via the Oregon Department of Aviation at least two months before construction begins. If during the preliminary design phase an obstruction conflict becomes apparent, immediate contact with FAA should be made.

1215.2.2 Diking and Irrigation District

When a proposed highway project is expected to impact an existing development that involved Federal funds in its construction (such as dikes, irrigation projects, revetments, dams, etc.) an investigation shall be made by the Project Manager or a designated representative of the Region Manager, to determine the need for notification, approval or permits of another agency. In most cases, approval will be required from the Federal authority originally involved, as well as the local agency.

The Project Manager should establish communications with these Districts to alert them that some work is proposed that will affect their facility and to ascertain what special considerations are needed in the project plans & specifications.

1215.2.3 Use Permits and Agreements

Right of way over government land is acquired through right of entry on Bureau of Land Management property and through an easement from the U.S. Forest Service. Applications for these are made through the Right of Way Section in Salem. The government classification and proposed right of way lines are to be shown on the detail map in the usual manner. The Memorandum of Understanding between the U.S. Forest Service and the Oregon Department of Transportation details the process by which right of way through National Forest land is obtained. Obtaining right of way over government land is a very detailed and time consuming process. There are other permits and authorizations required from the U.S. Forest Service, Bureau of Land Management, and other Federal Agencies.

1215.2.4 Department of Geology and Mineral Industries

A permit is required from the Department of Geology and Mineral Industries (DOGAMI) for all work in all aggregate sources or borrow sources, whether publicly owned, privately owned and commercially operated, or other private sources (e.g., a farmer). These permits control the development and assure the reclamation of the sites as required by state law (ORS 517.750 - 517.955).

After the need for borrow/aggregate has been determined, the Region Geologist will determine whether ODOT will offer its own prospective source or rely on the contractor to obtain his own material source.

When the source is ODOT owned or controlled (ODOT has a lease with the landowner), the Region Geologist will determine the source and prepare the necessary documentation for the permit. The application and supporting documentation and fee is then submitted directly to DOGAMI.

The Region Geologist will forward a copy of the development plan and reclamation specifications directly to the designer for incorporation into the plans and specifications.

When the contractor provides the source, the contractor will obtain the permit. The Construction Project Manager has the ultimate responsibility to verify that the material site has a valid DOGAMI permit.

1215.2.5 U. S. Coast Guard Permit

Some of the larger rivers as well as bays and estuaries in Oregon are navigable. The Coast Guard and the Corps of Engineers operate according to a list of officially designated navigable waters. Commercial navigation may no longer be practical in some of the waterways listed as being navigable and projects over those waters may be exempt from the need for a permit. Since it is easier to define when a permit is not needed that will be the starting point.

For projects involving the construction of bridges or the major reconstruction of bridges over navigable waters a Coast Guard permit may not be required if the bridge is over waters:

1. Which are not being used or are not susceptible to use in their natural condition or by reasonable improvement as a means to transport interstate or foreign commerce; and
2. Which are (a) not tidal, or (b) if tidal, used only by recreational boating, fishing, and other small vessels less than 21 feet in length. (Federal Aid Highway Manual, Vol. 6, Chapter 7, Sec. 1, Par. 1)

The Permit Coordinator requests that the Federal Highway Administration makes the determination that a Coast Guard permit is not required under these criteria.

If the waters in question do not meet Criteria 1 and 2 above, a Coast Guard Permit will be required.

The application for the permit is made by letter to the 13th Coast Guard District (Seattle). This application should be made one year in advance of the project construction date.

The Coast Guard should be contacted, and their comments requested about provisions for navigation when a project involves a navigable waterway, whether or not a Coast Guard permit

is required. Their stipulations concerning such items as navigation clearances, lighting, etc., will then be included in the project plans and specifications.

1215.2.6 U.S. Army Corps of Engineers/Division of State Lands Permit

The US Army Corps of Engineers (USACE) regulates discharge of dredged or fill material into waters of the United States, including wetlands, pursuant to Section 404 of the Clean Water Act (33. S.C. 1344). A permit will generally be required when filling into waters of the U.S.

The Oregon Division of State Lands, as the state regulating agency, will generally require that a permit be obtained for fill or removal in the beds or banks of streams or wetlands. A joint permit application form is used for both of these agencies. However, two or more permits may be issued.

The joint permit application is reviewed by State and Federal Resource Agencies (Oregon Department of Fish and Wildlife, DEQ, U.S. Fish and Wildlife Services, Environmental Protection Agency, National Marine Fisheries Services, etc.) for compliance with statutes, such as the Endangered Species Act (ESA), and good resource management practices. Their comments and conditions will be incorporated into the permits.

It is extremely helpful during the field survey for the Project Manager to contact the local District Fish Biologist of the Oregon Department of Fish & Wildlife to discuss the project and learn in advance the conditions under which work will be allowed in any streams. The Permits Coordinator obtains the permit. Application is made when the following information is available for the impact site:

1. Vicinity map which shows the location of the project.
2. Plan, elevation and typical section drawings which show the existing and proposed structures.
3. Any environmental documents required for the project such as a Wetland Delineation, Impact Assessment and Mitigation Report.
4. The Biological Assessment for the project impacts to the threatened and endangered species can be sent when it is completed.

This information should be submitted as early in the design process as possible. This will ensure any conditions or stipulations contained in the permits can be incorporated into the project plans and specifications. These conditions may be as minor as time limits for in-stream work or as major as extensive wetland mitigation plans.

Any special conditions or stipulations regarding work in the stream are then included in the final project plans and specifications. (For Corps of Engineers Permit Rules see Code of Federal Regulations (CFR 33, Ch. 11, part 323)

1215.2.7 Construction Permit

The construction permit applies to land service facilities to be built for individuals on their land. It gives the State or its contractor a right to enter upon the property of an individual to perform construction work for the benefit of the owner. This might include road approaches or access roads which cannot be accommodated in their entirety within the highway right of way; irrigation facilities which serve only the individual involved; or any other facility constructed for the sole use and benefit of the owner involved, the later removal of which would not be detrimental to the highway. No time limits are placed on construction permits.