

Public Works Engineering Standards



Table of Contents

Public Works 1

Engineering Standards.....	1
Table of Contents.....	i
SECTION 1 INTRODUCTION	1-1
1-1 Purpose	1-1
1-2 Guiding Principles	1-1
1-3 Scope	1-1
1-4 Clarifications and Final Authority	1-2
1-5 Revisions.....	1-2
1-6 Deviations from Standards	1-2
1-7 Related Documents.....	1-3
1-8 City Contacts	1-3
SECTION 2 OVERVIEW OF THE DEVELOPMENT PROCESS	2-1
2-1 Purpose	2-1
2-2 Summary	2-1
2-3 New Development - Permit Process	2-1
2-3.1 Development Permit.....	2-1
2-3.2 Site Construction Permit.....	2-2
2-3.2.1 Inspection and Fees	2-2
2-3.2.2 Site Construction Permit Expiration.....	2-3
2-4 Other Permits	2-3
2-4.1 Encroachment Permits	2-3
2-4.2 Obstruction of Public Way Permit.....	2-3
2-5 Land Parcel Management	2-4
SECTION 3 GRADING AND EROSION CONTROL	3-1
3-1 Purpose	3-1
3-2 Summary	3-1
3-3 Definitions.....	3-1
3-3.1 Average Site Slope.....	3-1
3-3.2 As-graded.....	3-1
3-3.3 Bedrock	3-2
3-3.4 Bench	3-2
3-3.5 Best Management Practices (BMPs).....	3-2
3-3.6 Borrow	3-2
3-3.7 Civil Engineer	3-2
3-3.8 Clearing	3-2
3-3.9 Compaction	3-2
3-3.10 Conveyance System	3-2
3-3.11 Denuded.....	3-2
3-3.12 Development	3-2
3-3.13 Drainage Course	3-2
3-3.14 Earth Material	3-3
3-3.15 Engineering Geologist.....	3-3
3-3.16 Engineering Geology Report	3-3
3-3.17 Erosion	3-3
3-3.18 Erosion Prevention	3-3
3-3.19 Excavation.....	3-3

3-3.20	Fill	3-3
3-3.21	Floodplain	3-3
3-3.22	Geotechnical Engineer	3-3
3-3.23	Grade	3-3
3-3.24	Grading.....	3-4
3-3.25	Ground Disturbing Activity	3-4
3-3.26	Key	3-4
3-3.27	Outfall	3-4
3-3.28	Pollutant	3-4
3-3.29	Public Storm Drain	3-4
3-3.30	Receiving Water	3-4
3-3.31	Sediment	3-4
3-3.32	Sediment Control.....	3-4
3-3.33	Site	3-5
3-3.34	Slope	3-5
3-3.35	Soil	3-5
3-3.36	Soils Engineer (Geotechnical Engineer).....	3-5
3-3.37	Soils Engineering Report.....	3-5
3-3.38	Stabilization	3-5
3-3.39	Storm Event.....	3-5
3-3.40	Surveyor	3-5
3-3.41	Terrace	3-5
3-3.42	Tributary Area.....	3-6
3-3.43	Visible and Measureable Erosion or Sediment.....	3-6
3-3.44	Wetland	3-6
3-4	Other Agencies May Require Grading and/or Erosion Control Plans	3-6
3-5	Planning and Site Construction Approval Process	3-6
3-5.1	Planning-Level Reviews	3-6
3-5.2	Site Construction Permits	3-7
3-5.2.1	Small Site	3-7
3-5.2.2	Large Site	3-7
3-5.2.3	How long is a grading and erosion control plan valid?	3-10
3-5.3	Public Works Review and Inspection Procedures and Fees	3-10
3-5.3.1	Professional Inspection	3-10
3-5.4	Record Drawings.....	3-11
3-6	Grading Policies and Criteria.....	3-11
3-6.1	Referenced Standards	3-11
3-6.2	Cuts	3-11
3-6.3	Fills	3-11
3-6.3.1	Slopes.....	3-11
3-6.3.2	Fill Material	3-12
3-6.3.3	Compaction	3-12
3-6.4	Grade Breaks	3-12
3-6.5	Existing Vegetation.....	3-12
3-6.6	Drainage Courses	3-12
3-6.7	Setbacks.....	3-12
3-6.8	Drainage and Terracing.....	3-13
3-6.8.1	Terraces	3-13
3-6.8.2	Subsurface Drainage.....	3-13
3-6.8.3	Disposal.....	3-13

3-6.8.4	Interceptor Drains	3-13
3-7	Erosion Control Policies and Criteria.....	3-13
3-7.1	General.....	3-13
3-7.2	Referenced Standards	3-14
3-7.3	Small Site Required Best Management Practices (BMPs).....	3-14
3-7.3.1	Mark Clearing Limits.....	3-14
3-7.3.2	Construction Stabilized Construction Entrance	3-14
3-7.3.3	Protect Stockpiles and Staging Areas	3-14
3-7.3.4	Install Sediment Barrier at Toe of Disturbed Area and Material Stockpiles ..	3-15
3-7.3.5	Backfilling	3-15
3-7.3.6	Storm Drain Inlet Protection	3-15
3-7.3.7	Slope Protection and Temporary Cover	3-15
3-7.3.8	Remove Sediment.....	3-15
3-7.3.9	Establish Permanent Cover.....	3-15
3-7.4	Large Site Erosion Control Requirements.....	3-16
3-7.4.1	Delineation of Clearing Limits.....	3-16
3-7.4.2	Construct Stabilized Construction Entrance	3-16
3-7.4.3	Prevent Pollution from Equipment and Material Storage and Maintenance ..	3-16
3-7.4.4	Surface Water Controls	3-16
3-7.4.5	Perimeter Sediment Controls	3-17
3-7.4.6	Remove Excess Soil.....	3-17
3-7.4.7	Storm Drain Inlet Protection	3-17
3-7.4.8	Slope Protection and Temporary Cover	3-17
3-7.4.9	Remove Sediment.....	3-17
3-7.4.10	Dust Control.....	3-17
3-7.4.11	Establish Permanent Cover.....	3-18
3-7.5	Project Types Requiring Special Consideration	3-18
SECTION 4	STORMWATER FACILITIES.....	4-1
4-1	Purpose	4-1
4-2	Summary	4-1
4-3	Definitions.....	4-2
4-3.1	Best Management Practices (BMPs).....	4-2
4-3.2	Bioengineering	4-2
4-3.3	Biofiltration.....	4-2
4-3.4	Conjunctive Use	4-2
4-3.5	Conveyance System	4-2
4-3.6	Design Storm.....	4-2
4-3.7	Detention Facility	4-2
4-3.8	Development	4-2
4-3.9	Drainage Course	4-3
4-3.10	Erosion	4-3
4-3.11	Floodplain.....	4-3
4-3.12	Grading.....	4-3
4-3.13	Impervious Areas	4-3
4-3.14	Natural Drainage Course.....	4-3
4-3.15	On-site Detention	4-3
4-3.16	Outfall	4-3
4-3.17	Pollutant	4-3
4-3.18	Public Storm Drain	4-3
4-3.19	Receiving Water	4-4

4-3.20	Retention Facility	4-4
4-3.21	Sediment	4-4
4-3.22	Site	4-4
4-3.23	Tributary Area.....	4-4
4-3.24	Wetland	4-4
4-4	Other Agencies May Require Stormwater Reviews	4-4
4-5	Referenced Standards	4-4
4-6	Planning and Design Approval Process	4-5
4-6.1	Is a Stormwater Site Plan required for your project?	4-5
4-6.2	Planning-Level Reviews	4-5
4-6.3	Site Construction Permit.....	4-6
4-6.4	Detailed Information Regarding Stormwater Site Plans	4-6
4-6.4.1	What is the purpose of a Stormwater Site Plan?	4-6
4-6.4.2	Who can prepare a Stormwater Site Plan?	4-6
4-6.4.3	What portion of the site must be examined in the Stormwater Site Plan?	4-6
4-6.4.4	Stormwater Site Plan Required Contents	4-7
4-6.4.5	Criteria for Approval of the Stormwater Site Plan	4-8
4-6.4.6	How long is a Stormwater Site Plan valid?	4-8
4-6.5	Submitting Design Drawings and Specifications	4-8
4-6.5.1	Preliminary Drawings.....	4-8
4-6.5.2	Final Design Drawings.....	4-8
4-6.5.3	Record Drawings	4-9
4-6.5.4	Required information on Final Design Drawings and Record Drawings.....	4-9
4-7	Public Works Review and Inspection Procedures and Fees	4-9
4-8	Deviations from Standards	4-10
4-9	Hydrologic and Hydraulic Analysis Methods	4-10
4-9.1	Acceptable Methods for Determining Design Flows and Volumes.....	4-10
4-9.2	Design Storm Volumes	4-11
4-9.3	Soil Information	4-11
4-9.4	Curve Numbers and Runoff Coefficients	4-11
4-9.5	Time of Concentration	4-11
4-9.6	Analysis Methods for Sizing Conveyance System Components	4-11
4-10	Select Appropriate Discharge Location	4-11
4-11	Perform Off-Site Analysis	4-12
4-11.1	Levels of Analysis.....	4-12
4-12	Control Water Quantity	4-12
4-12.1	Additional Detention/Retention Requirements	4-12
4-12.2	Analysis Methods	4-13
4-12.3	Submittal Requirements	4-13
4-12.4	Ponds	4-13
4-12.5	General Pond Requirements	4-14
4-12.6	Detention Tanks and Vaults and Underground Pipe Storage.....	4-14
4-12.7	Private Parking Lot Ponding	4-14
4-12.8	Retention	4-14
4-12.9	What site conditions are favorable for utilizing infiltration?	4-14
4-12.10	UIC (Underground Injection Control) Rules.....	4-15
4-13	Design Conveyance Systems	4-15
4-13.1	Overview	4-15
4-13.2	When do these standards apply?	4-15
4-13.3	Submittal Requirements	4-16

4-13.4	Design Flow	4-16
4-13.5	General Design Route Requirements	4-16
4-13.6	Pipe Systems	4-17
4-13.6.1	Pipe Materials	4-17
4-13.6.2	Pipe Sizes, Slopes, and Velocities	4-18
4-13.6.3	Pipe Alignment/Cover	4-18
4-13.6.4	Manholes and Catch Basins	4-19
4-13.6.5	Frames/Lids/Grates/Covers	4-20
4-13.6.6	Restrictor Devices	4-20
4-13.6.7	Debris Barriers	4-21
4-13.7	Pump Stations and Forcemains	4-21
4-13.8	Culvert Design Criteria	4-21
4-13.8.1	Headwater	4-21
4-13.8.2	Inlet	4-21
4-13.8.3	Outlets	4-22
4-13.9	Outfall Design Criteria	4-22
4-13.9.1	General	4-22
4-13.9.2	Outfall Systems Traversing Steep Slopes	4-23
4-13.10	Open Channel Design Criteria	4-23
4-13.10.1	Constructed Channel Design Criteria	4-23
4-13.10.2	Riprap Lining Design	4-24
4-13.11	Drainage Easements and Access	4-24
4-14	Control Water Quality	4-25
4-14.1	How can site design reduce pollution?	4-25
4-14.2	What is required?	4-25
4-14.3	Site Uses/Characteristics Requiring Source Control BMPs	4-26
4-14.4	General Principles of Source Control	4-26
4-14.5	NPDES Industrial Stormwater Permits	4-27
4-15	Perform Erosion Control	4-27
4-16	Provide for Maintenance and Operation	4-27
4-16.1	Submittal Requirements	4-28
4-17	Provide Financial Guarantees	4-28
4-17.1	Submittal Requirements	4-28
SECTION 5 WASTEWATER COLLECTION, TREATMENT AND RECLAMATION		
FACILITIES		5-1
5-1	Purpose	5-1
5-1.1	Development Permit	5-1
5-1.2	Site Construction Permit	5-1
5-1.3	The Sewer Use Ordinance and Pretreatment Act, City Codes Sections 4.100 to 4.198	5-2
5-1.4	The Systems Development Charge, City Codes Section 3.505 to 3.605	5-2
5-2	Summary	5-6
5-2.1	Design Criteria	5-6
5-2.1.1	Size/Velocity	5-7
5-2.1.2	Design Calculations	5-7
5-2.1.3	Flows	5-8
5-2.1.4	Odor and Corrosion Prevention	5-8
5-2.1.5	Spacing	5-8
5-2.1.6	Design Life	5-9
5-2.2	Easements	5-9

5-2.3	Construction Drawings	5-9
5-2.3.1	General.....	5-9
5-2.4	Manholes, Sewer System Structures	5-9
5-2.4.1	Materials.....	5-10
5-2.4.2	Bedding	5-10
5-2.4.3	Joints	5-10
5-2.4.4	Manhole Channels.....	5-10
5-2.4.5	Manhole Pipe Connections.....	5-10
5-2.4.6	Connections to Existing Manholes	5-10
5-2.5	Sewer Interceptors and Mains.....	5-11
5-2.5.1	Sewer Main, Interceptors and Force mains.....	5-11
5-2.5.2	Sanitary Sewer Laterals	5-13
5-2.6	Wastewater Lift Stations to be Dedicated to the City (see 5-2.6.2).....	5-14
5-2.6.1	Sites.....	5-14
5-2.6.2	Type of Pump Station	5-15
5-2.6.3	Design Capacity	5-15
5-2.6.4	Wet Well	5-15
5-2.6.5	Pumps	5-15
5-2.6.6	Station Piping	5-16
5-2.6.7	Odor Control.....	5-16
5-2.6.8	Forcemains.....	5-16
5-2.6.9	Electrical/Instrumentation	5-16
5-2.6.10	General Design Details.....	5-16
5-2.7	Connection to Public Sewer and On-Site Sewer Systems	5-16
5-2.7.1	New Subdivision/Development Sewer Storm Pipes Televised.....	5-17
5-2.8	Pretreatment Requirements, Grease Traps/Interceptors	5-17
5-3	Wastewater Treatment and Reclamation Systems	5-17
5-3.1	Wastewater Treatment and Reclamation Facility Siting and Impacts	5-17
5-3.1.1	Technological Solutions.....	5-18
SECTION 6	GEOTHERMAL HEATING FACILITY.....	6-1
6-1	Purpose.....	6-1
6-2	Geothermal Pricing and Extension Incentive Policy.....	6-1
6-3	Design Criteria.....	6-1
6-3.1		6-1
6-3.2		6-1
6-3.3		6-1
6-3.4		6-2
6-4	Design Life	6-2
6-4.1	General.....	6-2
6-4.2	Geothermal Service Line Connections.....	6-2
6-4.3	Heat Exchangers.....	6-2
6-4.4	Flow/BTU Meters.....	6-2
6-5	Environmental and Aquifer Protection.....	6-2
6-6	Personal Safety and Health, Ergonomics, Workspace and Control Facilities	6-3
SECTION 7	WATER FACILITIES.....	7-1
7-1	Purpose.....	7-1
7-2	Summary.....	7-1
7-2.1	Definitions.....	7-1
7-2.1.1	Air Vacuum Control Valve (AVC):.....	7-1
7-2.1.2	Appurtenances	7-2

7-2.1.3	Average Day Demand (ADD)	7-2
7-2.1.4	Back Flow Prevention Assembly:	7-2
7-2.1.5	City Water System	7-2
7-2.1.6	Engineered Plan	7-2
7-2.1.7	Equivalent Residential Unit (ERU).....	7-2
7-2.1.8	Flush Out	7-2
7-2.1.9	Point of Service (POS)	7-2
7-2.1.10	Pressure Zone	7-3
7-2.1.11	Tie-ins	7-3
7-2.1.12	Water Mains	7-3
7-2.1.13	Water Utility Maps	7-3
7-2.1.14	Water Services	7-3
7-2.1.15	Water System Model	7-3
7-2.2	Development Permit	7-3
7-2.3	Site Construction Permit	7-4
7-3	Production Facilities	7-4
7-3.1	Wells.....	7-4
7-3.2	Well Pumping Plants and Facilities	7-5
7-3.3	Water Storage Reservoirs	7-5
7-3.4	System Control	7-5
7-4	Design Criteria.....	7-5
7-4.1.1	City Wells.....	7-6
7-4.1.2	Fire Flow Requirements	7-6
7-4.1.3	Storage Requirements.....	7-6
7-4.1.4	System Pressure	7-6
7-4.1.5	Water Velocity	7-6
7-5	Distribution Systems.....	7-6
7-5.1	Water Mains	7-6
7-5.1.1	Tapping Main Lines	7-7
7-5.1.2	Working with Asbestos Pipe	7-7
7-5.2	Distribution Pumping Plants (Booster Stations).....	7-8
7-5.3	Valves.....	7-8
7-5.4	Services.....	7-9
7-5.5	Fire Hydrants	7-9
7-5.6	Pressure Zone Control	7-9
7-5.7	Air-Vacuum Control	7-9
7-5.8	Flush Outs	7-9
7-5.9	Backflow Control	7-10
7-5.10	Appurtenances	7-10
7-5.11	Disinfection of Facilities	7-10
7-6	Facilities, Infrastructure and Property.....	7-10
7-6.1	Site Enclosures	7-10
7-6.2	Buildings.....	7-10
7-6.3	Access.....	7-11
7-6.4	Property	7-11
SECTION 8	STREETS AND RELATED WORK.....	8-1
8-1	General Requirements	8-1
8-1.1	Development Permit	8-1
8-1.2	Site Construction Permit.....	8-1
8-1.3	Standards	8-2

8-2	Traffic Studies	8-2
8-3	Roadway Classification	8-2
8-4	Rights-of-Way/Easements.....	8-2
8-5	Design Standards.....	8-3
8-5.1	Bike Lanes.....	8-3
8-5.2	Utilities	8-3
8-5.3	Streets	8-3
8-5.3.1	General Design Criteria	8-3
8-5.3.2	Horizontal/Vertical Alignment	8-4
8-5.3.3	Structural	8-4
8-5.3.4	Sight Distance	8-5
8-5.3.5	Intersections	8-5
8-5.3.6	Curb Return Radii.....	8-5
8-5.3.7	Street Ends.....	8-5
8-5.3.8	Driveways.....	8-6
8-5.4	Traffic Control Signing and Striping.....	8-9
8-5.5	Street Illumination & Electrical Power.....	8-9
8-5.6	Fire Department Access	8-9
8-5.7	Guardrails & Hand Rails	8-9
8-5.8	Mailboxes	8-9
8-5.9	Improvement in Area of Limited Street Improvements	8-9
8-6	Monuments.....	8-10
8-7	Rockeries and Rockwalls	8-10
8-8	Street Cuts	8-10
8-8.1	Asphalt Concrete Pavement & Pavement Patching	8-11
8-8.1.1	Materials.....	8-11
8-8.1.2	Construction	8-12
8-8.1.3	Asphalt on Granular Base	8-13
8-8.1.4	Portland Cement Concrete Patching.....	8-13
8-8.1.5	Temporary Pavement Patching.....	8-13
8-8.1.6	Trenching Longitudinal to Travel Lanes	8-13
8-8.1.7	Trenching Transverse to Travel Lanes.....	8-14
8-8.1.8	Boring, Jacking, Augering or Tunneling.....	8-14
8-9	Underground Utilities.....	8-14
8-9.1	General.....	8-14
8-9.2	Trenching	8-14
8-9.3	Public Safety	8-15
8-9.4	Backfill	8-15
8-9.5	Compaction	8-16
8-10	Portland Cement Concrete Sidewalks.....	8-16
8-11	Parking	8-17
SECTION 9	ELECTRICAL, CONTROLS, INSTRUMENTATION, LIGHTING AND	
	TRAFFIC SIGNAL STANDARDS	9-1
9-1	Purpose	9-1
9-2	Summary	9-1
9-3	Definitions.....	9-1
9-4	Permits	9-1
9-5	Electrical.....	9-1
9-6	Controls.....	9-1
9-6.1	Standardization	9-1

9-6.2	Telemetry	9-2
9-6.3	UPS	9-2
9-6.4	Power monitors	9-2
9-6.5	Operations	9-2
9-6.6	Sensors	9-2
9-6.7	Variable Frequency Drives	9-2
9-6.8	Voltage	9-2
9-6.9	System Design	9-2
9-7	Instrumentation.....	9-3
9-7.1	Requirements	9-3
9-7.2	Operation/Maintenance Manuals	9-3
9-8	Street Illumination.....	9-3
9-8.1	Street Lighting Required.....	9-3
9-8.2	Luminaire Types.....	9-3
9-8.3	Poles	9-3
9-8.4	Wiring	9-3
9-8.4.1	Disconnect Location	9-3
9-8.5	Luminaire Size.....	9-3
9-8.6	Placement of Luminaires.....	9-4
9-8.7	Developer's Responsibility	9-4
9-9	Traffic Signals.....	9-4
SECTION 10	DRAFTING STANDARDS	10-1
10-1	Purpose.....	10-1
10-2	Summary	10-1
10-3	Definitions.....	10-1
10-4	Media.....	10-1
10-4.1	Preliminary Drawings	10-1
10-4.2	Final Design Drawings	10-2
10-4.3	Record/As-built Drawings.....	10-2
10-5	Sheet Sizes	10-2
10-5.1	ANSI Drawing Sizes	10-2
10-5.2	City Drawing Sizes	10-2
10-6	Drawing Layout	10-3
10-6.1	Cover Sheet Arrangement.....	10-3
10-6.2	General Drawing Sheet Arrangement	10-3
10-6.3	Plan and Profile Drawing Sheet Arrangement.....	10-3
10-7	Titleblocks	10-3
10-7.1	Preliminary Drawings	10-3
10-7.2	Final Design Drawing & Record/As-built Drawings	10-3
10-7.3	Revisions	10-4
10-7.4	Discipline/Drawing Numbers	10-4
10-7.5	Digital File Information.....	10-4
10-8	Layering (For Electronic Drawing Files)	10-5
10-8.1	General.....	10-5
10-8.1.1	CATEGORY 1	10-5
10-8.1.2	CATEGORY 2	10-5
10-8.1.3	CATEGORY 3	10-5
10-8.1.4	CATEGORY 4	10-6
10-8.1.5	CATEGORY 5	10-6
10-8.1.6	Layers by Pipe Diameter	10-6

10-8.2	Colors and Line Widths	10-7
10-8.3	Line types	10-7
10-8.4	External Reference dependent layers	10-7
10-8.5	Layer Features for AutoCAD 2000 and Beyond	10-8
10-9	Lettering	10-8
10-9.1	General.....	10-8
10-9.1.1	Manual Drafting	10-8
10-9.1.2	CAD Drafting	10-8
10-9.2	Text Plotted at Other than Full Size ANSI D Drawing	10-9
10-9.3	Underlining	10-9
10-9.4	Orientation	10-9
10-9.5	Dimensions.....	10-9
10-9.6	Leaders	10-9
10-10	Line Work	10-10
10-10.1	Manual Drafting	10-10
10-10.2	CAD Drafting	10-10
10-10.3	Screening Backgrounds	10-11
10-11	Standard City Symbols	10-11
10-11.1	Discipline-related Symbols	10-11
10-11.2	General Symbols	10-11
10-11.2.1	North Arrows.....	10-11
10-11.2.2	Graphic Scales	10-12
10-11.2.3	Section-cuts, Section and Detail Callouts.....	10-12
10-12	Standard City Hatch Patterns	10-12
10-12.1	General.....	10-12
10-13	Images, Pictures, Photographs	10-12
10-14	Electronic File Submittals	10-13
SECTION 11	STANDARD DRAWINGS	11-1
SECTION 12	GUIDELINES FOR TRANSPORTATION IMPACT ANALYSES	12-1
12-1	PURPOSE.....	12-1
12-1.1	Transportation Planning and Transportation Impact Analyses.....	12-1
12-1.2	The Need for Transportation Analyses for Individual Developments	12-1
12-1.3	The Level of Analysis and Documentation	12-2
12-2	OVERVIEW	12-2
12-2.1	Different Documentation for Different Development Proposals.....	12-2
12-2.2	Content of Transportation Impact Analyses Generally	12-2
12-2.3	Responsibilities of Those Preparing Transportation Analyses Generally.....	12-3
12-2.4	Responsibilities and Authority for the City.....	12-3
12-3	TRANSPORTATION IMPACT ANALYSIS DOCUMENTS.....	12-3
12-3.1	Determining the Required Level of Transportation Analysis and Documentation	12-3
12-4	PROCESS AND PROCEDURES.....	12-4
12-4.1	Pre-Application Meeting	12-4
12-4.2	Establishing the Scope of Work	12-4
12-4.2.1	Potential for Expansion of the Scope of Work	12-5
12-4.2.2	Time Limit on the Scoping Summary.....	12-5
12-4.3	Completeness Review.....	12-5
12-4.4	Technical Review	12-5
12-5	TRANSPORTATION ANALYSIS LETTER CONTENTS	12-6
12-6	TRANSPORTATION IMPACT STUDY CONTENTS.....	12-6

12-7	STANDARDS AND PROCEDURES	12-8
12-7.1	Preparer Qualifications	12-9
12-7.2	TIS Study Area	12-9
12-7.3	Analysis Years to be Analyzed in the TIS.....	12-10
12-7.4	Analysis Periods to be Analyzed in the TIS.....	12-10
12-7.5	Applications Involving Zone Changes	12-11
12-7.6	Traffic Count Requirements	12-11
12-7.7	Trip Generation for the Proposed Development.....	12-12
12-7.8	Trip Distribution and Assignment.....	12-12
12-7.9	Intersection Operational Standards.....	12-13
12-7.9.1	Intersection Level of Service Standards	12-13
12-7.9.2	Intersection Design Features and Queuing Calculations	12-13
12-7.10	Access Spacing Standards.....	12-14
12-7.11	Sight Distance	12-15
12-7.12	Crash History.....	12-15
12-7.13	Safe Routes to School.....	12-15
12-7.14	Warrants (Turn Lane, Traffic Control).....	12-16
12-7.14.1	Traffic Control Warrants	12-16
12-7.14.2	Turn Lane Warrants.....	12-16
12-8	COMMON ERRORS AND OMISSIONS	12-17
12-9	TIS CHECKLIST.....	12-18

SECTION 1 INTRODUCTION

1-1 Purpose

The purpose of the *City of Klamath Falls Engineering Standards*, hereinafter referred to as the “Engineering Standards” is to provide the development and contracting community with the requirements for improvements within the jurisdiction of the City of Klamath Falls (as defined in Section 1-3).

These standards are understood to be the minimum acceptable standards. More rigorous standards may be required depending on the nature of the work performed and the proposed improvements. The policies in this manual shall not relieve any person from the obligation to comply with the regulations or permits of any federal, state, or local authority.

1-2 Guiding Principles

In developing these standards, City staff endeavored to develop policies consistent with the following guiding principles:

- Safety (Public and Staff)
- Simplicity
- Equity among developers, customers, etc.
- Cost efficiency with respect to operation, maintenance and design
- Quality

1-3 Scope

These standards shall apply whenever any public or private work is performed within limits the City of Klamath Falls, including work performed by private parties at their own expense under authority granted by ordinance(s) of the City Council. These standards also apply to extensions of City water and sewer services outside the City limits and work on sites to be annexed as part of the development process.

Airport Project Exclusion: Projects on the Airport that are grant funded and for which there is a consolidated set of grant agency specifications for the performance of the work, shall be excluded from these specifications. Projects on the Airport which are on street right of way or which are inter-tied with water or sewer systems are not excluded from these specifications.

Except where these Design Standards provide otherwise, design, construction and materials shall conform to the appropriate standards of the most current edition of the following publications:

- “Oregon Standard Specifications for Construction: and “Oregon Standard Drawings (English)” also referred to as “ODOT/APWA Standards.”
- American Water Works Association Standards
- Oregon Utilities Coordinating Council, Standards Manual – Oregon Utilities Coordinating Council

- Department of Environmental Quality Sewer Design Criteria, Oregon Administrative Rules.
- For all projects which include dedicated City infrastructure, design plans and record drawings submitted shall utilize Oregon Coordinate Reference System (OCRS) for the Bend-Klamath Falls Zone, Transverse Mercator Map Projection. The OCRS zones are referenced to the National Spatial Reference System (NSRS) which is currently defined geometrically as NAD 83 (GRS-80 ellipsoid) and it will follow the National Geodetic Survey (NGS) path (new datum definitions) in future. The vertical datum will be the current NAVD 88, but will also follow the NGS lead adopting the future NAVD based on a pure gravimetric geoid (via the Grav-D Project).

1-4 Clarifications and Final Authority

Requests for clarification of these standards should be directed to:

City of Klamath Falls
Public Works Department
Attn: Engineering Standard Clarification
226 South Fifth Street
Klamath Falls, OR 97601
(541) 883-5365

The Public Works Director is the final authority on all questions which may arise as to the interpretation of these standards.

1-5 Revisions

This document will be periodically updated due to new technology, changes in policy or procedures and methods of design and construction. Updates to the Engineering Standards will be mailed to all standards holders at the current address on file at the Public Works Department. Should you change your address, please notify us so that your manual remains current.

Suggestions for revisions to this manual should be directed to:

City of Klamath Falls
Public Works Department
Attn: Engineering Standard Revisions
226 South Fifth Street
Klamath Falls, OR 97601
(541) 883-5365

1-6 Deviations from Standards

It is not the intent of this manual to limit the ingenuity of engineers. It cannot provide for all situations, nor can it substitute for competent work by design professionals. However, it is essential to have uniformity in City-maintained facilities to avoid the need for large and varied inventories of maintenance materials and to reduce the amount of maintenance equipment required.

Any proposed departure from this manual will be reviewed with the expectation that such a variance will produce a better result that is in every way adequate for the City and its residents.

Any proposed departure from the manual should be discussed with Public Works prior to design submittal. When the design is submitted for review, a written request for approval with an

explanation of any departure must accompany the submittal. These requirements are intended to assure that departures from the manual will only be undertaken with forethought and adequate reason.

1-7 Related Documents

This manual is not complete by itself. It should be used in conjunction with the latest revisions of the following documents:

- Adopted City Code
- Adopted Community Development Ordinances
- Klamath County Building Codes
- City of Klamath Falls Master Plans
- Transportation System Plan
- Comprehensive Plan

1-8 City Contacts

The following is a list of City contacts:

Public Works Engineering
226 South 5th Street
Klamath Falls, OR 97601
(541) 883-5365

Community Development Department
226 South 5th Street
Klamath Falls, OR 97601
(541) 883-5361

SECTION 2 OVERVIEW OF THE DEVELOPMENT PROCESS

2-1 Purpose

This section is provided to familiarize developers, consultants, contractors and other parties with the permit policies and procedures for all proposed development projects within the City of Klamath Falls. Property owners outside the City limits, but within the Urban Growth Boundary area, who need to extend City water and/or sanitary sewer mains, are also required to follow the process of this section. This section is also intended to provide a brief overview of the permits required for construction within the City limits.

2-2 Summary

Development within the City limits can be divided into two discrete review and approval processes: the Planning Development Permit and the Public Works Site Construction Permit. The Development Permit (including the Residential Review Permit and the Conditional Use Permit) is the review of all proposed development falling under the general jurisdiction of the City's Community Development Ordinance (CDO). Those permit processes are administratively managed by the City's Community Development Department with permits generally issued upon approval (or conditional approval) of the applicant's concept.

The Site Construction Permit process is the review and conditional acceptance of the technical and engineering details of any proposed construction associated with improvements within the public right-of-way (including on-site grading, erosion and stormwater) or associated with any project that has been issued a Development Permit. The Site Construction Permit process is administered by the Public Works Department. Klamath County currently issues all building permits within the City limits. The City's Site Construction permit process and any conditions required as a result thereof are independent of the County's building permit requirements.

In general, a Site Construction Permit is required for most construction work within the City limits. All residential subdivision, commercial and industrial development is required to follow the same review and approval procedures.

It is emphasized that permits will not be issued to start work until all engineering plans for that work are approved by the Public Works Department and required agreements, bonds, or guarantees have been submitted. It is the developer's responsibility to acquire all permits, licenses and easements that may be required by another entity (i.e. other than the City of Klamath Falls) that affects the construction of dedicated infrastructure.

2-3 New Development - Permit Process

2-3.1 Development Permit (Including Subdivision Approvals and Residential Review Application Approvals)

In general, any new development that is not exempt under the City's excavation and grading standard, dedicates public infrastructure, or is required to submit a stormwater plan under the City's stormwater standard must submit planning level concepts for those areas governed by the Public Works Engineering Standards with the Development Permit Application. These planning level concepts shall include preliminary information for all initial, phased, and ultimate build-out of the site improvements, anticipated stormwater and erosion control programs, infrastructure system concepts and address any other specific requirements identified within City standards. This information will assist the City in confirming that the existing infrastructure has adequate capacity to support the proposed development and will be used to determine whether the applicant may be required to assume financial responsibility for any public safety improvements necessary to accommodate the proposed development.

2-3.2 Site Construction Permit

A Site Construction Permit will be required for all sites proposing improvements that may have a potential impact on stormwater runoff, downstream water quality or those developments that intend to dedicate infrastructure to the public. This permit also integrates other miscellaneous permits issued by Public Works Department including sidewalk, curb cut and excavation permits.

In summary, a permit will be required for any development if any of the following apply to the site (See Figure 2-1):

- The quantity of imported fill will equal or exceed 50 cubic yards (e.g. 1350 square feet x 1 foot deep) or
- The quantity of excavation will equal or exceed 50 cubic yards (e.g. 1350 square feet x 1 foot deep), or
- Excavation, fill or grading is in or adjacent to any drainage course or wetlands, or
- One acre or more of land will be disturbed, or
- 5000 square feet or more of new impervious area will be added to the site, or
- A total of 10,000 square feet or more of impervious area will be added or reconstructed on the site (e.g. 7000 square feet of parking lot is fully reconstructed, and a new 4000 square foot building is constructed on an area that was previously landscaped), or
- Infrastructure will be constructed and dedicated to the City, or
- A curb cut is made for a driveway location, or
- Excavation will occur within a public right-of-way, or
- Sidewalks are constructed or replaced within a public right-of-way, or
- The sites will be converted from an existing use to a use that is a potentially significant source of pollution (e.g. converting a retail store to an automotive repair facility, equipment rental yard, or chemical storage facility).

Appendix A shows the process for issuing a Site Construction Permit. The application for a Site Construction Permit triggers the review process to determine if the proposed construction meets the Engineering Standards established by the City. This permit must be issued prior to initiating any and all construction activities on a site. The permit can be issued to a developer, landowner, or the developer/landowner's agent (e.g. general contractor, project manager or project engineer). The Engineering Division of Public Works administers this permit and will coordinate reviews within other City divisions. Some approvals such as sidewalk replacements/construction, excavation and curb cuts require only a sketch for approval, and therefore detailed construction drawings are not required.

2-3.2.1 Inspection and Fees

The City charges a non-refundable fixed fee for initiating the Site Construction Permit process. This fee offsets the cost of meetings, plan reviews and records management. A separate construction inspection fee is charged prior to the issuing of the Site Construction

Permit if the project will proceed with construction. That fee is based on the anticipated and actual cost(s) of construction inspection by the City.

For smaller scale projects such as excavations (in public right-of-way), curb cuts (driveways), sidewalks (new construction) and site grading (small and large sites) require a Site Construction Permit and a one-time fixed fee to be paid prior to starting any work. Sidewalk replacements require a permit but there is no fee required.

The City will inspect the construction work on behalf of the City's interest, to ensure that construction is being carried out in accordance with the approved plans and specifications. The City's inspection is required for the protection of existing or potential dedication of public assets and to meet the State and Federal regulatory requirements for the protection of the environment. The City's inspection should not be construed as an inspection or validation of a contractor's contractual agreement with a developer or owner. Developers are encouraged to retain the appropriate professionals to represent their interest on construction projects.

The developer shall identify a contact person to act as the liaison between the contractor and the City of Klamath Falls.

At the completion of the development project the design engineer shall submit a set of Record Drawings (As Built) to Engineering Division prior to that office accepting the infrastructure improvements that were constructed (See Section 10-4.3).

2-3.2.2 Site Construction Permit Expiration

The permit is valid for a period of sixty days (curb cuts, sidewalks and excavation in the public right-of-way) to one year (subdivision, commercial development, etc.). Extensions of the permit may be requested from the City prior to expiration. Permit extensions must comply with any changes or revisions made to the City's standards from the date of the original issuance. Extensions are not typically granted on expired permits.

2-4 Other Permits

The following is a list of other City permits that are issued by the Engineering Division of the Public Works Department:

2-4.1 Encroachment Permits

Encroachment permits are required when any person desires to erect, construct or maintain an encroachment structure upon public property. An encroachment structure shall include any tower, pole, pole line, pipe, pipeline, deck, billboard, stand or building, or any other such object or structure that is placed in, upon, under or over any public street, highway or alley right of way, or other public property. A review and recording fee is required.

2-4.2 Obstruction of Public Way Permit

Any temporary closure of a public right of way to vehicular or pedestrian traffic requires City approval prior to the proposed closure. Closures include street/alley, traffic lane, parking lane, bicycle lane and sidewalks that are not covered by a permit issued under Section 2-4.1 of this manual. Currently no fee is required.

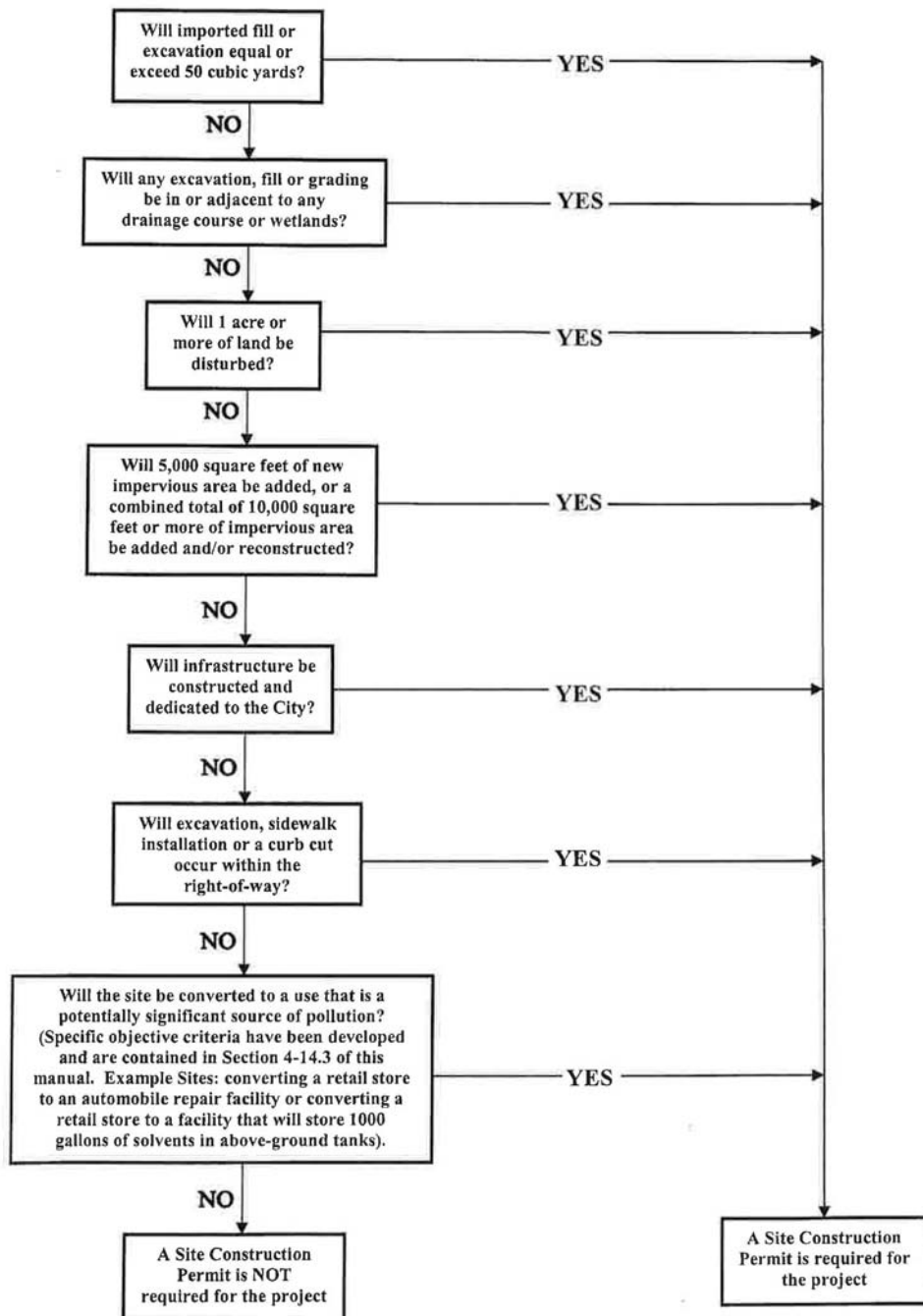
All the permit applications mentioned in this section are available in hard copy at the Engineering office or on the City's website, www.ci.klamath-falls.or.us.

2-5 Land Parcel Management

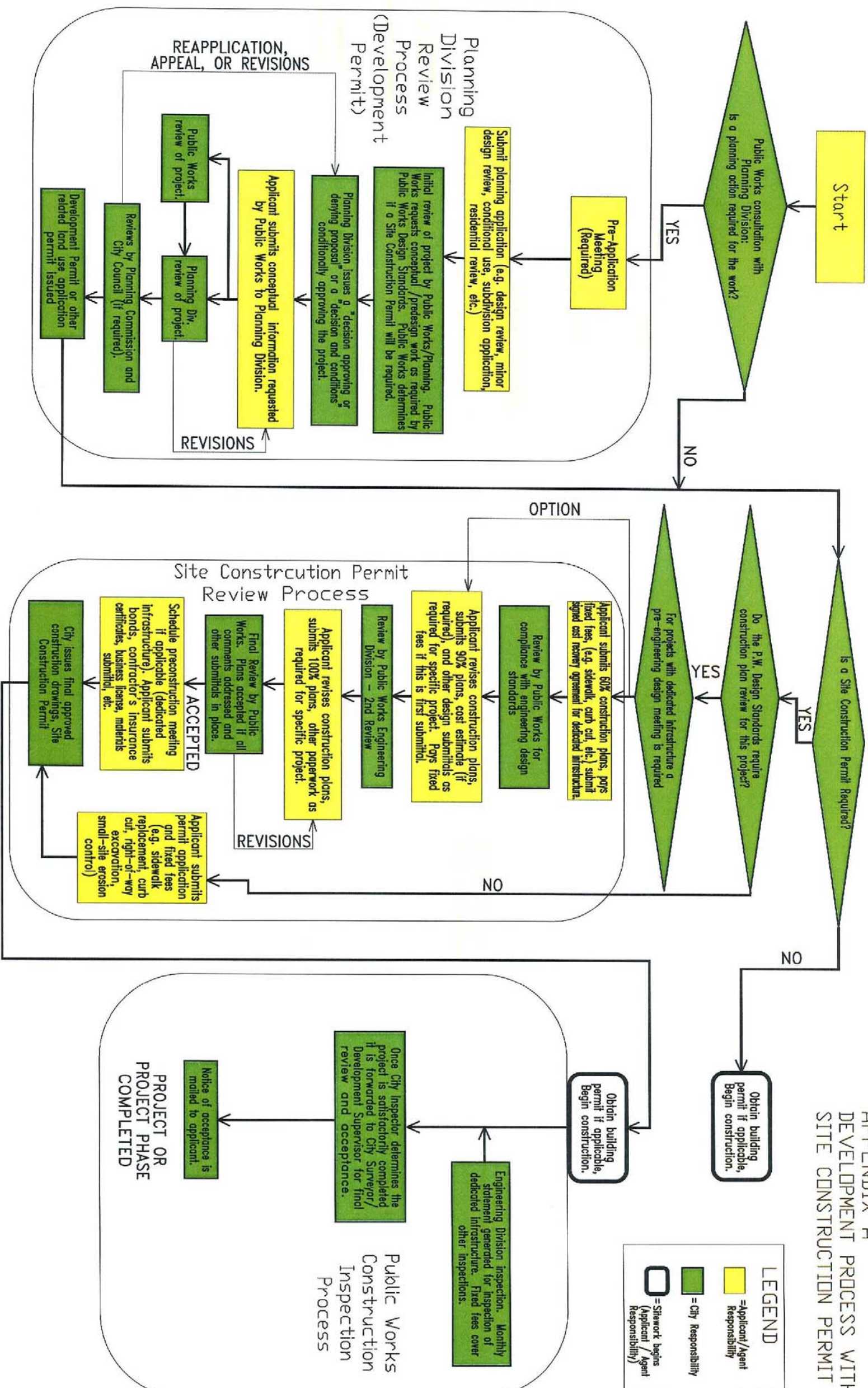
Information about property that is serviced by a City utility is tracked as location information through a software program maintained by the City of Klamath Falls titled "Land Parcel Management." Various City offices that utilize the information as part of their job can access the program. Any new service connection requires the applicant to first fill out a Land Parcel Management Information Sheet prior to receiving City water and sewer service. The information provided allows the City to enter the data required, so the property in question can be activated within the City's information system and the applicant can apply for those utility services.

Copies of this form can be obtained at the City of Klamath Falls Engineering, Planning or Utility Billing offices.

FIGURE 2-1
IS A SITE CONSTRUCTION PERMIT REQUIRED?



APPENDIX A DEVELOPMENT PROCESS WITH SITE CONSTRUCTION PERMIT



SECTION 3 GRADING AND EROSION CONTROL

3-1 Purpose

The purpose of this standard is to reduce the amount of sediment and pollutants reaching the storm and surface water system and reduce damage to other public infrastructure resulting from activities that accelerate erosion. The objective is to control erosion and pollution at its source to maintain and improve water quality, reduce downstream impacts and protect natural drainages.

3-2 Summary

The review of grading and erosion control by the City falls into two categories:

- Review of rough grading and erosion control during the Community Development Department review process. This applies to sites where the cut or imported fill is anticipated to exceed 1000 cubic yards.
- Review of final grading and erosion control during the Site Construction Permit process. This applies to sites as shown in Figure 3-1.
- In addition, this section also specifies the following:
- Inspection procedures for grading and erosion control on sites requiring a Site Construction Permit,
- Design criteria for grading and erosion control,
- The owner's/developer's/contractor's responsibilities for meeting erosion control performance criteria.

3-3 Definitions

3-3.1 Average Site Slope

Average site slope shall be calculated using the following formula:

$$S = (0.0029 * I * L) / A$$

I = Contour interval in feet

L = The summation of length of the contour lines in feet

A = Area of the site in acres

If accurate topography is not available for the site, determination of the average slope shall be at the discretion of the City.

3-3.2 As-graded

The extent of surface conditions on completion of grading.

3-3.3 Bedrock

In-place solid rock.

3-3.4 Bench

A relatively level step excavated into earth material on which fill is to be placed.

3-3.5 Best Management Practices (BMPs)

A physical, chemical, structural or managerial practice that prevents, reduces, or treats the contamination of water, or which prevents or reduces soil erosion.

3-3.6 Borrow

Earth material acquired from an off-site location for use in grading on a site.

3-3.7 Civil Engineer

A professional engineer licensed to practice civil-engineering in the state of Oregon.

3-3.8 Clearing

Any activity that removes vegetative surface cover and/or trees including, but not limited to, root mat removal and/or topsoil removal.

3-3.9 Compaction

The densification of a fill by mechanical means.

3-3.10 Conveyance System

The stormwater conveyance system includes all portions of the surface water system, either natural or man-made, that transport surface water runoff.

3-3.11 Denuded

Land that has had the natural vegetative cover or other cover removed leaving the soil exposed to the elements.

3-3.12 Development

Activities requiring a design review, minor design review, conditional use permit, site construction permit, subdivision tentative or final plat approval, or planned unit development (PUD) master plan approval in accordance with Chapters 11 and 12 of the City Code.

3-3.13 Drainage Course

Any ditch, waterway, drainage way or other land feature which serves as a course for the transmission of surface water or stormwater. Drainage courses are a minimum of 12 inches deep or receive surface and stormwater from a pipe/ditch/waterway at least 12 inches in diameter/depth.

3-3.14 Earth Material

Any rock, natural soil or fill or any combination thereof.

3-3.15 Engineering Geologist

A geologist experienced and knowledgeable in engineering geology. Engineering geology is the application of the knowledge of the forces of nature, principles of mechanics and the properties of materials to the evaluation, design and construction of civil works.

3-3.16 Engineering Geology Report

A report prepared by an engineering geologist including an adequate description of the geology of the site, conclusions and recommendations regarding the effect of geologic conditions on the proposed development, and opinion on the adequacy for the intended use of sites to be developed by the proposed grading, as affected by geologic factors.

3-3.17 Erosion

The wearing away of the ground surface as a result of the movement of wind, water or ice.

3-3.18 Erosion Prevention

Measures designed to protect soil particles from the force of rain and wind so that they will not erode.

3-3.19 Excavation

The mechanical removal of earth material.

3-3.20 Fill

A deposit of earth material placed by artificial means.

3-3.21 Floodplain

The area adjoining a stream, river, or lake that is subject to regional flooding. A regional flood is the largest flood that has a one percent chance of occurring in any one year in an area as a result of periods of higher than normal rainfall or stream flows, high winds, rapid snow melt, natural stream blockages, or combinations thereof. This is often referred to as the "100-year floodplain" or "FEMA floodplain."

3-3.22 Geotechnical Engineer

See "soils engineer."

3-3.23 Grade

The vertical location of the ground surface referenced to a temporary or permanent bench mark. Elevations for dedicated infrastructure shall be referenced to the NAVD 88 Datum or a City approved benchmark or temporary benchmark.

- Existing grade is the grade prior to grading.

- Rough grade is the stage at which the grade approximately conforms to the approved plan.
- Finish grade is the final grade of the site that conforms to the approved plan.

3-3.24 Grading

Any excavating or filling or combination thereof.

3-3.25 Ground Disturbing Activity

An activity that exposes soil through the use of motorized equipment.

- PERMANENT: ongoing areas of exposed soils or ground disturbance such as mining operations, farming, gardening and sports fields.
- TEMPORARY: short duration ground disturbance that occurs over a very limited time frame (less than 6 months between disturbances) such as construction, fill placement, landscape installation, and other vegetation clearing activities.

3-3.26 Key

A designed compacted fill placed in a trench excavated in earth material beneath the toe of a proposed fill slope.

3-3.27 Outfall

A point where collected and concentrated surface and stormwater runoff is discharged into an open drainage feature. These drainage features include ditch channels, swales, streams, rivers, ponds, lakes, and other open bodies of water.

3-3.28 Pollutant

Contaminant in a concentration or amount that adversely alters physical, chemical or biological properties of the environment.

3-3.29 Public Storm Drain

Any conveyance system in public right-of-way or easement operated and maintained by the City.

3-3.30 Receiving Water

Body of water that receives drainage or effluent from a particular location.

3-3.31 Sediment

Soil, sand, and minerals washed from land into water, usually after rain. Sediment is a leading source of pollution on construction sites because it decreases water clarity, and carries pollutants such as nutrients, pesticides, and other chemicals to receiving waters.

3-3.32 Sediment Control

A measure that prevents or reduces the amount of eroded material from leaving the site.

3-3.33 Site

Any lot, parcel or tract of land or contiguous combination thereof, under the same ownership, or common plan of development or sale. The area of land disturbed applies to land disturbed by the owner, the land owner's representative, or a contractor to the land owner and applies even if the proposed development will be disturbed in multiple phases.

3-3.34 Slope

An inclined ground surface the inclination of which is expressed as a ratio of horizontal distance to vertical distance.

3-3.35 Soil

Naturally occurring superficial deposits overlying bedrock.

3-3.36 Soils Engineer (Geotechnical Engineer)

An engineer experienced and knowledgeable in the practice of soils engineering (geotechnical engineering). Soils engineering is the application of the principles of soils mechanics in the investigation, evaluation and design of civil works involving the use of earth materials and the inspection or testing of the construction thereof.

3-3.37 Soils Engineering Report

A report prepared by a soils engineer (or other licensed engineer qualified to perform the work) including data regarding the nature, distribution and strength of existing soils, conclusions and recommendations for grading procedures and design criteria for corrective measures, including buttress fills, when necessary, and opinion on adequacy for the intended use of sites to be developed by the proposed grading as affected by soils engineering factors, including the stability of slopes.

3-3.38 Stabilization

The process of establishing an enduring soil cover of vegetation or mulch or other ground cover and may be in combination with installation of temporary or permanent structures. Stabilization shall reduce to the maximum extent practicable the erosion process and the resultant transport of sediment.

3-3.39 Storm Event

A rainfall or snowfall event that produces 0.2 inch of runoff or more during any 24 hour time period.

3-3.40 Surveyor

A Professional Land Surveyor licensed to practice surveying in the state of Oregon.

3-3.41 Terrace

A relatively level step constructed in the face of a graded slope surface for drainage and maintenance purposes.

3-3.42 Tributary Area

A hydrologic land area in which all surface water flows toward the project site.

3-3.43 Visible and Measureable Erosion or Sediment

- Deposits or tracking of mud, dirt, sediment, or similar material which exceeds one cubic foot in volume, on public or private streets, adjacent property, or into the storm drainage system or a drainage course, either by direct deposit, dropping, discharge, or as a result of the action of erosion, or
- Evidence of concentrated flows of water over bare soils; turbid or sediment laden flows; or evidence of on-site erosion such as rivulets on bare soil slopes, where the flow of water is not filtered or captured before leaving the site, or
- Earth slides, mud flows, earth sloughing, or other earth movement in excess of one cubic foot in volume which leaves the site.

3-3.44 Wetland

Those areas that are inundated or saturated by surface or groundwater at a frequency and duration sufficient to support and that, under normal circumstances do support, a prevalence of vegetation typically adapted for life in saturated soil conditions. Wetlands generally include swamps, marshes, bogs and similar areas.

3-4 Other Agencies May Require Grading and/or Erosion Control Plans

It is not the intent of this section to supersede the requirements of the Klamath County Building Department with respect to grading and/or erosion control requirements that may be required as a condition of the County's building permit. The intent of this section is to ensure that the City's minimum design requirements are met. The City defers to the County for review of the structural integrity of retaining walls or other concrete structures associated with grading/erosion control. The applicant, however, will be required to demonstrate to the City that such structures have been reviewed and approved by the County prior to their construction.

Depending on the location and nature of the work, permits may also be required from the Oregon Department of Environmental Quality (DEQ), Oregon Division of State Lands (DSL), the Army Corps of Engineers, the Oregon Department of Fish and Wildlife (ODFW), or US Fish and Wildlife. If such permits are required, the applicant shall provide evidence to the City that a permit has been obtained prior to any clearing, grading, or excavation activities.

3-5 Planning and Site Construction Approval Process

3-5.1 Planning-Level Reviews

If the applicant intends to excavate or fill (imported) 1000 cubic yards or more, or if requested by the City, then the applicant shall submit a conceptual grading plan for review and approval prior to approval of the Development permit application by the Community Development Department. The plan shall be prepared by an engineer licensed in the State of Oregon. The purpose of this conceptual plan is to provide the City with a tool that will allow preliminary assessment of the impact of any proposed clearing, grading, or excavation on adjacent properties, right-of-ways and public infrastructure. Complete design documents shall be required before receiving a Site Construction Permit for each phase of construction. The conceptual plan is valid for the period that the planning approval is valid.

The plan shall be submitted on ANSI B or D size drawings and to a legible scale, not to exceed 1 inch = 50 feet (e.g. 1 inch = 100 ft is not acceptable). It shall show the following:

- Property lines, existing buildings or structures, easements, utilities, and drainage courses, existing trees (six inches in diameter and larger) and the location of any building or structure within 25 feet of the property boundary (location may be approximate),
- Contours showing the topography of the existing ground (Contour lines shall extend a minimum of 25 feet beyond the limits of the site. Contour lines outside the site boundaries may be approximate).
- Contours, elevations, dimensions, locations, extent, and the slopes of all proposed rough grading. Label slopes 3:1 and steeper. Due to the conceptual nature of the plan, these may be approximate in nature.
- Locations of retaining walls and other structures to be constructed as part of project,
- Estimated quantities of excavation and fill (cubic yards, including estimated import and export quantities), top and toe of cut and fill slopes, direction of sheet and concentrated drainage,
- Anticipated locations of stormwater conveyance/detention facilities,
- Proposed types of permanent cover to be established on disturbed areas of site (e.g. lawn, native vegetation, rockery, gravel, asphalt, etc.), and
- Phasing of proposed grading work (e.g. Will work be phased? What work will be done in each phase of development?).

3-5.2 Site Construction Permits

Figure 3-1 shows the process for determining if a Site Grading and Erosion Control Plan will be required for the site and if the site is categorized as “small” or “large.” The Site Grading and Erosion Control Plan (large sites only) shall be submitted for review and approval prior to issuance of the City’s Site Construction Permit.

3-5.2.1 Small Site

No formal plan is required for a small site. However, applicants must complete a Site Construction Permit and employ the minimum erosion control techniques specified herein.

3-5.2.2 Large Site

A Site Grading and Erosion Control Plan shall be submitted for review and approval for all large sites as defined in Figure 3-1 prior to issuance of the City’s Site Construction Permit. It shall be prepared by an engineer licensed in Oregon and qualified to perform the work submitted within the plan. Soils reports, surveys, and other specialized work shall be performed (and stamped or otherwise certified) by professionals licensed/certified to perform such work.

The applicant shall complete a permit application form and include construction documents (refer to 3-5.2.2.2 and 3-5.2.2.3) ANSI B or D, scale not to exceed 1 inch = 50 feet, showing the following:

- Property lines, existing buildings or structures, easements, utilities, and drainage courses, existing trees (six inches in diameter and larger) and the location of any building or structure within 25 feet of the property boundary (location may be approximate),
- Contours (2-foot interval maximum) with existing elevations to show existing topography (Contour lines shall extend a minimum of 25 feet beyond the limits of the site. Contour lines outside the site boundaries may be approximate). Contours and elevations shall be used on NAVD 88 or a City approved benchmark or temporary benchmark if the work will construct dedicated infrastructure.
- Elevations, dimensions, locations, extent, and the slopes of all proposed grading shown by contours and/or other means (label slopes 3:1 and steeper),
- Locations of retaining walls and other structures to be constructed as part of project (label wall height),
- Approximate amount of excavation and fill (cubic yards), top and toe of cut and fill slopes, direction of sheet and concentrated drainage,
- Locations of existing and proposed stormwater conveyance/detention facilities including inlets immediately downstream of site (for the purpose of evaluating drainage patterns during and after construction),
- Location of gravel construction entrance,
- Limits of clearing,
- Location for storage of excavated materials, wastes, and other construction materials,
- Placement of other erosion control devices including installation details and maintenance criteria (Incorporate these into the plans and specifications),
- Proposed types of permanent cover to be established on disturbed areas of site (e.g. lawn, native vegetation, rockery, gravel, asphalt, etc.),
- Standard City of Klamath Falls Erosion Control and Grading Notes (refer to Drawing 3-225),
- Project phasing (if applicable to project), and
- Recommendations of soils engineering and engineering geology reports,

3-5.2.2.1. Supporting Documentation

The following supporting documentation shall be submitted to the City for review and approval prior to the issuance of the Site Construction permit.

- A current record of survey that establishes or re-establishes the property corners,
- A grading narrative - The purpose of this narrative is to address any site grading practices that may conflict with the engineering criteria. The engineer shall either certify that the design meets the grading policies and criteria set by the City in Section 3-6 or the engineer

shall explain why a variance is requested and attach supporting documentation (e.g. soils engineering report or engineering geology report).

- A construction schedule showing the relative sequence of major stormwater and erosion control activities relative to other construction activities,
- An erosion control narrative – The purpose of this narrative is to address each of the requirements listed in Section 3-7. List each requirement and briefly address how this will be met. Include calculations for sizing BMPs (if applicable) and information on proposed BMPs that are not in the referenced manual.
- A cost estimate for grading improvements and installation and maintenance of erosion control measures (if a project proposes to construct public infrastructure (excluding small projects such as sewer laterals, utility extension or other similar projects approved by Public Works) or if the total quantity of cut or fill (imported) is 10,000 cubic yards or more).

3-5.2.2.2. Preliminary Drawings

As part of the Site Construction Permit Process, the City strongly encourages applicants to submit 60% and 90% design documents (and required calculations) for review. This will reduce the need for applicants to make significant design changes later in the review process.

Preliminary drawings may be prepared on any type of material that is easily reproduced in-house (i.e. Xerox, velum, sepia, etc.) Line work should be of sufficient quality to reproduce clearly. The City project manager will determine drawing size and number of copies for City review.

3-5.2.2.3. Final Design Drawings

Prior to issuance of the Site Construction Permit, final design and construction documents shall be submitted to the City for review and approval. Approval will not be granted until the City has been satisfied that the requested design modifications have been made. The design submittal shall include all drawings, specifications and supporting calculations needed to verify that the proposed grading and erosion control align with the concepts approved in the planning-level review and meets the City's design standards as specified herein.

The City will not accept any new infrastructure constructed prior to issuance of the Site Construction Permit, or infrastructure not inspected at the site and certified by the City as meeting the required standards.

Final design drawings shall be prepared on translucent velum, sepia, or Mylar with the appropriate professional stamp. Final drawings shall be full size unless approved by the City. Graphical representations of dedicated infrastructure on final design drawings must meet City Drafting Standards (Refer to Section 10). Capital improvement projects shall use the standard City title block and drawing format. Land development projects with dedicated infrastructure shall use the City supplied signature block on every drawing sheet submitted (see Dwg. 10-100).

3-5.2.2.4. Bonds

If a project proposes to construct public infrastructure (excluding small projects such as sewer laterals, utility extensions, or other similar projects as approved by the City), the applicant shall submit an engineer's estimate and bond for 120% of the cost to construct the following (to be estimated separately):

- Proposed grading (excavation and fill) and
- Installation and maintenance of erosion control measures for the duration of the project (including the cost of final stabilization).

3-5.2.3 How long is a grading and erosion control plan valid?

A Site Grading and Erosion Control Plan is valid for a period of one year following the date of its approval. At the end of that time, if final construction plans have not been approved and substantial site grading activities completed, then the Site Grading and Erosion Control Plan approval shall be null and void and become effective only if resubmitted to Public Works and re-approved. All re-submitted plan(s) shall be subject to the standards and fee schedule effective at the time of the re-submittal. Phases of the project that are actively under construction or have been previously completed and accepted are not subject to revisions of this standard unless additional development is proposed that requires submittal of a new Site Grading and Erosion Control Plan, OR if the site is not meeting the erosion control performance standard.

3-5.3 Public Works Review and Inspection Procedures and Fees

Fixed fees are charged for review and inspection of site grading and erosion control. Refer to Section 2 of this manual.

At a minimum, the following inspections will be performed:

- Initial site review during Site Construction Permit application and/or planning-level review,
- Inspection of erosion control measures prior to initiating clearing/grading (It is the applicant's responsibility to contact the inspector 48 hours prior to requiring an inspection. Construction may not proceed until the inspection has been performed.)
- Spot inspection(s) during construction as required (The number of inspections is at the discretion of the inspector).
- Final inspection once site work is complete and site is stabilized (It is the applicant's responsibility to contact the inspector 48 hours prior to requiring an inspection. Erosion control measures must remain in place until the inspection is completed and approval is given by the City inspector).

3-5.3.1 Professional Inspection

Professional inspection of grading operations shall be provided by the civil engineer, geotechnical engineer, and/or the engineering geologist at the applicant's expense if requested by the City. Typically, the City will only request this for sites where failure to meet precise specifications may pose a hazard (e.g. fill sites on steep slopes or deep fills).

3-5.4 Record Drawings

Record drawings are required for permanent infrastructure or other work associated with grading and erosion control on City property or within an existing or proposed City right-of-way or easement (e.g. retaining walls or finished grades/slopes/surfacing for roadways, shoulders, and cut or fill slopes). Prior to City acceptance of the improvements, the contractor shall supply the City with record drawings of the installation. The contractor shall make all changes to the record drawings as directed by the inspector before the City will approve and accept the project.

All final record drawings shall be ink on polyester (Mylar) base drafting film at least .003 inch thick and coated for drafting on both sides. Graphical representations of dedicated infrastructure must meet City Drafting Standards (refer to Section 10). Standard City of Klamath Falls title block and drawing format shall be used.

Submitted drawings shall be on Mylar as well as in electronic format (refer to Section 10). Final record drawings shall be stamped or otherwise marked as such, indicating the date of their preparation. Graphical representation of final electronic drawings submitted with Mylar drawings shall match. Digital files that do not agree with the Mylars will be returned and corrected at no cost or liability to the City.

Record Drawings shall clearly identify deviations from the approved final design drawings using the standards established in Section 10 of this manual.

3-6 Grading Policies and Criteria

3-6.1 Referenced Standards

The grading requirements of this section are focused on protection of water quality and drainage courses. In cases where additional clarification is needed for acceptable grading practices, the City and applicant will reference Chapter 70 of the Uniform Building Code (UBC). In cases of conflict, the provisions of this section will govern.

Grading plans must conform to the following design criteria unless approved otherwise by the City. To justify a variance from these requirements, the applicant may be required to furnish a soils engineering or engineering geology report (or both) which states that the site has been investigated and that a less-restrictive criteria will not create an unstable condition posing a hazard to public or private property. These reports must be submitted to the City for its review.

3-6.2 Cuts

Cut slopes for non-engineered sites shall not exceed 1 foot vertical to 2 feet horizontal (50% slope). The City may consider approval of a proposed slope that is steeper than the criteria stated herein provided that a stamped soils engineering report clearly states that the site-specific soils conditions are capable of supporting the proposed cut and that all recommendations of said report are incorporated in the site design. Any approved modification to this slope criteria will not exempt cuts slopes from the requirement of erosion stabilization as outlined herein.

3-6.3 Fills

3-6.3.1 Slopes

Fill slopes for non-engineered sites shall not exceed 1 foot vertical to 2 feet horizontal (50% slope). The City may consider approval of a proposed slope that is steeper than the criteria stated herein provided that a stamped soils engineering report clearly states that the site-

specific soils conditions are capable of supporting the proposed fill and that all recommendations of said report are incorporated in the site design. Any approved modification to the slope criteria will not exempt fill areas from the requirement of erosion stabilization as outlined herein.

3-6.3.2 Fill Material

The type of soil utilized for fill shall have shearing, slumping, and similar characteristics necessary to support the structure intended. Fill materials that may present a water quality problem on site or within the surrounding area, due to their physical characteristics or contamination from oil, industrial waste or similar pollutants, shall not be permitted.

3-6.3.3 Compaction

Fill shall be compacted to accepted engineering standards sufficient to support the structure intended and existing water shall be allowed to settle prior to development upon the site. Fill shall be placed and compacted in lifts of not more than six inches, unless on-site testing supports thicker lifts.

3-6.4 Grade Breaks

Changes in slopes shall be rounded and cut and fill slopes shall be stabilized with material suitable to prevent erosion or similar soil instability problems.

3-6.5 Existing Vegetation

Existing vegetation shall be preserved when to do so will not adversely affect the engineering soundness of the cut or fill involved.

3-6.6 Drainage Courses

The alignment and capacity of existing drainage courses shall not be modified by grading activities. Installation of culverts shall meet the requirements of SECTION 4.

3-6.7 Setbacks

Cut and fill slopes shall be set back from drainage courses a minimum of 25 feet from the top of bank.

Cut and fill slopes shall be set back from site boundaries as described below:

- Top of Cut Slope. The top of cut slopes shall not be made nearer to a site boundary line than one fifth of the vertical height of cut with a minimum of 2 feet and a maximum of 10 feet. The setback may need to be increased for any required interceptor drains.
- Toe of Fill Slope. The toe of fill slope shall be made not nearer to the site boundary line than one half the height of the slope with a minimum of 2 feet and a maximum of 20 feet. Where a fill slope is to be located near the site boundary and the adjacent off-site property is developed, special precautions shall be incorporated in the work as the City deems necessary to protect the adjoining property from damage as a result of such grading. These precautions may include, but are not limited to:
 - o Additional setbacks.
 - o Provision for retaining or slough walls.

- o Mechanical or chemical treatment of the fill slope surface to minimize erosion.
- o Provisions for the control of surface waters

3-6.8 Drainage and Terracing

For cut and fill slopes steeper than 1 foot vertical to 3 feet horizontal, the following requirements apply:

3-6.8.1 Terraces

Terraces at least 6 feet in width shall be established at not more than 30 foot vertical intervals on all cut or fill slopes to control surface drainage and debris except that where only one terrace is required, it shall be at mid-height. For cut or fill slopes greater than 60 feet and up to 120 feet in vertical height, one terrace at approximately mid-height shall be 12 feet in width. Terrace widths and spacing for cut and fill slopes greater than 120 feet in height shall be designed by a civil engineer and approved by the City. Suitable access shall be provided to permit proper cleaning and maintenance.

Swales or ditches on terraces shall have a minimum gradient of 5 percent and must be paved with reinforced concrete not less than 3 inches in thickness or an approved equal paving. They shall have a minimum depth at the deepest point of 1 foot and a minimum paved width of 5 feet.

A single run of swale or ditch shall not collect runoff from a tributary area exceeding 13,500 square feet (projected) without discharging into an approved underground storm drainage system or other approved point of discharge.

3-6.8.2 Subsurface Drainage

Cut and fill slopes shall be provided with subsurface drainage as necessary for stability.

3-6.8.3 Disposal

All drainage facilities shall be designed to carry waters to the nearest practicable piped stormwater system or drainage course approved by the City. For guidance on discharge locations, refer to Section 4 of this manual.

3-6.8.4 Interceptor Drains

Paved interceptor drains shall be installed along the top of all cut slopes where the tributary drainage area above slopes toward the cut and has a drainage path greater than 40 feet measured horizontally. Interceptor drains shall be paved with a minimum of 3 inches of concrete or gunite and reinforced. They shall have a minimum depth of 12 inches and a minimum paved width of 30 inches measured horizontally across the drain. The slope of drain shall be approved by the City. Alternate methods for preventing erosion on cut and fill slopes will be evaluated on a case by case basis.

3-7 Erosion Control Policies and Criteria

3-7.1 General

The required best management practices (BMPs) listed in this section are minimum measures. To meet the erosion control performance standard, the developer may be required to design and implement additional erosion control measures. **The City will review Site Grading and Erosion**

Control Plans for completeness and compliance with the requirements of this section. However, it is the responsibility of the applicant to meet the following erosion control performance standard:

- **Erosion control measures shall be designed and implemented as required to prevent visible and measureable erosion or sediment** (refer to Section 3-3.43 for definition).

3-7.2 Referenced Standards

For erosion control best management practices (BMP's), this standard references the Central Oregon Stormwater Manual available from <http://www.coic.org/cd/stormwater/index.htm>.

3-7.3 Small Site Required Best Management Practices (BMPs)

The BMPs listed below are required for small sites as defined in Figure 3-1.

3-7.3.1 Mark Clearing Limits

Clearing and grading of the site should be planned properly. It is important to clear only the areas needed, thus keeping exposed areas to a minimum. Clearing should be phased so that only those areas that are actively being worked are uncovered. Clearing limits shall be flagged prior to the initiation of clearing.

3-7.3.2 Construction Stabilized Construction Entrance

A stabilized construction entrance shall be the sole entrance or egress from the site. Prior to initiating construction, construct a stabilized construction entrance. Refer to standard drawing 3-100 for details. Do not install gravel on paved surfaces.

Perform maintenance on construction entrance as follows:

- Additional gravel shall be added as required to maintain function of the pad.
- Additional measures may be required if mud and dirt tracking is evident on access road.

3-7.3.3 Protect Stockpiles and Staging Areas

Soil and material stockpiles shall be situated so that the material does not erode into the street or adjoining yard. Excavated basement soil and material stockpiles should be located a reasonable distance behind the curb (10 feet, minimum), such as in the backyard or side yard area. This practice will increase the distance eroded soil and stockpiled material must travel to reach the stormwater conveyance system.

If applicable to the site, concentrated flows shall be diverted away from staging areas and stockpiles using best management practices from the Central Oregon Stormwater Manual available from <http://www.coic.org/cd/stormwater/index.htm>. Soil and material stockpiles shall be covered when not in use (e.g. when not accessed for 48 hours or more) during the period of October 1st to April 30th. This requirement may be waived for soil and gravel stockpiles on flat (<5%) slopes if in the opinion of the inspector, the risk of erosion is minimal.

3-7.3.4 Install Sediment Barrier at Toe of Disturbed Area and Material Stockpiles

Refer to Table 3-1 below. Install a sediment barrier as required for existing site slope.

Minimum sediment barrier requirement	Slope < 5%	Slope > 5%
No barrier required unless visible and measureable erosion or sediment is observed	X	
Silt Fence, Biofiltration Bags, or Straw Bales at toe of disturbed area and stockpiles		X

3-7.3.5 Backfilling

Basement walls should be backfilled as soon as possible and the lot rough graded. This practice will eliminate large soil mounds that are highly erodible and prepares the lot for temporary cover which will further reduce erosion potential. Excess soil should be removed from the site as soon as possible after backfilling. Quantities of soil in excess of 50 cubic yards shall be hauled to the site specified by the applicant on the permit application. A separate permit is required for sites within the City limits that will receive in excess of 50 cubic yards of material.

3-7.3.6 Storm Drain Inlet Protection

Protect storm drain inlets immediately downstream from sediment using best management practices from the Central Oregon Stormwater Manual available from <http://www.coic.org/cd/stormwater/index.htm>.

3-7.3.7 Slope Protection and Temporary Cover

Slope stabilization measures (for slopes 3:1 and steeper) must be initiated within 14 calendar days between May 1st and September 30th and within 7 days between October 1st and April 30th after construction activities in that portion of the site where earthmoving activities have temporarily or permanently ceased. Slopes shall be covered using mulch, erosion control matting, or other methods described in the Central Oregon Stormwater Manual available from <http://www.coic.org/cd/stormwater/index.htm>. Follow guidelines for securing mulch or matting. Slopes must be protected while permanent cover is established.

3-7.3.8 Remove Sediment

- Visible deposits of sediment that leave the site shall be cleaned up within 24 hours and placed back on the site or properly disposed.
- Under no condition shall sediment from the construction site be washed into sewers, drainage courses, or other portions of the conveyance system.

3-7.3.9 Establish Permanent Cover

Prior to removal of erosion control measures, permanent cover must be established on the site. Once construction is complete and permanent cover is established, call for final

inspection from the City. Remove temporary erosion control measures when approved by the City inspector.

3-7.4 Large Site Erosion Control Requirements

The minimum requirements for large site erosion control are described in this section. Review the BMPs in the Central Oregon Stormwater Manual available from <http://www.coic.org/cd/stormwater/index.htm> and apply them as required to meet these minimum requirements. Due to variations in site conditions and construction timing, the BMPs required will vary by site. Maintenance of BMPs shall be as specified in the *Central Oregon Stormwater Manual*.

3-7.4.1 Delineation of Clearing Limits

Follow the BMP guidelines in the *Central Oregon Stormwater Manual*. Show clearing limits on construction plans and mark them in the field prior to the initiation of clearing and grading. Show phasing in construction schedule (e.g. "Install sediment fence below area A" then "Clear and rough grade area A" followed by "Seed, mulch, and install erosion control matting on slopes of area A," etc.)

3-7.4.2 Construct Stabilized Construction Entrance

A stabilized construction entrance shall be the sole entrance or egress from the site. Refer to standard drawing 3-100. Additional guidance is available from the *Central Oregon Stormwater Manual*. Show the location of the construction entrance on the plan. Do not install gravel on paved surfaces.

Perform maintenance on construction entrance as follows:

- Additional gravel shall be added as required to maintain function of the pad.
- Additional measures may be required if mud and dirt tracking is evident on access road.

3-7.4.3 Prevent Pollution from Equipment and Material Storage and Maintenance

Specify locations on site for equipment storage and maintenance and storage of construction materials and wastes. Protect this location from surface water run-on and flooding. Review *Central Oregon Stormwater Manual* BMPs "Protection of Staging Areas," "Cover for Materials and Equipment," "Spill Prevention and Control" and "Waste Management." Specify the types of materials stored on-site (e.g. fuel or fertilizer) which may pose a water quality hazard and specify measures to be taken to prevent pollution. Covering of construction equipment is not required. Covering materials and stockpiles may be required depending on type of material and downstream controls. Protect stockpiles on slopes greater than 5 percent using perimeter controls at the base. Locate stockpiles a minimum of 10 feet away from property boundaries or stormwater conveyance systems.

3-7.4.4 Surface Water Controls

Surface water controls shall be installed to intercept all concentrated flow from disturbed areas, convey it to an appropriate sediment trap or pond, and discharge it downstream of any disturbed areas. However, areas at the perimeter of the site that are small enough to be treated solely with perimeter protection do not require surface water controls. Significant sources of upstream surface water that drain onto disturbed areas shall be intercepted and conveyed (in a non-erosive pipe or channel) to a stabilized discharge point downstream of

the disturbed areas. Surface water controls shall be installed concurrently with or immediately following rough grading. Special caution shall be used in protecting stockpile, material storage and equipment maintenance areas to prevent surface water from flooding these areas. Select BMPs for controlling surface water from *Central Oregon Stormwater Manual*. Show surface water controls on plan.

3-7.4.5 Perimeter Sediment Controls

Perimeter protection to filter sediment from sheet flow shall be provided downstream of all disturbed areas with slopes 5 percent or steeper. Perimeter protection may include preserving vegetated strips as well as more conventional constructed measures such as sediment fences, straw bales, and bio-filter bags (refer to *Central Oregon Stormwater Manual*). Such protection shall be installed prior to upslope grading.

3-7.4.6 Remove Excess Soil

Excess soil should be removed from the site as soon as possible after earthwork is completed. Quantities of soil in excess of 50 cubic yards shall be hauled to the site specified by the applicant on the permit application. A separate permit is required for sites within the City limits that will receive in excess of 50 cubic yards of material.

3-7.4.7 Storm Drain Inlet Protection

Protect storm drain inlets downstream from disturbed areas and stockpiles using best management practices from the *Central Oregon Stormwater Manual*.

3-7.4.8 Slope Protection and Temporary Cover

Slope stabilization measures (for slopes 3:1 and steeper) must be initiated within 14 calendar days between May 1st and September 30th and within 7 days between October 1 and April 30th after construction activities in that portion of the site where earthmoving activities have temporarily or permanently ceased. Slopes shall be covered using mulch, erosion control matting, or other methods described in the *Central Oregon Stormwater Manual*. Follow guidelines for securing mulch or matting. Slopes must be protected while permanent cover is established.

3-7.4.9 Remove Sediment

- Visible deposits of sediment that leave the site shall be cleaned up within 24 hours and placed back on the site or properly disposed.
- Under no condition shall sediment from the construction site be washed into sewers, drainage courses, or other portions of the conveyance system.

3-7.4.10 Dust Control

Preventative measures to minimize wind transport of soil shall be implemented when a nuisance or traffic hazard may be created or when sediment transported by wind may be deposited in water resources. Reference *Central Oregon Stormwater Manual* for BMPs or as directed by City or as directed by the City.

3-7.4.11 Establish Permanent Cover

Prior to removal of erosion control measures, permanent cover must be established on the site. Once construction is complete and permanent cover is established, call for final inspection from the City. Remove temporary erosion control measures when approved by the City inspector.

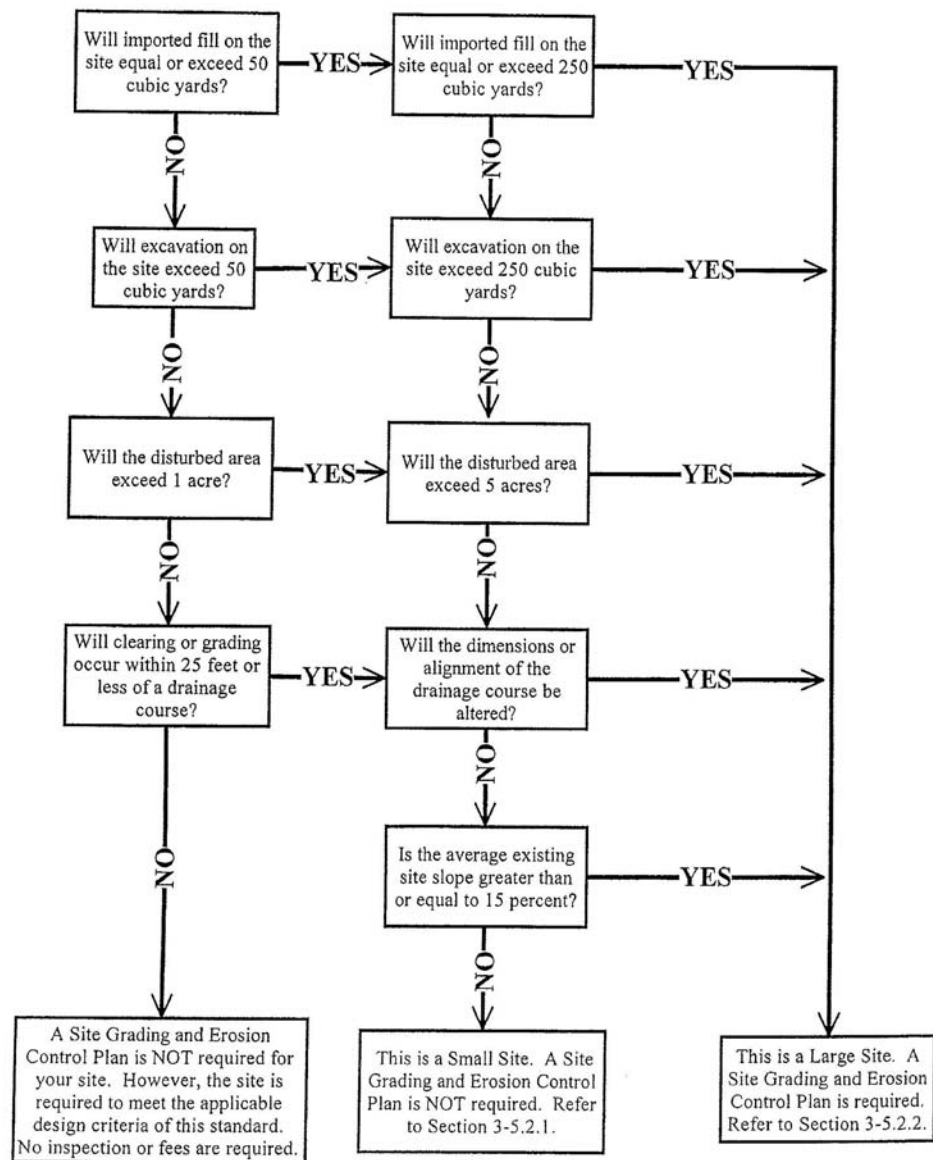
3-7.5 Project Types Requiring Special Consideration

“Large” or “Small” linear projects such as roads or utilities may require special consideration for meeting the erosion control performance standard. One way of performing adequate erosion control is to stabilize construction as the work proceeds. For example, on a road the base rock may be placed on the first portion of the road before the rough grading is complete at the end. At a minimum, the following measures are required for these types of projects:

- Protect downstream storm drain inlets (or if site drains to a ditch system, install check dams or other devices to retain sediment),
- Protect stockpiles and work site from concentrated flows,
- Remove excess soil and materials as soon as possible,
- Filter dewatering pump effluent,
- Remove sediment/debris from the right-of-way and conveyance system (including gutters) at the end of the day,
- Cover material and soil stockpiles when not (e.g. over weekend or if work will be delayed for 48 hours or more) in use during the period of October 1st to April 30th (this requirement may be waived if measures are in place to prevent erosion from reaching the right-of-way or drainage system) or when windy conditions may cause a nuisance or hazard due to dust, and
- Protect slopes and establish permanent cover as required for a large or small site.

Figure 3-1

Is a Site Grading/Erosion Control Plan Required?



SECTION 4 STORMWATER FACILITIES

4-1 Purpose

This standard represents the minimum requirements for the analysis, design, construction and maintenance of stormwater facilities on development sites.

The provision for adequate stormwater management in the City of Klamath Falls is necessary to promote the general health, welfare, and economic wellbeing of our community as well as to protect the health of the Klamath Basin Watershed. The potential effects of failure to manage stormwater include increased water pollution, flooding, damage to public and private infrastructure, regulatory fines, and increased costs to remedy problems in the future.

The City of Klamath Falls has developed the *StormWater Facilities* standard contained in this section to summarize the stormwater analysis, design, construction and maintenance requirements for proposed development sites. **This section does not apply to single family residences or duplexes in existing subdivisions (in-filling).** The goal of this standard is to conserve public resources by:

- Ensuring adequate site drainage,
- Reducing water quality and quantity impacts from new development or redevelopment by requiring the consideration and mitigation of these impacts during site design,
- Protecting existing drainage courses,
- Providing design criteria which will reduce infrastructure maintenance costs, and
- Planning for future development as stormwater facilities are designed and constructed.

4-2 Summary

This standard represents the minimum requirements for the analysis, design, construction and maintenance of stormwater facilities on development sites. **This section does not apply to single family residences or duplexes in existing subdivisions (in-filling).**

The review of stormwater facilities by the City falls into two categories:

- Review of conceptual plans during the planning review process (refer to Sections 4-6).
- Review of detailed design drawings and calculations during the Site Construction Permit process.

Review criteria for proposed improvements are organized into the following categories:

- Select appropriate discharge location,
- Perform off-site analysis,
- Control water quantity,
- Design conveyance system,

- Control water quality,
- Perform erosion control,
- Provide for maintenance and operation, and

Provide financial guarantees.

4-3 Definitions

4-3.1 Best Management Practices (BMPs)

A physical, chemical, structural or managerial practice that prevents, reduces, or treats the contamination of water, or which prevents or reduces soil erosion.

4-3.2 Bioengineering

The use of natural, non-structural solutions to provide bank stabilization and water quality treatment within drainage systems.

4-3.3 Biofiltration

The process of reducing pollutant concentrations in water by filtering the polluted water through biological materials.

4-3.4 Conjunctive Use

A stormwater facility that is designed and used to serve multiple uses, such as a regional detention basin that is used as a park or playground during non-storm periods.

4-3.5 Conveyance System

The stormwater conveyance system includes all portions of the surface water system, either natural or constructed, that transport surface water runoff.

4-3.6 Design Storm

A rainfall event of a specified recurrence interval that is selected as the basis for facility design.

4-3.7 Detention Facility

A stormwater facility that delays the downstream progress of stormwater runoff in a controlled manner. This is typically accomplished using temporary storage areas and a controlling outlet device.

4-3.8 Development

Activities requiring a design review, minor design review, conditional use permit, site construction permit, subdivision tentative plan or final plat approval, or planned unit development (PUD) master plan approval in accordance with Chapters 11 and 12 of the City Code.

4-3.9 Drainage Course

Any ditch, waterway, drainage way or other land feature which serves as a course for the transmission of surface water or stormwater. Drainage courses are a minimum of 12 inches deep or receive surface and stormwater from a pipe/ditch/waterway at least 12 inches in diameter/depth.

4-3.10 Erosion

The wearing away of the ground surface as a result of the movement of wind, water or ice.

4-3.11 Floodplain

The area adjoining a stream, river, or lake that is subject to regional flooding. A regional flood is the largest flood that has a one percent chance of occurring in any one year in an area as a result of periods of higher than normal rainfall or stream flows, high winds, rapid snow melt, natural stream blockages, or combinations thereof. This is often referred to as the "100-year floodplain" or "FEMA floodplain."

4-3.12 Grading

Any excavating or filling or combination thereof. Grading standards are contained in Section 3.

4-3.13 Impervious Areas

Surfaces which either prevent or retard saturation of water into the land surface, as existed under natural conditions prior to development and cause water to run off the land surface in greater quantities or at an increased rate of flow. Impervious areas include but are not limited to: parking lots and other paved areas, gravel or paved roads, structures, and roofs.

4-3.14 Natural Drainage Course

A drainage course which receives/or received runoff due to predevelopment site topography

4-3.15 On-site Detention

The storage of excess runoff on the development site prior to its entry into a public storm drain system and gradual release of the stored runoff after the peak of the runoff has passed

4-3.16 Outfall

A point where collected and concentrated surface and stormwater runoff is discharged into an open drainage feature. These drainage features include ditch channels, swales, streams, rivers, ponds, lakes, and other open bodies of water.

4-3.17 Pollutant

Contaminant in a concentration or amount that adversely alters physical, chemical or biological properties of the environment.

4-3.18 Public Storm Drain

Any conveyance system in public right-of-way or property deeded to the City operated and maintained by the City.

4-3.19 Receiving Water

Body of water that receives drainage or effluent from a particular location.

4-3.20 Retention Facility

A facility designed to store water and dissipate it slowly by evaporation, plant transpiration, or infiltration into the soil.

4-3.21 Sediment

Soil, sand, and minerals washed from land into water, usually after rain. Sediment is a leading source of pollution on construction sites because it decreases water clarity, and carries pollutants such as nutrients, pesticides, and other chemicals to receiving waters.

4-3.22 Site

For the purposes of this standard, the term site refers to an individual parcel or multiple parcels under common ownership or a common plan of development.

4-3.23 Tributary Area

A hydrologic land area in which all surface water flows toward the project site.

4-3.24 Wetland

- Those areas that are inundated or saturated by surface or groundwater at a frequency and duration sufficient to support and that under normal circumstances do support, a prevalence of vegetation typically adapted for life in saturated soil conditions. Wetlands generally include swamps, marshes, bogs and similar areas.

4-4 Other Agencies May Require Stormwater Reviews

Stormwater flows across governmental jurisdictions and affects downstream landowners, habitat and water quality. Other agencies may also require drainage review. The policies in this manual shall not relieve any person from the obligation to comply with the regulations or permits of any federal, state, or local authority having jurisdiction over a development (For example: Oregon Department of Environmental Quality, Oregon Division of State Lands, the Army Corps of Engineers, Oregon Department of Fish and Wildlife, U.S. Fish and Wildlife, Klamath County, and local irrigation districts).

A common problem encountered is the development of parcels within the City that drain directly to drainage facilities maintained by the County or a local irrigation district. In this case, the applicant is required to meet City standards as well as any quantity or quality standards imposed by the County or district. Application for review by other agencies shall be made separately.

4-5 Referenced Standards

This standard is not all-inclusive. Materials, construction methods, and testing procedures not specified in this section shall be as specified in the most recent edition of the:

- "Oregon Standard Specifications for Construction" and the "Oregon Standard Drawings (English)" also referred to as "ODOT/APWA Standards."

In developing this standard, many stormwater management manuals from Oregon, California and Washington were referenced. Most stormwater management manuals detail very complex requirements, often comprising several volumes. The City has attempted to avoid including information that will not be frequently used in order to simplify this standard. As regulatory requirements pertaining to stormwater become more definite, we anticipate that this standard will be updated and additional detail added.

If additional clarification is required regarding acceptable design principles for hydrology, conveyance systems, flow control, or water quality control, then the following reference should be cited:

- Central Oregon Stormwater Manual
<http://www.coic.org/cd/stormwater/index.htm>

For further information on pipe and channel hydraulics, consult the following reference:

- Oregon Department of Transportation Hydraulics Manual
http://www.oregon.gov/ODOT/HWY/GEOENVIRONMENTAL/hyd_manual_info.shtml

4-6 Planning and Design Approval Process

4-6.1 Is a Stormwater Site Plan required for your project?

Stormwater Site Plans are required for developments as follows (see Figure 4-1):

- Imported fill will equal or exceed 250 cubic yards, or
- Excavation will equal or exceed 250 cubic yards, or
- 5,000 square feet of new impervious area or more will be added to the site (e.g. a new 5500 square foot parking lot replaces existing pervious area), or
- A total of 10,000 square feet of impervious area, will be added or reconstructed (e.g. a new 5500 square foot building addition on existing pervious area, plus 5,000 square feet of existing asphalt is removed and reconstructed) or
- Stormwater infrastructure will be constructed and dedicated to the City, or
- The site will be converted to one of the uses described in Section 4-14.3.

4-6.2 Planning-Level Reviews

If required by Section 4-6.1, a Stormwater Site Plan must be submitted for review and approval prior to planning-level approval (issuance of a development permit or decision) of the project. The Stormwater Site Plan will provide a planning- level concept for the development's drainage system and best management practices (BMPs).

4-6.3 Site Construction Permit

Prior to issuance of the site construction permit, the following items shall be submitted for review and approval by the City:

- A Stormwater Site Plan, if required by Section 4-6.1 (If the development was subject to planning-level review, a plan may have already been submitted and approved. If a plan has previously been submitted and approved, update the plan for changes made during design that will affect the conclusions of the report. For example, if basin areas or proposed impervious areas/land use change, update the projected flows and proposed conveyance facilities/BMPs. Changes to a plan must be approved by the City.),
- Final design drawings and specifications,
- Final design calculations as required by this standard or as requested by the City (e.g. final calculations for sizing pipes, channels, detention basins, etc.),
- Permits, easements, required agreements with other entities, and other submittals requested during review, and
- Proposed infrastructure agreements between the developer and the City regarding cost sharing, advance financing, etc. (These shall be in signed written form prior to the issuance of the Site Construction Permit).

4-6.4 Detailed Information Regarding Stormwater Site Plans

4-6.4.1 What is the purpose of a Stormwater Site Plan?

The purpose of the Stormwater Site Plan is to provide a planning- level concept for the development's drainage system and best management practices (BMPs). In general, existing and future conditions shall be analyzed and the applicant shall state how each of the requirements of this standard will be met. Major conveyance systems shall be tentatively sized and the approximate location of water quality and quantity facilities shall be established. Drainage easements to be dedicated shall also be tentatively identified. For multi-phase projects, the plan shall propose which facilities will be constructed within each phase and shall analyze the resulting flows.

A required table of contents is contained in Section 4-6.4.4.

4-6.4.2 Who can prepare a Stormwater Site Plan?

A Stormwater Site Plan must be prepared and stamped by an engineer licensed in Oregon and qualified to perform the work submitted within the plan. Wetlands delineations, geotechnical reports, surveys, and other specialized work shall be performed (and stamped or otherwise certified) by professionals licensed/certified to perform such work.

4-6.4.3 What portion of the site must be examined in the Stormwater Site Plan?

The Stormwater Site Plan must address stormwater runoff for the entire site, not just the areas where new construction is occurring. In some cases, retrofits to existing systems may be required. These are outlined in the design criteria.

4-6.4.4 Stormwater Site Plan Required Contents

The following outline describes the sections that must be included in a Stormwater Site Plan.

Project Overview: The project overview shall briefly describe the nature and goals of the project. A vicinity map shall be included to show the location of the project site.

Preliminary Conditions Summary: This section will include a topographical map and narrative describing existing drainage patterns of the site as well as the surrounding area. Sufficient adjoining area shall be included on the map to determine the existing stormwater movement in and onto the proposed development, as well as the areas downstream that may be impacted by development. The map shall indicate the total site acreage, existing land use, drainage courses, flow direction, basins (including hydrologic data used for existing runoff calculations), any existing development and/or drainage facilities, and information regarding areas such as wetlands that may require additional permits.

Proposed Improvements Summary: This section will include a map and narrative describing proposed improvements as relevant to the requirements of this standard. Include drawings as needed to show proposed topography, structures and impervious areas, basins, hydrologic data, flowpaths, existing and proposed drainage infrastructure and other Best Management Practices (BMPs) as required to demonstrate compliance. Sufficient adjoining area shall be included on the map to determine the relationship of the development to the preliminary conditions map.

Discharge Location: Where will the flows discharge? Are permits required? State how the project will satisfy the requirements of Section 4-10.

Off-Site Analysis: An offsite analysis shall be provided if requested by the City. Refer to Section 4-11.

Water Quantity: Is detention/retention required? State how the project will satisfy the requirements of Section 4-12.

Conveyance System: Will the proposed concept/design satisfy the requirements of Section 4-13? If not, state what variances are requested or are anticipated during the design process?

Water Quality: Is the site characterized by any of the criteria listed in Section 4-14.3? If so, how will water quality be protected?

Erosion Control: Is a grading and erosion control plan required for the site? Refer to Section 3 of this manual.

Maintenance and Operation: What infrastructure is proposed for dedication? For private infrastructure, who will be responsible for maintenance? What is the anticipated level and frequency of maintenance for water quality/quantity facilities? State how the project will satisfy any additional requirements of Section 4-16.

Financial Guarantees: Does the standard require financial guarantees for this site? State how the project will satisfy the requirements of Section 4-17.

Appendix A: Additional Permits: Attach all additional permits required by other agencies that are relevant to stormwater. For example, include DEQ 1200C Permits, DSL permits, etc. Provide a summary of any special or unusual conditions or mitigation required as part of these permits. If permits are currently under review, or will be obtained later in the

development process, state which permits will be obtained, for what purpose, and when they will be obtained. The applicant may be required to submit copies of permits prior to issuance of the Site Construction Permit.

Appendix B: Additional Calculations: Attach any calculations that were too detailed to include within the text. Additional appendices may be added to separate calculations. Calculations shall be clearly labeled to help expedite the review process. Enough detail must be included so the calculations can be independently verified.

4-6.4.5 Criteria for Approval of the Stormwater Site Plan

Due to variations in site complexity and stormwater impacts, the amount of work involved in preparing a Stormwater Site Plan will vary greatly. The detail of the plan must be commensurate to the complexity of the site. The criteria for approval is that the plan must be detailed enough to convey to the reviewer that the proposed design concept is feasible and will meet City standards if designed appropriately.

4-6.4.6 How long is a Stormwater Site Plan valid?

A Stormwater Site Plan is valid for a period of one year following the date of its approval. At the end of that time, if final design drawings have not been approved and substantial site grading or construction of stormwater infrastructure is not completed, then the Stormwater Site Plan approval shall be null and void and become effective only if resubmitted to The City and again approved. The site plan and design drawings shall be subject to the standards effective at the time the Stormwater Site Plan was most recently submitted for review. Phases of the project that are actively under construction or have been previously completed and accepted are not subject to revisions of this standard unless additional development is proposed that requires submittal of a new Stormwater Site Plan.

4-6.5 Submitting Design Drawings and Specifications

4-6.5.1 Preliminary Drawings

As part of the Site Construction Permit process, the City strongly encourages applicants to submit 60% and 90% design documents (and required calculations) for review. This will reduce the need for applicants to make significant design changes later in the review process.

Preliminary drawings may be prepared on any type of material that is easily reproduced in-house (i.e. Xerox, velum, sepia, etc.) Line work should be of sufficient quality to reproduce clearly. The City will determine drawing size and number of copies for City review.

4-6.5.2 Final Design Drawings

Prior to issuance of the Site Construction Permit, final design and construction documents shall be submitted to the City for review and approval. Approval will not be granted until the City has been satisfied that the requested design modifications have been made. The design submittal shall include all drawings, specifications and supporting calculations needed to verify that the proposed stormwater system aligns with the concepts approved in the planning-level review and meets the City's design standards as specified herein.

The City will not accept any new infrastructure constructed prior to issuance of the Site Construction Permit, or infrastructure not inspected at the site and certified by the City as meeting the required standards.

Final design drawings shall be prepared on translucent velum, sepia, or Mylar with the appropriate professional stamp. Final drawings shall be full-size unless approved by the City. Graphical representations of dedicated infrastructure on final design drawings must meet City Drafting Standards (Refer to Section 10). Capital improvement projects shall use the standard City title block and drawing format. Land development projects with dedicated infrastructure shall use the City supplied signature block on every drawing submitted (see Dwg. 10-100).

4-6.5.3 Record Drawings

Record drawings are required for stormwater infrastructure that will be dedicated to the public. Prior to City acceptance of the improvements, the contractor shall supply the City with record drawings of the installation. The contractor shall make all changes to the record drawings as directed by the inspector before the City will approve and accept the project.

All final record drawings shall be ink on polyester (Mylar) base drafting film at least .003 inch thick and coated for drafting on both sides. Graphical representations of dedicated infrastructure must meet City Drafting Standards (refer to Section 10). Standard City of Klamath Falls title block and drawing format shall be used.

Submitted drawings shall be on Mylar as well as in electronic format (refer to SECTION 10). Final record drawings shall be stamped or otherwise marked as such, indicating the date of their preparation. Graphical representation of final electronic drawings submitted with Mylar drawings shall match. Digital files that do not agree with the Mylars will be returned and corrected at no cost or liability to the City.

4-6.5.4 Required information on Final Design Drawings and Record Drawings

Plans shall show inlet and outlet invert elevations at catch basins, manholes, ditch inlets, culverts, outfalls, and changes of grade or cross section. Manhole and catch basin rim and grate elevations, and pipe and channel slopes shall also be shown. Pipes shall be labeled with material and diameter. Channels shall be labeled with side slope, depth and lining material. Spot elevations and/or contours shall be included as required to show the direction of sheet and concentrated flows. The profile view shall show the existing and finish ground elevation over the pipe, as well as crossings of other existing or proposed utilities. Details of connections to the existing drainage system shall also be shown. Record Drawings shall clearly identify deviations from final design drawings using the standards established in Section 10 of this manual.

4-7 Public Works Review and Inspection Procedures and Fees

Review and inspection fees and procedures are described in Section 2 of this manual. Fixed fees are charges for review and inspection of private infrastructure. Hourly-rate fees apply to inspection of dedicated infrastructure.

City inspectors will inspect the following items relative to stormwater management:

- All infrastructure that will be dedicated to the public,
- Work within a public right of way or property deeded to the City,
- Erosion control measures (see also Section 3 of this manual),

- Private stormwater infrastructure and best management practices for compliance with the Stormwater Site Plan and approved drawings.

4-8 Deviations from Standards

As stated previously in Section 1 of this manual, "It is not the intent of this manual to limit the ingenuity of engineers." This is particularly true with the design and implementation of stormwater facilities. As more focus is placed on stormwater, many new technologies and designs are emerging. Engineers are encouraged to make use of these new technologies and designs. However, due to the need to ensure effective performance of a design, deviations from these Design Standards must be submitted as specified in Section 1. The burden of proof is on the applicant to demonstrate that a design will "produce a better result that is in every way adequate for the City and its residents."

4-9 Hydrologic and Hydraulic Analysis Methods

This section provides a brief overview of the acceptable methods for hydrologic and hydraulic analysis. Methods not specified in this section shall be in accordance with the methods specified in the Central Oregon Stormwater Manual (<http://www.coic.org/cd/stormwater/index.htm>) for additional guidance on acceptable methods for hydrologic and hydraulic analysis.

Imported water, including irrigation water from previous agricultural use, shall not be included in the existing runoff quantity because it does not typically correspond with the anticipated peak runoff from a design storm under existing conditions.

4-9.1 Acceptable Methods for Determining Design Flows and Volumes

The following table summarizes the standard methods for determining design flows and volumes. Alternate methods will be considered on a case by case basis.

Application	Method
Sizing conveyance systems with a tributary area less than 10 acres, if the attenuation effects of existing storage are ignored. The rational method may be used to size detention facilities with tributary areas less than 5 acres utilizing the "Bowstring Method" as described in the Central Oregon Stormwater Manual.	Rational Method using ODOT Zone 10 IDF Curves
All other analyses, except as approved by Public Works.	Approved hydrograph techniques such as the Soil Conservation Service Unit Hydrograph (SCSUH or SCS TR-55) or Santa Barbara Urban Hydrograph (SBUH) method. Use level pool routing and SCS Type I storm (same type as used by Klamath County)

4-9.2 Design Storm Volumes

Recurrence Interval	24-Hour Storm Depth (Inches)	Comments
2-Year	1.8	
10-Year	2.1	
25-Year	2.6	
100-Year	3.0	Size detention overflow to pass this storm.
Water Quality Design Storm	0.5	Use for designing water quality BMPs. Install bypass for additional flows.

4-9.3 Soil Information

Hydrologic soil groups shall be determined from the SCS Soil Survey of Klamath County or as determined by a soils report prepared by a qualified professional engineer or geologist.

4-9.4 Curve Numbers and Runoff Coefficients

Curve numbers and runoff coefficients shall be selected from the Central Oregon Stormwater Manual. For undeveloped rangeland areas, the curve numbers shall be selected from "Runoff curve numbers for arid and semiarid rangelands." Choices of curve numbers are subject to City approval.

4-9.5 Time of Concentration

The time of concentration shall be calculated using the methods shown in the Central Oregon Stormwater Manual. Separate times of concentration shall be calculated for the predevelopment and developed conditions (including intermediate development phases as applicable to the project).

4-9.6 Analysis Methods for Sizing Conveyance System Components

Standard engineering practice is required. For hydraulic analysis methods, consult engineering textbooks, the Oregon Department of Transportation (ODOT) Hydraulics Manual, and the Central Oregon Stormwater Manual.

4-10 Select Appropriate Discharge Location

All surface and stormwater runoff from a development that proposes to construct new or modify existing drainage facilities must be piped to discharge directly into the City storm drainage system or other approved discharge location, if a City storm drain is not available. Sites without available City storm drain shall discharge at the natural location so as not to divert flow onto or away from the adjacent downstream property. Discharge from the proposed project must be designed to produce no significant adverse impact to the drainage system of the downhill property (refer to Section 4-11). Outfalls to natural drainages or ditches shall have energy dissipaters. A "bubble

up” catch basin or curb drain (depending on site conditions) may be required for discharge to City streets.

Where no existing conveyance system (either piped or open channel) exists at the adjacent downstream property line of the development and the discharge was previously unconcentrated flow OR if discharge to the existing conveyance system (pipe, natural drainage, ditch, etc.) will produce a significant adverse impact (e.g. increased erosion, refer to Section 4-11), the developer shall install a conveyance system across the downstream properties to an acceptable discharge point with drainage easements secured from the downstream owners and recorded prior to issuance of the Site Construction Permit.

Discharge across sidewalks and streets is prohibited because ice formation will result in a safety hazard.

4-11 Perform Off-Site Analysis

Some proposed developments may create new or aggravate existing water quality and quantity problems downstream of the site that will have significant impact to the City and its residents. If requested by the City, a proposed project shall evaluate drainage system problems (ponding water, flooding, high flows, siltation, erosion, poor water quality, etc.) upstream, on-site, and downstream of the proposed project. The design engineer shall demonstrate that the proposed project has been designed so that it neither aggravates (increases the magnitude, frequency, or duration of) an existing drainage problem nor creates a new drainage problem.

4-11.1 Levels of Analysis

The level of analysis required will vary depending on the specific site and drainage system conditions. If required by Section 4-11, the applicants shall first submit a qualitative evaluation of the site. Upon review of the qualitative analysis, the City may request additional quantitative analyses as required to determine the required level of mitigation.

4-12 Control Water Quantity

Water quantity control is required for all developments that add over 10,000 square feet of new impervious area. The base requirement for water quantity control is to construct detention or retention as required to limit runoff from new impervious area to a rate less than or equal to the existing peak flow for a 25-year, 24-hour storm under predevelopment conditions. For sites adding less than 10,000 square feet of new impervious area, detention may be required if, in the opinion of the City, the downstream pipe or drainage course does not have sufficient capacity to convey the design storm.

4-12.1 Additional Detention/Retention Requirements

The City may impose additional requirements for sites where existing downstream erosion or flooding problems may be aggravated due to increased total runoff volume or in basins with no outlets or containing wetlands (refer to Section 4-11). The additional required measures may include:

- Additional detention capacity and multiple restrictors to further control peak flows to a level that will not adversely impact downstream infrastructure and/or property. Retention of stormwater rather than detention, or a combined detention/retention system to limit discharge to a predevelopment volume.

- Developer may be required to install a security fence around the perimeter of the Detention Pond, prior to City acceptance of the project, which is in compliance with City of Klamath Falls Code and Community Development Ordinance pertaining to fences. The developer will apply to City Planning for a fence permit. (This needs to be placed on the plans either in the General Notes or on the sheet showing the pond.)

4-12.2 Analysis Methods

Analysis methods for sizing shall be consistent with Section 4-9 and standard engineering practice. Imported water shall not be included in the existing runoff from the site. The applicant shall submit clearly labeled calculations including:

- Hydrologic parameters and source(s) of data
- Analysis methods used
- Additional assumptions made (infiltration rates may require field tests, consult Public Works before proceeding)
- Spreadsheet, printouts, or hand calculations
- Results (required volume, orifice size, stage discharge curve for hydrograph methods, etc.)

Event simulations such as those specified in Section 4-9.2 overestimate the existing runoff from sites that consist mainly of rangeland, pasture, or forest. A correction factor of 10% shall be added to the calculated storage volume to determine the actual design storage volume, if 50% or more of the site is currently pervious (e.g. rangeland, pasture, or forest). The additional volume shall be added by increasing the surface area at a given water surface elevation rather than increasing the depth (e.g. add surface area to ponds or length to piped storage without increasing the maximum water surface elevation above the control orifice).

4-12.3 Submittal Requirements

The engineer shall submit the calculations used to determine the existing flow, developed flow, and detention volume.

4-12.4 Ponds

Detention ponds are the most desirable alternative for detention facilities for water quality benefits, relative ease of inspection and access for maintenance. The City encourages the design of conjunctive use detention ponds that can serve multiple purposes of recreation (such as playgrounds and picnic areas), wildlife habitat (wetlands areas) and aesthetics (landscaping to provide for a natural appearance). Conjunctive use ponds must meet all the requirements of the purposes they are required to perform. In conjunctive use ponds incorporating recreational facilities, the recreational facilities must be designed in a manner compatible with the stormwater functions and maintenance standards. Detention ponds may also include wetponds to improve water quality.

Refer to the Community Development Department for landscaping requirements. Landscaping materials shall be selected to minimize the potential for washing sediment or debris downstream.

4-12.5 General Pond Requirements (including wetponds, dry ponds, and retention ponds)

- Side slopes shall not be steeper than 3:1 unless approved by the City.
- Maintenance access shall be provided to the pond as required to meet long-term maintenance requirements.

A maintenance ramp to the bottom of the pond shall be included in the design unless alternate provisions have been made for access and maintenance.

4-12.6 Detention Tanks and Vaults and Underground Pipe Storage

Detention tanks and vaults are underground facilities for the storage of surface water. Tanks are typically constructed of corrugated pipe and vaults are constructed of reinforced concrete. Tanks and vaults provide less water quality benefit (biofiltration and biologic activity). Therefore, incorporating biofiltration into the drainage design is encouraged.

Underground storage facilities shall be designed to fully drain (except for sediment capturing sumps) within 48 hours of the design rain event. .

4-12.7 Private Parking Lot Ponding

Private parking lots may be used to provide detention volume. The following guidelines apply:

- The depth of water detained cannot exceed 0.5 feet at any location in the parking lot, and
- The minimum gradient of the parking lot area subject to ponding shall be 1.5 percent, and
- The emergency overflow path will not create a hazard, and
- Fire lanes used for emergency equipment shall be free from standing water.

4-12.8 Retention

Usually, retention facilities will not be a cost-effective means for providing peak rate runoff control, but rather are employed to control the increased volume of runoff from a proposed project as required to mitigate the findings in Section 4-11. The following are examples where the City may require the applicant to evaluate the feasibility of incorporating infiltration into the design:

- The proposed project discharges to a closed depression,
- The proposed project discharges to a severely undersized conveyance system that restricts the runoff volume that can be accommodated,
- The project discharges to a drainage course with an existing erosion problem, and
- The project discharges to a water body that is sensitive to volume fluctuations.

4-12.9 What site conditions are favorable for utilizing infiltration?

- Sites with permeable soils (consult Soil Conservation Service soil maps and verify rates through field testing), or

- Sites where infiltrated water will not contaminate ground water resources (Refer to Section 4-12.10), or
- Sites where infiltration will not result in a slope stability hazard (consult a geotechnical engineer and submit his/her report).

4-12.10 UIC (Underground Injection Control) Rules

The City of Klamath Falls Water Department is dependent on groundwater to supply the drinking water system. The City's groundwater resource is an extremely valuable asset considering the expense that would be involved in acquiring, treating, and distributing surface water. The injection of pollutants (such as heavy metals, toxic organics, volatile organic compounds, nutrients, pesticides, salts, and organics) that are common in storm water, mobile through the unsaturated soil zone, and persistent in groundwater has the potential to contaminate groundwater sources. In Oregon, 19 drinking water suppliers have lost the use of their wells due to contamination associated with use of Class V injection systems (e.g. sumps and drywells. In an effort to protect groundwater resources statewide and comply with the Safe Drinking Water Act, Oregon DEQ has adopted a policy on underground injection control. This policy classifies types of infiltration facilities and requires permitting of many facility types. Consult the DEQ water quality website (<http://www.deq.state.or.us/wq/uic/uic.htm>) or the Bend DEQ office ((541) 388-6146) for more information.

Developers designing infiltration facilities must demonstrate they have complied with the UIC rules.

4-13 Design Conveyance Systems

4-13.1 Overview

This section covers design criteria for design of the following components of the conveyance system:

- Pipe systems,
- Inlets,
- Culverts,
- Outfalls, and
- Open channels.

4-13.2 When do these standards apply?

The design criteria outlined in this section apply to the following types of proposed improvements:

- All new infrastructure that will be dedicated to the City and located within property deeded to the City or right-of-way, or
- New on-site storm water conveyance systems or improvements to existing on-site storm water infrastructure, with a tributary area greater than 5,000 square feet, or
- Connections to publicly owned storm water systems, or

- Outfalls or culverts in natural drainage courses, or
- Alterations or modifications to a natural drainage course, or
- Modifications to an existing roadway ditch (except routine maintenance).

4-13.3 Submittal Requirements

Submit calculations showing how infrastructure was sized. Briefly describe the methods used. Enough information must be included so the design can be independently verified. Submit design drawings in accordance with Section 4-6.5 detailing the proposed system. Refer to Section 4-9 for analysis methods.

4-13.4 Design Flow

All existing and proposed conveyance systems shall be designed to convey runoff from the 25-year storm unless approved or requested otherwise by the City. Bypasses shall be provided around water quality facilities for flows exceeding the water quality design storm.

A backwater analysis may be required for a proposed or existing pipe system if the ability of the pipe system to convey the peak rate of runoff from the 25-year design storm event may be affected by tail water conditions anywhere in the pipe system.

Structures such as catch basins (except as part of parking lot detention) and manholes for proposed pipe systems must provide a minimum of 0.5 feet of free board between the headwater surface (hydraulic grade line) and the top of the structure for flow from a 25-year storm. However, structures may overtop for the 100-year storm provided that the roadway section provides a safe floodway to convey the flow to a discharge point at a natural drainage course.

4-13.5 General Design Route Requirements

The most efficient route selected for new conveyance systems will result from careful consideration of the topography of the area to be traversed, the legal property boundaries, and access for inspection and maintenance. The general requirements for route design are as follows:

- Proposed new conveyance systems should be aligned to emulate the natural conveyance system to the extent feasible. Inflow to the system and discharge from the system should occur as determined by topography and existing drainage patterns. (Refer to Section 4-10 for discharge location requirements.)
- For developments discharging to an existing natural drainage course, detention shall be provided prior to discharge to the open drainage. The reason for this is to protect the existing drainage from erosion due to increased runoff.
- The developer shall not pipe existing natural drainages except where required for culverts at road crossings. The reason for this policy is to decrease long-term maintenance costs associated with large storm water pipes, and the capital costs associated with increasing downstream peak flows. Exceptions may be made on a case by case basis if the city determined that piping a natural drainage is the only feasible engineering solution. In cases where piping is allowed, the city will require that:
- A DSL/COE permit is acquired (if applicable to site conditions)

- The pipe is sized for a 25-year storm with build-out of all phases of development, and existing upstream flow from other tributary area.
- A safe pathway is provided for the 100-year storm that protects life and property.
- Vehicle access is provided to all structures requiring maintenance on all-weather paved or gravel surfaces.
- The infrastructure is dedicated to City and is located in a dedicated right-of-way or deeded property conveyed to the City.
- Drainage easements shall be located entirely on one property and not bisected by a lot line. Natural drainages shall not be relocated to meet this requirement.
- Roof drains shall not be connected to the sanitary sewer. Designers are encouraged to discharge roof drains to landscaping areas.
- Geothermal discharges to the stormwater system are prohibited

4-13.6 Pipe Systems

Pipe systems are networks of storm drain pipes, catch basins, manholes, inlets, and outfalls designed and constructed to convey storm and surface water. The hydraulic analysis of flow in storm drain pipes is typically limited to “gravity flow.” The following subsections give design criteria for different components and aspects of pipe systems.

4-13.6.1 Pipe Materials

Pipe material specifications, joints, gaskets, and protective treatment for public and private systems shall conform to the requirements set forth in APWA Standard Specifications except as amended below.

Publicly maintained pipe systems, or pipes within the right-of-way (except driveway culverts)

Pipe Diameter (Inches)	Depth (Feet)	Material
8 to 12	D<10 feet	PVC or HDPE (water tight)
8 to 12	D>= 10 feet	Reinforced Concrete
15 to 21	D<10 feet	Reinforced Concrete or HDPE (water tight)
15 to 21	D>= 10 feet	Reinforced Concrete
24 and over	Any	Reinforced Concrete

Culverts (Public or Private)

- HDPE, reinforced concrete, galvanized corrugated steel pipe, or galvanized aluminum installed per manufacturer's specifications.

4-13.6.2 Pipe Sizes, Slopes, and Velocities

- No storm drain pipe in the public right-of-way shall be less than 12 inches in diameter, except that private connections to public catch basins and manholes may be 6 inches or larger. Minimum size of culverts shall be 18 inches within the public right-of-way unless approved by the City.
- The minimum velocity in any pipe or culvert flowing full shall be 3.0 feet per second.
- Minimum slopes are as follows (Note that for pipe with $n > 0.012$, these slopes will not meet minimum velocity requirement):

<u>Pipe Size (Inches)</u>	<u>Minimum Slope (feet per 100 feet)</u>
12	0.37
15	0.27
18	0.22
21	0.18
24	0.23
27	0.13
30	0.11
36	0.09
42	0.07
48	0.06

- The maximum allowable velocity at design flow in any pipe shall be 30 feet per second.
- Pipes on slopes steeper than 20 percent must be anchored as shown in standard drawing 4-125.
- Downstream decrease in pipe size is not a recommended practice and will only be allowed under special conditions.

4-13.6.3 Pipe Alignment/Cover

- Maximum deviation from established line and grade shall not be greater than 1/32 inch per inch of pipe diameter and not to exceed 1/2 inch per pipe length. The difference in

deviation from established line and grade between two successive joints shall not exceed 1/3 of the amounts specified above.

- Minimum cover for storm drain pipe is 2 feet, except that 3 feet of cover is required for PVC and HDPE pipe. PVC and HDPE pipe shall not be exposed where damage may occur from ditch cleaning, fire, or traffic.
- 6 inches minimum vertical and 3 feet minimum horizontal clearance (between outside surfaces) shall be provided between storm drain pipes and other utility pipes and conduits, except for the greater separation to water lines as required by Oregon law.
- Trench excavation, bedding, backfill, and pavement repair shall conform to the City standard drawings for these items.
- In addition to testing by pulling of mandrel through the stormwater line, stormwater infrastructure that is either proposed for dedication to the City of Klamath Falls or required by formal agreement for potential dedication to the City of Klamath Falls shall be televised prior to acceptance by the City. The cost for storm sewer televising shall be \$0.40 per foot paid to the City of Klamath Falls.

4-13.6.4 Manholes and Catch Basins

- Catch basins shall be spaced as required to prevent ponding or flooding of the roadway during the design storm (except as allowed for parking lot detention). The ODOT Hydraulics Manual methodology shall be used to determine catch basin spacing.
- Catch basins or manholes shall be located at all changes in pipe slope, alignment or size. At a minimum, a catch basin or manhole shall be located every 400 feet for 12 inch to 18 inch diameter and 500 feet for 21 inch diameter and larger pipe. All catch basins and manholes shall be accessible to maintenance vehicles.
- Connections to a pipe system shall be made only at catch basins or manholes except as approved by the City. No wyes or tees are allowed except on roof, footing, or yard drain systems on pipes 8 inches in diameter or less, with clean-outs upstream or each wye or tee.
- Connections to existing catch basins and manholes shall be similar to those required in Section 5 of this manual for connection to existing sewer manholes.
- Any closed storm drainage system collecting runoff from paved areas within the public right-of-way or private property shall provide a pollution control manhole, a pollution control catch basin, or other approved floatable material separator prior to discharge to the main storm drainage system.
- Catch basins and manholes are not allowed in a fill section unless the base is on a cut section or in well compacted fill. A catch basin or manhole shall be provided within 50 feet of the entrance to a pipe system to provide for silt and debris removal.
- Manholes and catch basins shall be constructed of pre-cast units in accordance with the Standard Drawings (refer to SECTION 11).
- Catch basin (or manhole) diameter shall be determined by pipe size and orientation at the junction structure. A plan view of the junction structure, drawn to scale, will be required

when more than four pipes enter the structure on the same plane, or if angles of approach and clearance between pipes is of concern. The plan view (and sections if necessary) must insure a minimum solid concrete wall distance between pipe openings of 8 inches for 48 inch and 54 inch catch basins and 12 inches for 72 inch and 96 inch catch basins. Evaluation of structural integrity for H-20 loading may be required for multiple junction catch basins and other structures.

- All pre-cast concrete shall be Class 5000. All other concrete shall be a minimum of Class 3000.
- Standard pre-cast manhole cones shall provide reduction to a 24 inch diameter entrance with grade rings not less than 2 inches or more than 12 inches in height. Standard flat slab covers shall be a minimum of 8 inches thick and shall conform to the outer dimension of the standard sections upon which they are to be placed.
- The maximum slope of the ground surface for a radius of 5 feet around a catch basin grate shall be 3:1.
- All manholes or catch basins shall have a minimum drop of 0.10 feet between the inlet invert and the outlet invert to account for energy losses.
- Connections to new or existing manholes and catch basins shall be as shown in the Standard Drawings (refer to SECTION 11). The contractor shall verify all invert elevations of existing manholes and catch basins prior to construction. The contractor shall submit any required changes to the approved design for review and approval by the City. The contractor shall core drill an opening to match the size of pipe to be inserted. Jackhammers shall not be used. All openings must provide a minimum of 1 inch and a maximum of 2 inches clearance around the outside circumference of the pipe.

4-13.6.5 Frames/Lids/Grates/Covers

- In general, frames and grates shall be furnished as shown in the Standard Drawings.
- The cover or grating of a manhole or catch basin shall not be grouted to final grade until the final elevation of the pavement, gutter, ditch, or sidewalk in which it is to be placed has been established, and until permission thereafter is given by the City to grout the cover or grating in place.
- Lids, grates, and covers shall be seated properly to prevent rocking.
- The City may require locking frames and lids or grates in some conditions.
- Round lids on all storm drain structures shall have "Storm Drain", "Drain", "and Storm" or "SD" cast into the lid. Lids marked to denote sanitary sewer are NOT allowed, on storm drains.

4-13.6.6 Restrictor Devices

- The minimum orifice size diameter allowed for use in the City of Klamath Falls is one inch.

4-13.6.7 Debris Barriers

Debris barriers (trash racks) are required on all pipes entering a closed pipe system, including pipes entering or leaving a control/restrictor manhole or catch basin from a surface-type BMP (detention pond, infiltration basin, wetpond, biofiltration swale, etc.)

4-13.7 Pump Stations and Forcemains

Due to maintenance concerns, pump systems (includes the pumps, force mains, electrical equipment, structures, and appurtenances) are not allowed for publicly maintained storm water systems unless approved by the City. In the event that a new storm water pump station within the publicly maintained system will be added or retrofitted, the developer will be required to meet City requirements for pump types, configuration, instrumentation and controls, and startup and testing.

4-13.8 Culvert Design Criteria

4-13.8.1 Headwater

- For new culvert 18 inches in diameter or less, the maximum allowable 25-year design storm headwater elevation (measured from the inlet invert) shall not exceed two times the pipe diameter/arch culvert height used and shall be one foot or more below the road or parking lot subgrade.
- For new culverts larger than 18 inches in diameter, the maximum 25-year design storm headwater elevation for the new culvert shall be one foot or more below the road or parking lot subgrade.

4-13.8.2 Inlet

- For culverts 18 inches in diameter and larger, the embankment around the culvert inlet shall be protected from erosion as specified in the table below or utilizing the methodologies specified in the Central Oregon Stormwater Manual: :

Design Flow Velocity Upstream of Inlet (fps)	Required Protection (Minimum Dimensions)				
	Type (refer to APWA Specifications)	Thickness	Width	Length Upstream of Culvert	Height
0-5	Riprap Class 50 with filter blanket or riprap geotextile	1 ft	Diameter + 6 ft	5 ft	Design Headwater
>5 – 10	Riprap Class 100 with filter blanket or riprap geotextile	1 ft	Diameter + 6ft or 3X diameter, whichever is greater	5 ft	Design Headwater
>10	Gabion or Concrete	Site-specific design by qualified engineer			

- Trash racks/debris barriers are required on culverts that are over 60 feet in length and that are 18 inches to 36 inches in diameter.
- In order to maintain the stability of roadway embankments, concrete headwalls, wingwalls, or tapered inlets and outlets may be required if right-of-way and/or easement constraints prohibit the culvert from extending to the toe of the embankment slope. Normally, concrete inlet structures/headwalls installed in or near roadway embankments must be flush with and conform to the slope of the embankment.

4-13.8.3 Outlets

The receiving channel at the outlet shall be protected from erosion by rock lining, as specified in the table below:

Design Flow Discharge Velocity (fps)	Required Protection (Minimum Dimensions)				
	Type (refer to APWA Specifications)	Thickness	Width	Length Downstream of Culvert	Height
0-5	Riprap Class 50 with filter blanket or riprap geotextile	1 ft	Diameter + 6 ft	8 ft or 4X Diameter, whichever is greater	Max. tailwater elevation + 1 ft or Crown + 1ft, whichever is greater
>5 – 10	Riprap Class 100 with filter blanket or riprap geotextile	1 ft	Diameter + 6ft or 3X diameter, whichever is greater	12 ft or 3X diameter, whichever is greater	Max. tailwater elevation + 1 ft or Crown + 1ft, whichever is greater
>10	Gabion, grouted riprap or other material as approved by the City	Site-specific design by qualified engineer			

4-13.9 Outfall Design Criteria

4-13.9.1 General

- Outfalls shall discharge to locations as specified in Section 4-10.
- All outfalls (at a minimum) shall be provided with rock protection as specified in Section 4-13.8.3.
- Mechanisms which reduce velocity prior to discharge from an outfall are encouraged.
- Engineered energy dissipaters, including stilling basins, drop pools, hydraulic jump basins, baffled aprons, and bucket aprons, are required for outfalls with velocity at design flow greater than 20 fps.

- Inlet control will usually dictate outfall pipe system capacity. The inlet conditions should be carefully examined, as well as the consequences should the inlet to the pipe system become plugged or capacity exceeded.

4-13.9.2 Outfall Systems Traversing Steep Slopes

- Outfall systems constructed of pipe segments which are banded and/or gasketed are not acceptable for traversing steep slopes.
- Continuously fused, welded or flange bolted mechanical joint pipe systems (such as ductile iron pipe with flange-bolted mechanical joints) with proper anchoring shall be used for outfall systems traversing steep slopes.
- In general, outfall pipes systems shall be installed in trenches with standard bedding on slopes up to 20 percent. On slopes greater than 20 percent, outfall pipe systems shall be placed on the ground surface with proper pipe anchorage.
- Flows of very high energy will require a specifically engineered energy dissipater.

4-13.10 Open Channel Design Criteria

Open channels, either natural or constructed, may be used to convey storm water on and from a site. However, many of the natural drainage courses within Klamath Falls are susceptible to erosion from increases in flow (magnitude and/or duration). The applicant may be required to provide additional quantity and quality controls in order to discharge to a natural drainage course. Altering the flowpath or piping natural drainage courses through a site is discouraged. However, proposals to relocate or otherwise alter natural drainage courses will be reviewed on a case by case basis.

Constructed channels are those built in upland areas specifically to convey storm and surface water. In general, the criteria in this section do not apply to biofiltration swales, which are primarily designed to treat storm water runoff.

When constructing channels, vegetation-lined channels are preferred when properly designed and constructed. Rock-lining may be necessary along the length of channels or at specific locations (such as bends and outfalls) when a vegetative lining will not provide adequate protection from erosive velocities.

4-13.10.1 Constructed Channel Design Criteria

- Channels shall be designed to provide required conveyance capacity while minimizing erosion and allowing for aesthetics and preservation of riparian habitat.
- Channel section geometry shall be trapezoidal. Side slopes shall not be steeper than 3H:1V for vegetation-lined channels and 2H:1V for rock-lined channels, unless the channel is engineered specifically for steeper slopes.
- Vegetation-lined channels shall have bottom slope gradients of 6 percent or less and a maximum average velocity at the design flow of 5 fps.
- An established grass, vegetated lining, erosion control matting, or other approved erosion control measure (e.g. riprap) is required before the channel can be used to convey storm water.

- If the design velocity of a channel to be vegetated by seeding exceeds 2 fps, a temporary channel liner (erosion control matting) is required.
- A filter blanket or riprap geotextile is required for rock lined channels.
- The table below summarizes required channel type and freeboard by design velocity (as an alternative design method, engineers may use the methodology specified in the Central Oregon Stormwater Manual):

Velocity at Design Flow (fps)	Channel Type	Min. Height Above Design Water Surface
0 – 5	Grass lining / Bioengineering	0.5 ft
>5 – 8	Riprap / Bioengineering	1 ft
>8 – 12	Riprap	2 ft
>12	Site specific design approved by the City	

4-13.10.2 Riprap Lining Design

Engineers designing riprap lined channels shall follow procedures developed by the Army Corps of Engineers for selecting the median stone size and gradation of riprap. Refer to the Army Corps of Engineers Manual EM 1110-2-1601 (1970) "Hydraulic Design of Flood Control Channels." Additional information can be found in a paper by Maynard, et al. in the *Journal of Hydraulic Engineering* (A.S.C.E.) July 1989. As an alternative, engineers may use the design method specified in the Central Oregon Stormwater Manual. Filter Blankets and Riprap Geotextile

Riprap shall be underlain by a sand and gravel filter (or geotextile fabric) to keep the fine materials in the natural or artificial channel from being washed through the voids in the riprap. Likewise, the filter material must be selected so that it is not washed through the voids in the riprap. For additional information and procedures for specifying filters of riprap and general guidance, refer to the Army Corps of Engineers Manual EM 1110-2-1601 (1970) "Hydraulic Design of Flood Control Channels."

4-13.11 Drainage Easements and Access

- Piped drainage systems that will be maintained by the City shall be centered in a dedicated public right-of-way or within deeded property conveyed to the City. The width of the right-of-way or property shall be a minimum of 16 feet or twice the depth of the pipe invert, whichever is greater. Vehicle access on an all-weather paved or gravel surface shall be provided to all structures requiring maintenance.

- For open channels, a maintenance access easement, 16 feet wide (minimum) is required along all publicly maintained channels located on private property. However, required easement widths and building setback lines may vary with channel top width. A minimum 25 foot setback must be provided between any structures and the top of the bank of the channel.
- Drainage easements (open channels) shall not be bisected by a lot line. In general, the City does not allow open channels through residential lots. Specific requests will be reviewed by the Public Works Director on a case-by-case basis.
- Shared private pipes must be located within private drainage easements.
- Easements for downspout roof drains, yard drains, and footing drains are not required unless these systems are shared by more than one property owner.

4-14 Control Water Quality

As runoff passes through urban areas, it collects and transports pollutants to downstream receiving waters. Common urban pollutants include:

- Sediment (from erosion),
- Heavy metals (lead, copper, zinc, and cadmium),
- Nutrients (phosphorous and nitrogen),
- Bacteria and Viruses, and
- Organics (oil, grease, hydrocarbons, pesticides, solvents)

4-14.1 How can site design reduce pollution?

Generally site design can reduce pollution by two mechanisms:

- Source Control BMPs: Eliminating exposure of pollutants to storm water (e.g. covering bulk material storage so it is not exposed to storm water), and
- Treatment BMPs: Treating storm water to remove pollutants (e.g. installing a treatment swale or other treatment BMP).

4-14.2 What is required?

The City encourages designers to incorporate best management practices to treat storm water runoff into site design. Use of vegetated swales or other BMPs incorporated into parking lot landscaping to treat runoff is highly recommended. Incorporating treatment into quantity control facilities is also recommended.

Except as specified in Section 4-14.3 (Site Uses/Characteristics Requiring Source Control BMPs), Section 4-15 (Perform Erosion Control), and as needed to meet the requirements of Section 4-11 (Perform Off-Site Analysis), water quality BMPs are not required at this time.

4-14.3 Site Uses/Characteristics Requiring Source Control BMPs

Source control BMPs may be required for the site uses / characteristics listed below. Consult Public Works if any of these apply to your site. Specific requirements will be developed on a case by case basis. Guidance will generally be taken from *Central Oregon Stormwater Manual*. Structural controls will be emphasized due to their permanent nature.

The following site uses/characteristics require source control BMPs:

- Fuel dispensing facilities: Places where fuel is transferred from bulk storage tanks to vehicles, equipment, and/or mobile containers (including fuel islands, above ground fuel tanks, fuel pumps, and the surrounding pad).
- Exterior storage of liquid materials: A place where one or more above-ground storage tanks are used for outside storage of any type of liquid chemicals, waste oils, solvents, petroleum products, or food product.
- Storage, use and transportation of hazardous/toxic materials: A place where the total quantity of stored or transported toxic compounds, confirmed carcinogens, halogenated solvents, or chemicals with a pH less than 6.0 or greater than 9.0 is expected to exceed 200 gallons or 1,000 pounds.
- Exterior storage of bulk materials: Non-contained storage of materials that may adversely affect water quality. Examples are fertilizers, scrap and recycling materials, food items and wastes, soil and sand stockpiles, other raw materials and byproducts.
- Material transfer areas/loading docks: An area designed to accommodate a truck/trailer being backed up to or into them and used specifically to receive or distribute materials to/from trucks/trailers. This includes loading/unloading facilities with docks, and large bay doors without docks.
- Sites with existing or proposed interior floor drains.
- Vehicle or equipment washing facilities: Areas designated for equipment or vehicle washing or steam cleaning.
- Storm water disposal from development on a contaminated site: Land that currently or previously has had pollutants detected in the soil or groundwater at concentrations that exceed state/federal cleanup standards.
- Non-contained exterior solid waste storage areas.
- Discharge of geothermal water to storm water system.

4-14.4 General Principles of Source Control

- Eliminate pathways that may introduce pollutants to storm water,
- Capture acute releases and reduce chronic contamination,
- Cover and separate pollution generating surfaces and treat/discharge to the sanitary sewer system.

- Drain wastewater discharges, and areas with the potential for relatively consistent wastewater discharges (such as vehicle washing facilities) to the sanitary sewer system,
- Contain spills on-site, and
- Provide permanent structural solutions to address the range of potential impacts resulting from multiple site uses and tenant turnover.

4-14.5 NPDES Industrial Stormwater Permits

If an industrial permit is required for your site, the applicant will be required to submit a copy of the permit and supporting documentation to the City.

4-15 Perform Erosion Control

The applicant shall submit a Site Grading and Erosion Control Plan if required by Section 3 of this manual.

4-16 Provide for Maintenance and Operation

The City of Klamath Falls currently has no stormwater utility and no dedicated funding source for construction or maintenance of storm water facilities. Maintenance and operation of all drainage facilities is the responsibility of the applicant/property owner (public or private), except those facilities for which the City of Klamath Falls is granted a covenant or deeded property and assumes maintenance and operation as described below:

- The general policy of the City is to require dedication of conveyance systems that drain the area within a public right-of-way or other public facility.
- The City does not normally assume maintenance responsibility for conveyance systems that are outside of the improved public road right-of-way. However, in cases where the City does assume maintenance responsibility, the requirements of Section 4-13.11 apply.
- At this time, the City is not accepting responsibility for maintenance of public drainage easements or storm water detention facilities. At such time as the City develops a storm water utility, the City anticipates providing maintenance for public drainage easements and above-ground facilities that accept runoff from City streets and residential subdivisions. The City will require that these facilities meet requirements for accessibility and design in order to assume maintenance. These requirements will be developed by the City and made available to developers so they can design their detention structures accordingly.
- Detention ponds for commercial and industrial sites shall be maintained by the property owner. For residential subdivisions, a homeowner's association, or other legal entity approved by the City, shall be formed to provide ongoing maintenance.
- Private stormwater pipes within the public right-of-way that drain individual residences or other parcels to a City manhole, catch basin or ditch are the responsibility of the land owner. Driveway culverts across roadside ditches are the responsibility of the land owner.
- In some cases the City may require the dedication of drainage easements for drainage courses or other large conveyance systems that serve multiple parcels. The purpose of this dedication will be to ensure adequate maintenance of large systems that serve many properties and have the potential for flooding/erosion/water quality impacts.

Contact Public Works for more information.

4-16.1 Submittal Requirements

The engineer shall submit the following:

- A map and/or narratives proposing the portions of the storm water system to be dedicated to the City. Show proposed easements, rights-of-way and access in accordance with Section 4-13.11.
- Maintenance criteria (frequency of inspection, thresholds for maintenance, description of maintenance practices) for BMPs such as detention structures, oil/water separators, pollution control manholes, etc. Specify who will be responsible for maintenance of these facilities once the project is completed.

4-17 Provide Financial Guarantees

The objective of this requirement is to ensure that large development projects have adequate financial resources to fully implement the Stormwater Site Plan.

If a project proposes to construct public infrastructure (excluding small project such as sewer laterals or other similar projects as approved by the City), then prior to issuance of the Site Construction Permit, the developer shall submit a detailed estimate and bond for 120% of the cost to construct the following (to be estimated separately):

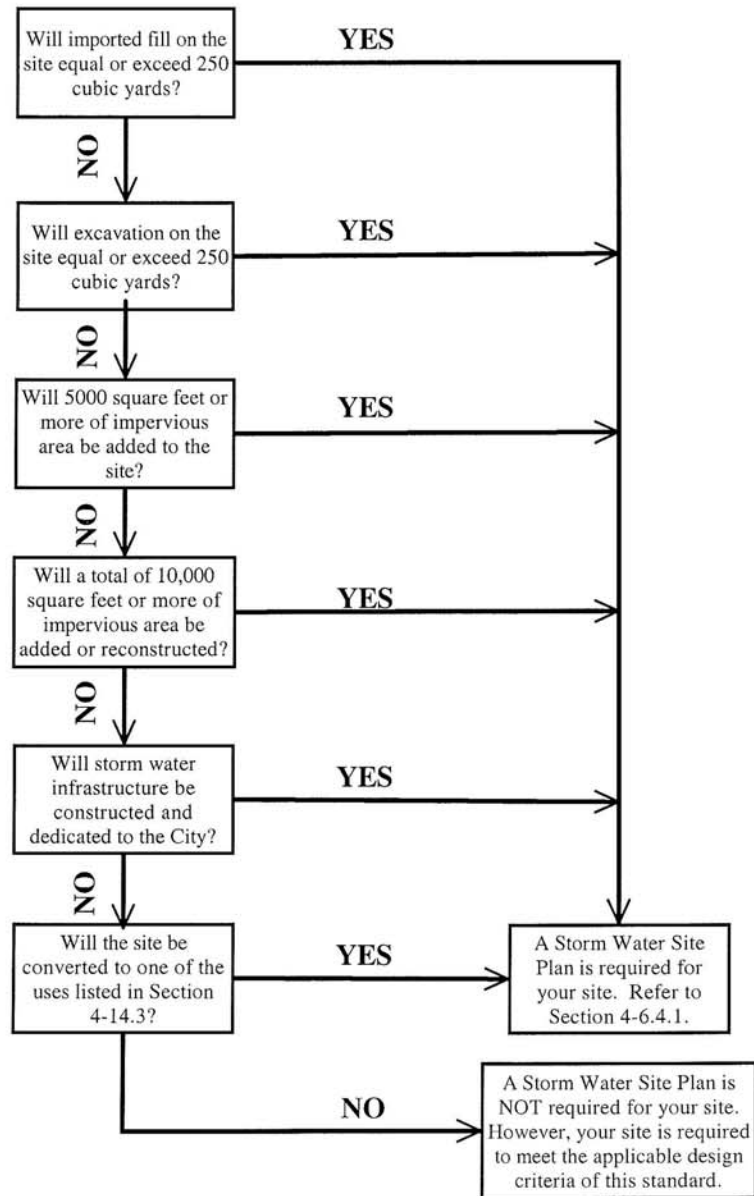
- Public stormwater infrastructure to be constructed, and
- Private stormwater infrastructure to be constructed, including detention facilities, culverts, structural BMPs and pipe/channel conveyance systems 12 inches in diameter/depth or greater.

4-17.1 Submittal Requirements

The applicant shall provide a planning-level cost estimate for the entire project and separate planning-level cost estimates for the construction of public and private stormwater infrastructure.

Figure 4-1

Is a Storm Water Site Plan Required?



SECTION 5 WASTEWATER COLLECTION, TREATMENT AND RECLAMATION FACILITIES

5-1 Purpose

The purpose of these standards is to provide criteria and guidance for the design of sanitary sewers, wastewater lift stations and wastewater treatment and reclamation facilities that are owned and/or will be dedicated to the City of Klamath Falls. These criteria and guidance are provided to improve the safety, quality, reliability, durability, efficiency, maintainability and operability of the City's facilities and to effectively convey and treat wastewater in full compliance with regulatory requirements.

It is also the intent of these standards to provide designers, engineers and developers with information about the City's Codes and policies governing pretreatment and connection requirements. In addition, the Wastewater System Master Plan is the City's guide for expansion of the current wastewater collection and treatment system. This plan provides planning level information regarding the general expansion of infrastructure necessary to support development within current planning and zoning designations, preliminary sizing of future wastewater collection and conveyance systems and allocation of interceptor and treatment capacity to the various areas served by City infrastructure. Development contrary to the infrastructure plans identified in the Master Plan will generally not be supported by the City without significant investment on the part of the developer.

5-1.1 Development Permit

The developer or development's representative shall provide Public Works with a planning level concept for the proposed collection system at saturation build-out. Residential developments with 100 or more ERUs (build-out) or all other developments with peak hour saturation wastewater flows greater than or equal to 50,000 gallons per day (gpd) are required to submit a planning level concept of the proposed collection system with the Development Permit application. The concept shall include preliminary flow calculations and/or modeling reports that estimate initial, phased, and ultimate flows to be generated by the development and identify infrastructure proposed for dedication. The concept shall include locations of all proposed connections to the existing collection system and preliminary sizing of any lift station(s) required to ensure adequate transport to the City's collection system. This information will assist the City in confirming that adequate capacity at, and downstream, of the proposed connection point(s) is available. In addition, the information will be used to determine whether the proposed development shall be responsible for all or a portion of any downstream capacity improvement costs necessary to accommodate the proposed development.

5-1.2 Site Construction Permit

Final design and construction documents shall be submitted to the Public Works Department for review and approval for all new sanitary infrastructure and any proposed connection(s) to existing City sewer prior to the City's issuance of the Site Construction permit. Approval will not be granted until the City has been satisfied that the requested design modifications have been made. The design submittal shall include all drawings, specifications and supporting calculations needed to verify that the proposed sewer collection system aligns with the concepts approved in the Development Permit process and meets the City's design standards as specified herein. Proposed infrastructure agreements between the Developer and the City regarding cost sharing, advance financing, utilization of SDC credits, etc. shall be presented in written form and signed by all parties prior to the issuance of the Site Construction Permit.

5-1.3 The Sewer Use Ordinance and Pretreatment Act, City Codes Sections 4.100 to 4.198

Sections 4.1 to 4.11 of the City Codes regulate the use of public and private sewers and drains, private sewage disposal, the installation of and connection of building sewers, and the discharge of waters and wastes into the public sewer system, and providing penalties for violations thereof, enabling the City to comply with State and Federal Laws required by the Clean Water Act and amendments. Customers connecting to the City wastewater system are subject to prohibitions for discharge of injurious, toxic, harmful, radioactive, polluted and untreatable substances, and prohibition of slug load and accidental discharges of prohibited or regulated materials. Commercial and industrial wastes may require pretreatment prior to discharge. The City requires that the proposed development evaluate, disclose and complete a Wastewater Discharge Data Disclosure form for any potential waste discharges that may be governed by these pretreatment regulations during the planning review process. Inquiries about Sewer Use and Pretreatment Act requirements are to be directed to the Wastewater/Geothermal Division, Pretreatment Coordinator.

5-1.4 The Systems Development Charge, City Codes Section 3.505 to 3.605

The City, through the use of System Development Charges (SDCs) imposes a portion of the cost of capacity replacement for water, wastewater, streets, and parks upon those developments that create the need for or increase the demands on the capital investment made by the existing customer base. These charges are separate from, and in addition to, any applicable tax, assessment, charge or fee otherwise provided by law or imposed as a condition of development. SDC fees shall be applied only to capital improvements associated with the systems for which the fees are assessed, and only on capacity increasing improvements including expenditures relating to repayment of future debt for the improvements. SDCs for sewer connections must be paid prior to connection to the City's wastewater system. The Code also includes provisions for delinquency of payments, installment payments, exemptions, credits, and appeals.

Wastewater SDCs are calculated based on an annually adjusted fee amount per Equivalent Residential Unit (ERU). Formulas for determining ERU's for various types of developments are as follows:

TYPE OF BUILDING AND SEWER USE	ERUs
1. Single Family Residence	1 each per unit
2. Multiple Family Residence	0.65 per dwelling unit
3. Mobile Home Space in Mobile Home Park (Common building at additional commercial rate and laundry areas at laundry rate.)	0.65 per space
4. Recreational Vehicle Waste Dumping Station	0.65 per station
5. Schools	0.030 per student capacity
6. Churches (School uses at additional per student capacity rate.)	0.64 per 100 seats
7. Hospitals – general	1 per bed
8. Convalescent Hospitals	0.5 per bed
9. Residential Care/Boarding Facilities	0.25 per bed
10. Hotels and Motels (Additional charges for restaurant or tavern at restaurant or tavern rate, laundry areas at laundry rates, and meeting room areas with fixtures at commercial rate.)	0.25 per room to motel unit
11. Food Preparation and/or Serving Areas	0.15 per 100 square feet
12. Vehicle Wash	
Self-Service Vehicle Wash	1.17 per bay
Full-Service Vehicle Wash	15.66 per bay

	All Other Vehicle Washes	See Wet Industrial
13.	Laundries & Laundromats	0.3 per 100 square feet
	Industrial Laundries	See Wet Industrial
14.	Commercial, Office and Dry Industrial	Charge for each plumbing fixture to be installed.
	Bath tub w/or w/o shower	0.13
	Dental unit or cuspidor	0.1
	Dishwasher	0.1
	Disposal	0.1
	Drinking Fountain	0.05
	Floor Drain	0.013
	Fountain/Backwash	0.1
	Kitchen Sink	0.08
	Laundry Tray	0.08
	Lavatory	0.05
	Service Sink	0.08
	Shower (each head)	0.13
	Swimming Pool/Backwash	0.1
	Urinal	0.17
	Urinal Trough (for each 2 foot section)	0.17
	Wash Sink (for each set of faucets)	0.08
	Washing Machine	0.07
	Water Closet	0.33
	In case of a remodel in types 5-13 which results in no increase in the units on which the charge for a new building is calculated, the ERU for the remodel will be calculate on the basis of the fixtures added using the amounts in Item 4.	
15.	Wet Industrial	To be determined on an individual basis by the City
16.	Undefined Building and Sewer Use	To be determined on an individual basis by the City
17	Additional Loading or Change of Use	Determined on a basis of new use for entire facility less credit for former use. No refunds if new use is less than former use.

The following are the definitions of the classifications used in establishing the ERUs.

1. A single family residence shall be defined as a building containing one kitchen, designed and/or used to house not more than one family, including all necessary employees of such family, such building having a single sewer service connection. Mobile homes occupying a separate lot and providing permanent housing with a separate sewer connected shall be classified as a single-family residence.
2. A multiple family residence shall be defined as a building or a group of buildings housing two or more families, living independently of each other, a family being defined as one or more persons living as a single housekeeping unit or household with sewer service being provided through not more than one sewer connection. Common buildings in an apartment house complex requiring sewer service shall be charged as commercial buildings and that portion of buildings housing common laundry facilities shall be charged as laundries and laundromats.

3. A mobile home park, including travel trailer parks, is defined as any area or tract of land having a sewer connection, and where sewerage collection pipes are extended to two or more spaces occupied by, or intended to be occupied by a mobile home, travel trailer or motor home which are defined as a vehicle with or without motive power which is designed, used or intended for use as a place of human habitation, or as eating, sleeping or living quarters or any combination thereof. A mobile home space is defined as the individual location having a sewer hookup for each such vehicle. For purposes of determining the SDCs for mobile home parks common buildings such as recreation halls, etc., shall be charged as commercial builders. Buildings housing laundry facilities shall be charged as laundries and Laundromats and food or drink service buildings shall be charged as food preparation and/or serving.
4. Recreation vehicle waste dumping stations are defined as buildings or structures used for the dumping of sanitary sewer wastes from recreational vehicle holding tanks. Includes gray water from sinks and showers. (This excludes an individual collector installed by a homeowner for his/her own use.)
5. Schools are defined as any building or group of buildings used for school purposes more than 12 hours per week, involving assemblage for instruction, education or recreation. Schools may be public or private.
6. Churches shall be defined as a building or structure whose principal use is for worship and in which the incidental use for school or recreational purposes is less than 12 hours per week. Church buildings used for school purposes in excess of 12 hours per week shall be charged the SDC per student capacity in addition to the charge per 100 seats as a church.
7. General hospitals shall be defined as a building or structure used for the temporary housing of ill or injured persons and containing facilities for medical and surgical treatment of such persons. No additional charge shall be made for laundry and food and drink preparation and serving facilities included in hospitals.
8. Convalescent hospitals or rest homes are defined as a building or structure used for housing of persons convalescing from illness or injury or persons requiring close personal care. No additional charge shall be made for laundry or food and drink preparation and serving facilities included in the convalescent hospitals.
9. Residential care/boarding facilities is defined as a residential building or structure used for housing of persons requiring long-term supervision and general care, or any type of dependency recovery. No additional charge shall be made for laundry or food and drink preparation and serving facilities included in the residential care/boarding facilities.
10. Hotels and motels are defined as a building or group of buildings used for temporary housing of persons containing rooms or units intended for the use of transient persons. Those areas within hotels and motels to be used for commercial preparation of and serving of food and drink shall be charged at the rate for food preparation and/or serving. Commercial area within hotels and motels, including convention facilities and other such common areas other than lobby areas, shall be charged at the rate for commercial and dry industrial areas. Areas used for laundry facilities in hotels and motels shall be charged at the rate for laundries and laundromats. Such additional charges for food and drink, commercial areas and laundry shall be in addition to the charge per room or motel unit.
11. Food preparation and serving, including restaurants, taverns, delicatessens and wholesale and retail bakeries, but does not include canneries, dairies, cheese factories, packing houses and similar facilities, which shall be classified as "Wet Industrial" under Item 15 of definitions.

12. Vehicle washes are defined as commercial buildings or structures used for washing vehicles. Self-service vehicle washes are coin-operated facilities serving the general public that require the customer to wash the vehicle. Full-service vehicle washes are facilities serving the general public, wherein the vehicle is washed for the customer, either automatically or by attendants. All other vehicle and parts washing or steam cleaning facilities that discharge to the sanitary sewer will be reviewed on a case-by-case basis.

13. Laundries and laundromats are defined as commercial buildings and structures, or parts of commercial buildings and structures used for housing and operating laundry equipment by the general public to wash clothes and lines for personal use.

Industrial laundries are defined as buildings or structures or parts of buildings and structures used for housing and operating laundry equipment for the large scale washing of uniforms, towels, linens, etc. The anticipated volume and strength of the sewage to be generated from an industrial laundry would be considerably more than that from a commercial laundry or laundromat. Industrial laundries shall be classified as "Wet Industrial" under Item 15.

14. Commercial buildings are defined as all buildings used for conducting of wholesale or retail trade. Dry industrial buildings or structures are those buildings or structures housing light industrial activities where use of water and subsequent discharge of sewer does not occur in connection with the industrial process. Warehouses and other storage buildings with sewer connections are classified as dry industrial buildings.

15. Wet industrial buildings are defined as those buildings and structures housing industrial activities where the use of water and subsequent discharge to the sewer occurs in connection with an industrial process. Facilities with a discharge of 200,000 gallons per day or greater are considered wet industrial. Other facilities that discharge less than 200,000 gallons per day, and whose anticipated strength of the sewage to be generated from the facility is greater than domestic sewage strengths may also be considered wet industrial. Those facilities will be reviewed on a case-by-case basis. The anticipated volume and strength of sewage from an average single-family residence shall be considered when calculating SDCs.

The SDC for wet industrial shall be determined on an individual basis for the Technical Advisory Committee's approval utilizing the formula listed below:

System Development Charge

$$\text{SDC} = \frac{\text{G.P.D.} \times \text{SFR} \times \text{F}}{415}$$

G.P.D. = Anticipated volume of discharge to sewer in gallons per day.

SFR = Current System Development Charge for single

F = Extra strength factor, whole number multiplier derived for every 330 mg/L of biochemical oxygen demand or suspended solids, or fraction thereof, in excess of the first 330 ms/L of biochemical oxygen demand or suspended solids.

Example:

<u>Factor</u>	<u>Range</u>
1	0-330
2	331-660
3	661-990
(continues per 330 increment)	

16. Undefined buildings and sewer use are those not defined above.

17. Additional loading or change of use is defined as an increased demand for wastewater treatment from an existing wet industrial building or structure. The additional loading may be the result of replacement or addition to an existing structure or facility, a change in use, or a fifteen percent (15%) or greater increase above the permitted volume or character of the wastewater constituents being discharged.

ERUs shall be determined on a basis of the number of single-family residence equivalent units with the additional loading or the new use with credit being given for the number of single-family residence equivalent units of the original facility. No refund will be given if the change of use results in a decreased sewer loading. Any addition to an existing single-family residence which does not result in an additional dwelling will be exempt from additional charge.

An alteration, addition, replacement or change in use, including redevelopment of a vacant lot that had the requested utility service within the previous ten (10) year period, shall be exempt; provided, there is no increase in the parcel lot's or structure's use of the public improvement facility.

For additional information regarding wastewater system standards contact the City of Klamath Falls Wastewater Division or the Utility Billing Office.

5-2 Summary

This section provides design criteria and guidance for sanitary sewers and related collection system structures, lift stations and pumping stations for pumping of wastewater, and for wastewater treatment and reclamation facilities consisting of multiple processes for conventional primary and secondary treatment, tertiary treatment and reclaimed water production. They are provided to support the City's growth and economic plans and in anticipation of future regulatory requirements as described in the Facilities Plan.

5-2.1 Design Criteria

The City of Klamath Falls, as conditionally authorized by the Department of Environmental Quality (DEQ), is exempt from the DEQ plan review requirements for gravity projects set forth in OAR 340-52-015 under several conditions with the least not being the following:

- Collection system projects shall be designed and constructed in accordance with approved City standards and shall conform to the rules and guidelines of the DEQ.
- Projects funded with Clean Water State Revolving Fund funds are subject to special requirements, as established in the loan agreement. Inclusion of such projects under the City's exemption from plan review will be considered on a project-by-project basis. For all projects, the City shall require a written certification of proper construction from the design engineer as required under OAR 340-52-040.
- The DEQ reserves the right to revoke the City of Klamath Falls' plan review exemption upon documentation of a reduction in staff of experienced sanitary engineers qualified to perform reviews, or upon non-compliance with the provisions of OAR 340-52-0045, the City's NPDES permit, or this letter of conditional approval.

Therefore, all sanitary sewer mains, side sewers, sanitary sewer manholes and sanitary sewer facilities shall be designed and constructed in accordance with the latest issue or revision of the

“Criteria for Sewage Work Design” published by the American Public Works Association (A.P.W.A.) Standards and Sewer Utility Standard Details and Engineering Specifications and Details and Oregon Department of Environment Quality Standards for sanitary sewers or other accepted references as approved by the City. All connections to City facilities shall conform to City Standards. Sanitary sewer main extension(s) shall be required when the property does not front on a sewer main, or when the existing sewer main is not adequately sized for the use proposed.

- All sewer lines, side sewers, sanitary sewer manholes and sanitary sewer facilities shall be constructed to the standards established by the City of Klamath Falls.
- The contractor shall have plans which have signature approval by the City’s Public Works Department, and have obtained all City, County, State, Federal and other required permits, and shall have posted all required bonds and hauling trusts prior to the start of any construction activities.
- Sanitary sewers are to be centered in a dedicated public right of way or deeded property (conveyed to the City) with a minimum width of 16’. Easement across property that can have a private single family residence or duplex property will not be considered by the City. No curved sewers will be accepted. Minimum cover over sanitary sewer pipe is to be three (3) feet, unless otherwise shown and approved. All types of sanitary sewer pipe shall be laid bell-end upstream.

5-2.1.1 Size/Velocity

The minimum pipe diameter for gravity sewer mains shall be eight (8”) inches. In general, gravity lines shall be sized based on the following criteria:

- 2.5 feet per second minimum velocity (full pipe flow) for gravity sewers maximum velocity of 10 feet per second at PWWF.

The City will not accept any forcemains that are smaller than four (4) inches in diameter.

5-2.1.2 Design Calculations

Design calculations are required for design of proposed sanitary sewer systems 100 or more ERU’s (build-out) and shall be submitted to the Public Works Department. The applicant shall submit a design stamped by an Engineer licensed by the State of Oregon. Single family residential services, provided they are not part of a larger development project, are not required to submit calculations to the City provided that they meet the minimum slope requirements. The calculations shall include the following items:

1. A plan showing the proposed street system, tributary sub-areas, existing and future tributary areas, outside the project limits, zoning, projected land use, and any features affecting the system design.
2. Minimum and maximum velocities at the proposed slope and design flows for the proposed development.
3. Load calculations for any shallow installation applications or where heavy traffic loads on the piping system is anticipated.

5-2.1.3 Flows

1. Commercial and industrial developments shall use a minimum peaking factor (ratio of peak hour flow to average daily flow) of 3.5. Residential development shall use a peaking factor of 3.0. Design flows at major junction points shall include flows coming from outside the project limits.
2. The average residential flows shall be computed on a per-capita basis using a minimum of 130 gallons per-capita per day. Commercial and light industrial shall be computed at 800 gallons per acre per day. All other industrial use shall be computed utilizing 3,000 gallons per acre per day unless a higher flow can be reasonably predicted. When the exact density is not known, the current zoning map and commercial development code limitations shall be used to determine the appropriate densities. Multi-family residential shall be 2.0 persons per unit. All other uses shall be 2.8 persons per unit.

5-2.1.3.1. Gravity Sewers Slope

All gravity sewers shall be designed and constructed to give mean velocities, of not less than 2.5 feet-per-second when flowing full. The following minimum slopes should be provided, however greater slopes are desired.

Sewer Size (inches)	Minimum Slope (feet per 100 feet)	Slope (foot per foot)
8	0.40	0.004
10	0.28	0.0028
12	0.22	0.0022
15	0.15	0.0015
18	0.12	0.0012
21	0.10	0.0010
24	0.08	0.0008

5-2.1.4 Odor and Corrosion Prevention

The developer may be required to use non-corrosive materials for the manhole and sewer connections if odor and corrosion problems have been identified in the connecting trunk or interceptor connection. In addition, ventilating the pipe and discharging the foul air through a biofilter may be required at the proposed connection point to the sewage collection system if the City anticipates a potential odor problem at the connection. All proposed pumping and lift stations should be equipped for chemical addition (ferric chloride, bioxide, peroxide, hypochlorite or other chemicals) to control sulfides. Specific application of odor control and corrosion control shall be evaluated on a case-by-case basis.

5-2.1.5 Spacing

Maximum spacing of manholes shall be 400 feet for 8, 10, 12, 15 and 18 inch diameter pipe, and 500 feet for 21 inch diameter and over diameter pipe. All manholes shall be accessible to maintenance vehicles by providing a graveled unpaved access route. Manholes shall be spaced at no greater than 200 feet where the slope of the pipe is greater than seven (7) percent.

Manholes are required at any change in pipe slope, alignment, or size. Manholes are not allowed in a fill section unless the base is on a cut section or well compacted fill. A manhole

is required at the ends of all sewer mains, unless a clean-out is specifically approved by the City.

5-2.1.6 Design Life

All sanitary sewer pipe systems shall be designed and installed with a design life of not less than 50 years.

5-2.2 Easements

Any proposed sewer main located in a dedicated easement on property where a multi-family, (triplex or larger), commercial or industrial buildings can be built, shall be centered within the easement. Easements shall be a minimum of 16 feet in width. If the sewer is placed deeper than 8 feet, the easement shall be a minimum of 2 times the depth of sanitary sewer burial. Easements are to be accurately located with off sets and dimensions shown on the plan sheets. All easements shall be agreed to between the applicant and the City before the issuance of the Site Construction Permit. If the easement is not a part of a subdivision or land partition, it shall be recorded on a separate document in the office of the Klamath County Clerk prior to the City accepting the sewer construction project.

No permanent structures are allowed to be constructed within the easement area, unless specific written permission, with conditions, is granted by the Public Works Director.

Landscaping within sanitary sewer easements shall be approved by the City.

5-2.3 Construction Drawings

5-2.3.1 General

The installation of all new, extensions to, and/or connections to the sanitary sewer system shall be prepared in accordance with the City's graphic standards if the infrastructure will be dedicated to the public. Plans shall show inlet and outlet invert elevations at manholes, slopes for sewer lines, and surface elevations of the manhole lid (north rim). The profile view shall also show the finish ground elevation over the pipe, as well as crossings of other existing or proposed utilities. Laterals or stubouts shall be shown with their stationing from the downhill manhole. All improvements shall be constructed in accordance to the record set approved prior to the issuance of the Site Construction permit.

All proposed sanitary sewers, which will be dedicated to and maintained by the City must be reviewed and approved by the City prior to the issuance of a Site Construction permit. Before the City accepts sanitary sewer improvements, the developer shall supply the City with photostatic mylar as-builts of the sanitary sewer system bearing the stamp and signature of an Oregon registered professional engineer, the applicant shall supply the City with an electronic copy of the construction plans per the City's graphic standards (refer to SECTION 10). The City must review and approve all as-builts. The contractor shall make all changes to the as-builts as directed by the City before the City will approve and accept the as-builts.

- The City will not accept any new facilities connected to the existing sanitary collection system unless inspected at the site and certified by the City as meeting the required design and construction standards.

5-2.4 Manholes, Sewer System Structures

Manholes shall be constructed in accordance with the City Standards.

5-2.4.1 Materials

Manhole covers will have two holes and be marked "SEWER" on the cover.

Manholes shall be constructed of pre-cast units in accordance with the City's Standards Details. Any request to deviate from these Standard Details must be reviewed and approved by the City.

All pre-cast concrete shall be Class 4000. Manhole channels shall be Class 4000 concrete. Concrete (masonry) grade rings may be used for adjustment of the casting to final street grade.

Standard pre-cast cones shall provide diameter reduction from 48 inches to 24 inches. Grade rings shall be placed above the cone section, not less than 2 inches or more than 12 inches in height.

Standard flat top covers shall be a minimum of 8 inches thick and shall conform to the outer dimension of the standard sections upon which they are to be placed.

5-2.4.2 Bedding

All manholes shall be constructed with pre-cast base sections placed to grade upon 12 inches (minimum depth) of Crushed Surfacing Base Course, or slurry. The approved base course must be compacted to 95% maximum density (AASHTO T-99).

5-2.4.3 Joints

Joints between pre-cast manhole elements shall be water tight gasketed.

5-2.4.4 Manhole Channels

All manholes shall be channeled unless otherwise approved by the City. Channels shall match existing sewer grades. Channels shall converge smoothly and well rounded into well finished junctions. Channel sides shall be carried up vertically to the crown elevation of the various pipes. Concrete shelves between channels shall be smoothly finished.

All manholes shall have a minimum drop of 0.10 feet to a maximum drop of 1.0 foot between the inlet invert and the outflow invert. Invert drops greater than 1 foot shall require an energy dissipation device.

5-2.4.5 Manhole Pipe Connections

Refer to Standard Drawings, Section 11.

Sewer pipe connections to manholes shall provide a water tight connection such as a rubber coupler and/or gasket or equivalent.

5-2.4.6 Connections to Existing Manholes

Refer to Standard Drawings, Section 11.

The contractor shall verify invert elevations on all existing manholes prior to construction. The contractor shall submit any required changes to the approved design for review and approval by the City.

The contractor shall core drill an opening to match the size of pipe to be inserted. Jackhammers shall not be used. All openings must provide a minimum of 1 inch and a maximum of 2 inches clearance around the outside circumference of the pipe.

5-2.5 Sewer Interceptors and Mains

5-2.5.1 Sewer Main, Interceptors and Force mains

5-2.5.1.1. Materials

Sanitary gravity and pressure pipe shall meet the following requirements:

Gravity Sewers

<u>Pipe Diameter, inches</u>	<u>Depth, feet</u>	<u>Material</u>
8 to 12	D<10 feet	PVC
8 to 12	D>= 10 feet	Reinforced Concrete
12 and over	Any	Reinf. Concrete w/ PVC liner or class 50 Ductile Iron Pipe

Forcemains

<u>Pipe Diameter, inches</u>	<u>Depth, feet</u>	<u>Material</u>
4 to 8	D>3 feet	PVC, HDPE
10 or larger	Any	Ductile Iron

1. Polyvinyl Chloride (PVC) gravity sanitary sewer pipe shall be ASTM 3034 green in color
2. Ductile Iron pipe shall be Class 50, cement mortar lined and meet the requirements of AWWA C151 unless load conditions dictate Class 52.
3. Pipe materials for small diameter forcemains include PVC, high density polyethylene (HDPE), and ductile iron. The selection of the appropriate pipe material depends on economics, corrosion potential, and suitability for pressure conditions.

Selection of pipe joints and restraint method will depend on the maximum design pressure and the pressure specified for leak testing. The City will supply the applicant with the required test pressure upon review of the specific wastewater and hydraulic application.

PVC pipe joints may be restrained with meg-a-lug type joints. An analysis should be performed to determine how many joints need restraint before there is adequate skin friction developed to allow push-on joints. Likewise, ductile iron pipe may be also restrained with meg-a-lug joints. Field lock gaskets should be used with caution because pipe flexibility is reduced and pressure rating is limited. However, field lock gaskets are economical to install. HDPE pipe is joined by heat fusion and therefore all joints are essentially restrained.

A surge analysis should be performed to determine the maximum pressure that the pipe will need to withstand. The surge analysis should also address the placement and sizing of air and vacuum relief valves. A complete analysis should be submitted to the City for approval before the force main is constructed.

4. Concrete sewer pipe will not be allowed in geological areas with high ground water or where high sulfur levels may exist, unless specifically approved by the City.
5. No broken or defective sewer pipe and related materials will be allowed

5-2.5.1.2. Underground Utilities

Activities such as trench excavation, tunneling or boring, pipe embankment, backfilling, compaction and pavement patching, whether for public or private utilities, shall conform to the requirements set forth in other sections of the City of Klamath Falls Design Standards.

5-2.5.1.3. Laying Sewer Pipe

All sewer main installations shall have line and grade set by a professional licensed engineer or land surveyor, prior to construction. Staking shall show each manhole, and cuts to all inverts. All mains are to be laid straight between manholes.

The contractor shall use an accepted method which would allow accurate transfer of the control points provided by the surveyor or engineer in laying the pipe to the designated alignment and grade.

Trenches shall be excavated to a depth and grade required. Pipe bedding shall be placed to provide a uniform and continuous bearing and support for the pipe on solid undisturbed or compacted ground.

Sewer lines shall be laid upgrade from the starting point of connection on the existing sewer or from a designated starting point, as approved by the City. Sewer pipe shall be installed with the bell end forward or upgrade. After placing a length of pipe in the trench, the spigot shall be centered in the bell and the pipe seated within and brought to correct line and grade. During joining, the pipe shall be partially supported to minimize unequal lateral pressure and to maintain concentricity. Pipe handling after the gasket has been affixed shall be carefully controlled to avoid disturbing and dislocating the gasket. Any disturbed or dislocated gaskets shall be removed, cleaned, replaced and lubricated before joining the sections.

No rubber couplers shall be allowed between manhole runs with the exception of connecting to an existing manhole. Any other use of rubber couplers shall be approved by the City prior to installation.

5-2.5.1.4. Plugs and Connections

All fittings shall be capped or plugged with approved material and gasketed with the same gasket material as the pipe unit, or the pipe shall be fitted with an approved mechanical stopper, or the pipe shall have an integrally cast knock-out plug. The plug shall be able to withstand all test pressures without leaking.

5-2.5.1.5. Jointing

Where it is necessary to break out or connect to an existing sewer during construction, only new pipe having the same inside diameter will be used in reconnecting the sewer. Where joints must be made between pipes with a mismatched wall thickness, the contractor shall use flexible gasketed coupling, adapter, or coupling-adapter to make a watertight joint.

5-2.5.1.6. Cleaning and Testing of Sanitary Sewers

The City has a check-off sheet which will be issued to the contractor prior to the start of construction detailing the testing and acceptance procedure.

5-2.5.1.7 Televising

In addition to mandrel and air testing of wastewater pipelines, wastewater infrastructure that is either proposed for dedication to the City of Klamath Falls or required by formal agreement for potential dedication to the City of Klamath Falls shall be televised prior to acceptance by the City. The cost for sewer main televising shall be \$0.40 per foot and will be paid to the City of Klamath Falls.

5-2.5.2 Sanitary Sewer Laterals

5-2.5.2.1. Responsibility for Laterals

The City is responsible for the maintenance of sewer laterals from the City's main to the property line. A clean-out and service box shall be installed to surface grade at the property line, placed behind the curb or the sidewalk. The property owners are responsible from the City's clean-out to the clean-out installed at the resident or business.

Sewer laterals installed prior to January 1, 2002 shall be the responsibility of the property owner until such time as a new service and cleanout are installed by the owner.

Stormwater runoff, including roof drains, shall not be connected to or discharged into a sanitary sewer.

The System Development Charge must be paid prior to any connections to the sanitary sewer main.

All laterals shall be plugged with flexible jointed caps, or acceptable alternate, securely fastened to withstand the internal test pressure. These plugs or caps shall be readily removable and their removal shall provide a socket suitable for making a flexible jointed lateral connection or extension.

5-2.5.2.2. Materials

All pipe shall be clearly marked with type, class, and/or thickness, as applicable. Lettering shall be legible and permanent under normal conditions of handling and storage.

Jointing shall be with approved flexible gasketing.

Flexible gasketing shall be construed to include rubber, synthetic rubber-like and plastic materials specially manufactured for the joint and pipe size.

5-2.5.2.3. Sizing Laterals

That portion of a lateral located within the public right-of-way shall have a minimum diameter of 4 inches for residential, single or multi-family. Commercial or industrial may require larger size pipes.

There shall be no more than 1 service connection per lateral.

5-2.5.2.4. Fittings & Cleanouts for Laterals

All fittings shall be factory-produced and shall be designed for installation on the pipe to be used.

Laterals shall be connected to the wye provided in the public sewer where such is available, utilizing approved fittings or adapter. Where no wye is provided or available, connection shall be made by core drilling and installing an approved sewer saddle connection.

5-2.5.2.5. Tracer Wire

Locator wire shall be installed over all lateral pipes. The locator wire shall be placed one foot above the top of the lateral sewer pipe and it shall extend its full length to the City service box and clean-out. Excess tracer wire shall be coiled 12" – 18" inside the box. Tracer wire shall be 14 AWG single strand, copper encased in green sheathing.

5-2.5.2.6 Sanitary Sewer Lateral Televising

Wastewater infrastructure that is either proposed for dedication to the City of Klamath Falls or required by formal agreement for potential dedication to the City of Klamath Falls shall be televised prior to acceptance by the City. The cost for sanitary sewer lateral televising shall be at the rate of \$25 per wastewater service lateral connection as measured from the point of exchange between the privately owned portion of the service lateral to the publicly operated and maintained portion of the lateral. Payment shall be made to the City of Klamath Falls.

5-2.6 Wastewater Lift Stations to be Dedicated to the City (see 5-2.6.2)

5-2.6.1 Sites

No permanent structures shall be constructed within 100 feet of any lift station that is to be dedicated to the City. This provides for a buffer zone, maintenance access, landscaping and unobstructed radio telemetry.

Adequate access must be furnished for vehicles of such size as may be necessary to deliver, or to remove station equipment. The site configuration and pad elevation shall be as required by the City to avoid drainage runoff problems from the surrounding area.

The site shall be fenced with 6' high chain link fencing with a 3' wide pedestrian gate and double wide vehicle access gate recessed a minimum of 20'. Contained within and leading up to the fenced site shall be an all-weather surface capable of supporting vehicles having a GVW up to 50,000 pounds.

5-2.6.2 Type of Pump Station

Two pump station configurations are acceptable to the City for public dedication of permanent wastewater pumping facilities. These include wet-well/dry-well configurations and submersible configurations. Prepackaged (canned) pumping units are acceptable for servicing residential areas with less than 100 ERUs (build-out) or saturation peak hour flows of 50,000 gallons per day for all other developments. The City has developed a standard specification for prepackage lift stations for convenience and is available for use by contractors and developers. The specification establishes the minimum requirements for package pumping stations.

The City will not accept a public dedication of a wastewater pumping station servicing residential areas with less than 100 ERUs (build-out) or saturation peak hour flows of 50,000 gallons per day (for all other developments). In those development situations where a lift station smaller than these threshold criteria is required to convey wastewater to the City, Developers are encouraged to design residential units with individual grinder pumps discharging to a common gravity collector or consider a common privately-maintained vacuum type system. The City will not exempt the slope/velocity requirements for their gravity lines for convenience in developing a site.

Design criteria for lift stations servicing residential areas with greater than 100 ERUs (build-out) or saturation peak hour flows greater than 50,000 gallons per day (for all other developments) must be approved prior to construction if the station is to be dedicated to the City. Applicable safety codes shall be incorporated in all pumping stations, including but not limited to, those features associated with electrical, controls, ventilation, and the location of railings and equipment guards.

5-2.6.3 Design Capacity

The station's initial pumping capacity may be less than the ultimate design depending upon the size of the service area and the phasing of development. In such an installation, allowances for larger or additional pumping equipment must be made for future modification. If the initial design capacity is in excess of anticipated initial flow, the effects of the minimum flow conditions must be estimated to be sure that the retention of sewage in the wet well will not create an odor or corrosion nuisance, and that the pumping equipment will operate with reasonable frequency.

5-2.6.4 Wet Well

Unless the station is of such size that variable speed drive pumps are justified, the shape of the wet well shall be cylindrical and the detention time should be such that the deposition of solids is minimized and the sewage does not become septic. Access hatches (4' X 4' minimum) shall be provided at the top of the deck and located as required by the City. The bottom of the wet well shall slope toward a flat bench area wide enough for the worker to stand on without depending on the sloped area as a footing surface.

5-2.6.5 Pumps

Pumps shall be submersible of a centrifugal variety for submersible configurations and mixed flow centrifugals for wetwell-drywell configurations. Self-priming (suction lift) centrifugal pumps are not acceptable. Pump suction and discharge size shall be a minimum of 4-inch diameter. Pump drive units shall be electric. A sufficient number of pumping units shall be installed such that station's average wet weather flow capacity can be maintained with any one unit out of service. Provisions for telemetry shall be included in the station control system.

5-2.6.6 Station Piping

Suction, discharge and header piping within the station shall be sized to adequately handle flows. Piping less than 4 inches in diameter shall not be used for conveying sewage. Valves shall be readily accessible for maintenance. The discharge main leaving the station shall be equipped to receive discharge from a bypass line through a tee riser, flow valve and blind flange.

5-2.6.7 Odor Control

All stations shall have electrical and water connections provided for the purpose of chemical addition on the upstream gravity line and/or the force main. Adequate provisions shall be made for the safe handling and storage of chemicals. All force mains shall have a tap for introduction of chemicals whether or not the odor control equipment is initially installed.

5-2.6.8 Force mains

Force main designs shall be such that velocities normally fall within a range of from 3 to 6 feet per second. If initial capacity of the station is considerably less than the ultimate, consideration should be given to the undesirable effect of extensive detention time within the force main. The feasibility of installing dual force mains to accommodate initial and ultimate flows should be investigated in such situations. Provision shall be made for introducing a cleaning pig into all force mains.

5-2.6.9 Electrical/Instrumentation

All electrical components shall be protected from wet weather, station flooding, and corrosion to the satisfaction of the City. All stations shall be designed with an enclosed full time backup generator with sound attenuation, an automatic transfer switch, and a fuel supply capable of operating the station for 24 hours. The control panel shall include provisions for installation of a developer provided/City installed standard City telemetry system to provide for remote monitoring and control. Magnetic flow meters shall be required at all new installations. The station shall be a fully integrated station with the wet well, wet well pumps and piping, electrical power and power controls, emergency backup power, fuel system, pumping station system appurtenances, etc., designed and supplied from a single vendor.

5-2.6.10 General Design Details

General design requirements are available from the Wastewater/Geothermal Division. The City shall make specific requirements as deemed necessary on a case by case basis.

5-2.7 Connection to Public Sewer and On-Site Sewer Systems

Where City public sewer is available within 300 feet of a property line, connection to the public sewer is required. Septic systems are generally not allowed within the City. If the City determines that public sanitary sewer service is not available or if it is not "practical" to provide public sewer service, then septic tank systems may be installed upon approval by the City, and issuance of a septic permit. In this case, the homeowner, developer, or land owner will be required to sign a non-remonstrative agreement with the City for future Local Improvement District (LID) actions. Alternative technologies for on-site systems shall be evaluated on a case-by-case basis.

5-2.7.1 New Subdivision/Development Sewer Storm Pipes Televised

It shall be the contractor/develop responsibility to flush/clean new constructed sewer and storm lines prior to requesting the Wastewater Division to perform the televising inspection. The Wastewater Division will not perform any flushing/cleaning of sewer and storm lines for contractors or developers to perform the televising inspection.

The project inspector will certify the "entire" sewer and storm pipe construction has passed a mandrel and pressure test before the contractor/developer requests the televising inspection from the Wastewater Division

The Wastewater Division shall issue a work request for all new subdivision/development televising inspection requests for recording Division employee and equipment hours for billing/payment of remittance to the Wastewater Division for the televising inspections.

The Wastewater Division will coordinate the televising inspection with the Engineering Division project inspector only.

The Wastewater Division will record the televising inspection and forward the recording and associated paperwork to the project inspector for review of the sewer and storm pipes. The project inspector shall notify the contractor/developer of any pipe defects and of acceptance of the pipe systems.

5-2.8 Pretreatment Requirements, Grease Traps/Interceptors

Grease traps and interceptors shall be sized according to the criteria in the Uniform Plumbing Code (UPC). Grease traps and interceptors shall be installed downstream of those businesses or uses which in the opinion of the County Building Official or the City will discharge significant fat and oil materials into the public sewer system. Grease trap and interceptors shall be located on private property, and they shall remain privately owned and maintained at the owner's or occupant's expense. These facilities shall be available for the inspection by the City with a 24-hour verbal notification to the occupant or property owner.

Sewer users connected to the City public sewer are advised that sewer use is regulated under the City of Klamath Falls City Code Section 4.100, and the Pretreatment Act, Ordinance No. 6588. These documents should be consulted for regulations, limits, and standards.

5-3 Wastewater Treatment and Reclamation Systems

5-3.1 Wastewater Treatment and Reclamation Facility Siting and Impacts

Siting of new wastewater treatment and reclamation facilities shall be guided by the City of Klamath Falls' water quality strategy and comprehensive plans which consider future growth and development, zoning requirements, need for buffer zone separation for visual disturbance, noise, odor control, traffic, impact on human, archeological and natural resources, and flood potential. The siting process shall provide for future modular expansion of facilities to meet the demands of water quality regulations and planned development. The siting process shall include adequate public participation to provide for successful siting and initiation of a positive, long-term, good neighbor relationship with affected citizens.

The City encourages development of a regional wastewater collection and treatment system and therefore discourages siting of on-site or package plant wastewater treatment systems to serve individual developments or economic development projects.

Industries with potential to generate high strength wastes with loading in excess of available treatment capacity, will be required to provide pretreatment before discharging to the public sanitary system. The City may, at its option, contract with industries to build, own and operate pretreatment facilities serving one or more industrial sewer users in planned industrial developments. Costs of design, construction, operation and maintenance of pretreatment facilities shall be borne proportionally by flow and load by connected industrial users.

5-3.1.1 Technological Solutions

Wastewater treatment and reclamation facility designs shall include technological solutions for siting impacts such as odor control, sound attenuation and traffic, to minimize impacts, risk and potential for regulatory penalties.

5-3.1.1.1. Industrial Waste Treatment

Facility planning shall consider current and proposed commercial and significant industrial users requiring treatment service. Assessment of the existing industries' and the City's philosophy, policies and plans for development and growth is required to assure adequate treatment capacity is provided to balance economic development with protection of water quality. Quantity and strength of industrial wastes will determine if a new or expanding industry's waste load can be treated within the available capacity of the City's system. Pretreatment of wastes may be required to meet pretreatment program effluent limitations and/or reduce wastewater loadings. The City reserves the right to build, own and operate pretreatment facilities serving one or more industrial customers.

SECTION 6 GEOTHERMAL HEATING FACILITY

6-1 Purpose

Geothermal system general criteria are provided to provide guidance for design of new and rehabilitated geothermal heating systems owned by the City. For detailed specifications about design of the mechanical, electrical and process systems for geothermal systems, contact the Water/Geothermal Division.

Geothermal heat is a unique resource that provides potential economic advantages for users of the system. Where use of geothermal heat is technically and economically feasible, the City will make it available, within the capacity of the system, for public, institutional, commercial and industrial uses. The City's goal is to fully utilize the system capacity, while preserving the integrity of the geothermal aquifer in compliance with the Geothermal Management Act, Sections 4.440 to 4.400 of the City Code.

6-2 Geothermal Pricing and Extension Incentive Policy

City Council resolution 01-13 governs the pricing of the City's geothermal heat. This pricing policy is subject to change at Council's discretion. The standards rate for geothermal service is indexed at eighty percent (80%) of the PUC approved rate for natural gas based on metered BTU consumption. An additional flow surcharge may be imposed by the City if the customer's installed system does not meet the City minimum design standards (See Subsection 6-3). The temperature design standards have been established to encourage efficient utilization of this precious resource. The City also encourages the retrofitting of existing buildings. Retrofits are eligible for up to one calendar year of geothermal service at no charge. The City also offers a three year no interest loan to encourage retrofit connections. The City may assist in the cost of extending the mainline service of a property when resources, distance and/or demand justify a City funded extension. However, in most cases the developer will be responsible for the costs associated with running the geothermal service to its property. Other recapture arrangements are available under certain circumstances.

6-3 Design Criteria

6-3.1

All construction shall conform to state, and City standards. Geothermal pipe to be installed shall be structurally approved by the City of Klamath Falls Engineering Division.

6-3.2

Trenches shall be excavated to the depth and grade required. Pipe bedding shall be placed to provide uniform and continuous bearing support for the pipe on solid compacted material. Refer to city trench detail drawings.

6-3.3

All geothermal pipes not located in public right-of-way are maintained by the City of Klamath Falls, shall be a minimum of 16 feet in width for an easement. The city is to receive the original recorded easement. Vehicular access for maintenance will be provided.

6-3.4

No permanent structures are allowed to be constructed within the easement area, unless specific written permission is granted by the City.

6-4 Design Life

6-4.1 General

Geothermal service lines will be owned by the customer downstream of the City's mainline geothermal system isolation valves. The Customer will install the mainline tap and isolation valves at the property line or back of sidewalk. Mainline taps must be pre-approved under a City Permit issued by the Engineering Division and can only be performed in the presence of a City Inspector. The Customer is responsible for the design and installation of both supply and return service lines to the buildings, installation of all internal isolation valves, flow/BTU meter and heat exchanger within the facility. The City will provide the customer with pipe and fitting specifications if it proposes to install a mainline extension.

6-4.2 Geothermal Service Line Connections

The City recommends the use of Type L Hard draws Copper Tubing conforming to ASTM B88 for geothermal service lines. The City requires that all service lines be encapsulated with a high impact insulated jacketing material to prevent heat loss between the City's and the customer's system.

6-4.3 Heat Exchangers

All service connections require indirect use of the City's geothermal system with the installation of a heat exchanger. An indirect system is required to prevent problems associated with one customer's system impacting all the other geothermal customers. Heat exchangers shall be sized to achieve a minimum of 40 degree C drop across the unit. Temperature gauges shall be installed on both the hot and cool side of the device. Units that cannot achieve this drop may be subject to a flow surcharge.

6-4.4 Flow/BTU Meters

Flow/BTU meters shall be installed inside the developer's building in a mutually agreed location that facilitates access for meter reading by City staff. Flow/BTU meters will be supplied to the developer at no charge. The Developer will provide 110V service at the meter location and install the unit on the supply side of the heat exchanger. Isolation valves shall be installed upstream and downstream of the meter location to facilitate future replacement. The City will calibrate the meters prior to charging the system

6-5 Environmental and Aquifer Protection

Geothermal heating systems shall be designed for a minimum environmental impact in materials used, methods of construction and impact of heat and reinjection on the environment. Designs shall consider impact of each project in the geothermal aquifer with the goal of sustainable use of this resource.

6-6 Personal Safety and Health, Ergonomics, Workspace and Control Facilities

Use of geothermal water heating sources creates a system with inherent hazards to safety and health of the public and utility employees. Risk of exposure to hot water under pressure, corrosive conditions, electrical and mechanical hazards and confined entry conditions shall be minimized through good design.

SECTION 7 WATER FACILITIES

7-1 Purpose

The City owns and operates its water system as a public utility. As such, the City is responsible for ensuring the safe and reliable production and distribution of potable water to its customers.

The standards provided herein are intended to protect the integrity of the existing system and ensure that the future system operates efficiently. The City reserves the right to approve or reject any materials and devices proposed to be incorporated into the water system. The City also reserves the right to require that any proposed addition(s) to the water system comply with reliability, redundancy, construction and capacity requirements as outlined in these standards.

7-2 Summary

These standards represent the minimum requirements for the design and construction of water production and distribution facilities within the City's water system.

All improvements and additions to the potable water system will comply with the current and applicable requirements of the following standards:

- 1) Only new, unused pipe, fittings, meters and all other appurtenances will be accepted by the City for dedicated infrastructure within the City's water system. Refurbished, reconditioned, etc. materials or equipment of any kind are not acceptable for use in the City's water system.
- 2) The current Oregon Revised Statutes.
- 3) The Oregon Department of Human Services (DHS), Drinking Water Section, of the Oregon Administrative Rules.
- 4) The current American Water Works Association (AWWA) Standards for the design and construction of public water systems.
- 5) The current City of Klamath Falls "Standard Guidelines for Back Flow Prevention Assemblies" manual.
- 6) The current American Public Works Association – Oregon Chapter Standard Specifications.
- 7) The current City of Klamath Falls Water System Master Plan

In case of a conflict between standards, the design criteria of the City as presented herein shall govern.

7-2.1 Definitions

The terms used in this Design Standard and on construction plans and details shall have the following meanings:

7-2.1.1 Air Vacuum Control Valve (AVC):

An air vacuum control valve (AVC) is a control device that allows air to vent from a water main or allows air to enter the main to prevent a vacuum from forming in the main.

7-2.1.2 Appurtenances

Appurtenances are the fittings, connections pieces, control devices and any other miscellaneous equipment that make up a functioning water system.

7-2.1.3 Average Day Demand (ADD)

The average daily usage of water over a given one year period.

7-2.1.4 Back Flow Prevention Assembly:

A “back flow prevention assembly” is a system of gate valves and check valves used to prevent the reversal of the flow of water from an individual consumer, back into the City water system.

7-2.1.5 City Water System

The City water system is a collection of elements that produce, store, distribute and deliver potable water to the public for a number of consumptive uses.

7-2.1.6 Engineered Plan

An engineered plan will be required for all water system improvements to be constructed for any given private development or public improvement project. This plan will be drawn to scale, showing the layout and details of all water system improvements to be constructed. Please note SECTION 10 of these Standards.

7-2.1.7 Equivalent Residential Unit (ERU)

An equivalent residential unit (ERU) is the amount of water required to support the domestic consumption for one family unit, residing in a typical single family home. Refer to the values in the Connection Request Report available from City Engineering.

7-2.1.8 Flush Out

A flush out is a combination of piping, valves and fittings that will allow water to be drained from the City water main.

7-2.1.9 Point of Service (POS)

The “point of service” (POS) is defined as the location, on any water service, where the City’s maintenance responsibility ends. The POS for service sizes two-inch and smaller is the outlet connection of the water meter, including the meter box and lid. The POS for service sizes three-inch and larger is the outlet connection of the water meter, excluding the meter vault and lid. The POS for fire services is the point at which the fire service line leaves the right of way (ROW) or easement. In case of a fire service double check valve assembly, with a usage detector check (DDC) in a vault in the ROW or water main easement, the POS is the location at which the fire service line enters the vault.

If any water service line extends out of the ROW or easement (i.e.: the meter or DDC is inside the facility’s “mechanical room”) the service owner will install a valve at the property line. In these cases the property owner will be responsible for maintenance and repair of all underground water infrastructure “downstream” from the valve.

7-2.1.10 Pressure Zone

A pressure zone is a portion of the distribution system in which all customers receive water within a defined pressure range. Due to the extreme elevation changes within the City system, pressure zone boundaries may fall within developmental areas. A pressure-reducing valve (PRV) is a control device that maintains system pressure at the intersection of two different pressure zones.

7-2.1.11 Tie-ins

A tie-in is the point of connection of a new water main to the existing water system. Tie-ins made to the existing main, while the main remains in service are tap connections. Tie-ins made by removing a piece of the existing main and inserting a connection fitting are cut-in connections. Tie-ins made at the end of an existing water main are dead end connections. All tie-ins will be connected using mechanical joint type “cut in sleeves”, with restrainer fittings at each end. No “flex type” couplings will be allowed.

7-2.1.12 Water Mains

Water mains are pipes placed in street rights-of-way and utility easements for distributing potable water to City customers.

7-2.1.13 Water Utility Maps

The water system utility maps are working drawings, compiled over the life of the utility. These maps represent the most accurate information available regarding the location, size and construction material of all City facilities.

7-2.1.14 Water Services

Water services are short runs of pipe connected to water mains to supply water to individual lots or parcels. A water service pipe installed to supply an on-site fire suppression system is a fire service. Fire services require a (DDC) approved by the Oregon State Health Division with a usage detector meter. A water service installed for the sole purpose of supplying water to a landscape irrigation system is an irrigation service. All irrigation services require a water meter and the installation of an Oregon State Health Division approved back flow assembly.

7-2.1.15 Water System Model

A water system model is a mathematical representation of the characteristics of a water system (pipes, storage, production, pumps, and controls) used to predict the pressure, flow, velocity, and energy losses expected under a given system demand scenario (e.g. peak day demand or peak day plus fire flow).

7-2.2 Development Permit

A water system concept (preliminary utility plan) will be submitted to the City with the Development Permit Application for all proposed development that will result in water supply demands exceeding two hundred and fifty (250) ERUs at its saturation build-out. The planning level concept shall include preliminary demand calculations and/or modeling reports that estimate initial, phased, and ultimate domestic and fire demand required by the development. The concept shall include general locations of any proposed connection to the existing water system, identification of proposed pressure zones, and preliminary locations of any booster station(s)

and/or reservoir(s) required to ensure adequate domestic and fire service pressures to the development.

This information will assist the City in confirming that adequate water capacity is available at the proposed connection point(s). In addition, the information will be used to determine whether the proposed development shall assume responsibility for the cost of any capacity improvements necessary to accommodate the proposed development. The City reserves the right to require a comprehensive system capacity analysis if, in its opinion, the proposed development may have the potential of operational, supply or hydraulic impact on the current water production or distribution system.

7-2.3 Site Construction Permit

Prior to the City's issuance of the Site Construction permit, design calculations and construction documents shall be submitted to the City for review and approval for any proposed connection or water system improvements regardless of development size. The submittal shall include a design stamped by an Engineer licensed by the State of Oregon and include all information necessary for the City to verify that the proposed facilities meet all design criteria defined in these standards. The plan will include detailed notes describing all pertinent construction phases, areas of responsibility, standard references and specific instructions that will affect the successful completion of the project. The plan shall meet the City's design and drafting standards.

The Site Construction Permit will not be granted until the City has been satisfied that all requested design modifications have been addressed by the applicant and that all required easements have been granted to the City. The design submittal shall include all drawings, specifications and supporting calculations needed to verify that the proposed water system improvements and/or connections align with the water system concept (utility plan) approved during the City's Development Permit process and that the design meets the City's standards as specified herein. All proposed agreements between the applicant and the City regarding cost sharing, advance financing, utilization of SDC credits, etc. shall be signed by all parties prior to the issuance of the Site Construction Permit. The City will not accept water system improvements that an applicant intends to dedicate to the public unless the improvements are reviewed and approved by the City prior to the start of construction.

7-3 Production Facilities

In general, the City assumes the lead in the design, construction and funding of water production system improvements. However, developers may be required to construct and dedicate new public facilities or provide the water system with the funding necessary to offset the cost of increased capacity required to serve a proposed development. Typically, this is the case with large "Planned Unit Developments", commercial/industrial users, and/or other users that will potentially place a significant demand on the current water system. Some capacity related dedications may be eligible, in part, for financing or expense recapture through various City programs. It is the City's intent to identify these requirements and/or options during the Development Permit process.

7-3.1 Wells

The City obtains all of its potable water from groundwater wells drilled into the water bearing strata beneath the Klamath Basin. Proper well placement, design, construction and development are critical to the economical and sanitary production of water supplies. Any proposed public dedication of new well facilities will be identified during the City's Development Permit process and identified on the required water system concept submittal. The proposed dedication will include a planning level concept outlining the preliminary demand and engineering production calculations that verify that the proposed well and the connecting water system will meet City's

capacity requirements and will be consistent with the hydraulic operation of the surrounding City system. The planning level concept must be approved by the City before well construction (or geological testing) begins.

The City will not consider or accept any production well dedications under 420 gpm of capacity. All new production wells over 420 gpm that the applicant intends to dedicate to the City will be designed and constructed to provide 140 percent of the maximum peak day demand at saturation build-out of the proposed development. Applicants must apply for and receive the appropriate "Water Rights" certification from the Oregon State Water Resources Department. These rights must be assigned to the City prior to the public dedication.

A testing and development plan must be approved by the City, for any proposed dedicated well, prior to construction of the production well.

7-3.2 Well Pumping Plants and Facilities

Well pumps are specific to individual wells and distribution system requirements. All pump designs will be submitted to the City for approval and shall include all engineering calculations necessary to verify the pump will meet City hydraulic and capacity requirements.

In order to maintain water supplies during emergency situations, the City will require generator "back-up" power at each well pump location. Generators will be sized to fully power the well pump and associated facilities. Generators shall be diesel powered and capable of operating at least 48 consecutive hours without re-fueling. The fuel tank shall be mounted within the unit (no free standing tanks).

7-3.3 Water Storage Reservoirs

Reservoirs are located throughout the current distribution system and are placed at locations and elevations that support the City's operational, hydraulic and system management plan. Any proposed development that will require demand capacity greater than 450 ERUs (or fire suppression requirements greater than the existing system will support) will be required to provide reservoir storage. New reservoirs will be designed to maintain water storage capacity equal to 150 percent of the development's peak day demand at saturation build-out. They will also be designed to meet applicable fire storage requirements. Fire storage for residential services will be equal to 1500 gpm for two hours. Developments that include commercial or industrial designations will provide fire storage at 2500 gpm for three hours. In areas served by more than one storage or pumping facility, "fire flow" storage requirements may be reduced with concurrence of the Fire Department. New reservoirs shall also be designed to complement their surrounding environment and meet any specific aesthetic requirements established as a condition of Development Permit. This storage capacity requirement does not exempt or offset the required SDC charges.

7-3.4 System Control

Control and remote operations of any proposed water system pumping, storage or production infrastructure that will be dedicated to the City shall include a computerized radio telemetry system. All facilities will be equipped with components that are compatible with the City's control and telemetry system. Please see SECTION 9 of these Standards.

7-4 Design Criteria

The following criteria will be used as minimums when planning and designing water facilities that will be dedicated to the City water system. Situations not specifically covered in this section (or

these Standards) should be discussed with Public Works Department staff before the Development Permit Application is submitted.

7-4.1.1 City Wells

Wells dedicated to the City will provide at least 115 percent of the maximum PDD for the development served.

7-4.1.2 Fire Flow Requirements

The amount of flow (gpm) and duration (hours) required at a site for fire protection are as per City Standards and the requirements set by the Oregon State Fire Marshall (OSFM) in the Oregon Fire Code. City minimum Fire flow requirements are 1500 gallons per minute for 2 hours in residential (only) areas and 2500 gallons per minute for 3 hours in commercial / industrial areas. OSFM requirements are based on the International Fire Code (IFC) with amendments as authorized by the Oregon Revised Statute (ORS) 476.030 and in accordance with OAR Chapter 837, Division 40. Flow Capacity Requirements

Flow capacity requirements for domestic and commercial services are as follows:

1. Peak Day Demand equals 960 gallons per day for one ERU. (.67 GPM)
2. Average Day Demand equals 750 gallons per day for one ERU. (.52 GPM)
3. Peak Hour Demand equals 64 gallons per hour for one ERU. (1.07 GPM)

7-4.1.3 Storage Requirements

Storage requirements are 100 percent of the Peak Day Demand plus the applicable fire flow for any development larger than 450 ERUs or a development that will impose capacity requirements greater than the existing water system will support.

7-4.1.4 System Pressure

System pressure within new development service areas (and in the existing service area affected by the development) will be maintained at a minimum of 42 pounds per square inch and at a maximum of 105 pounds per square inch. Please see 7-5.2.

7-4.1.5 Water Velocity

Water velocity in any City water main will not be permitted to exceed limits discussed in 7-5.1

7-5 Distribution Systems

7-5.1 Water Mains

All new water mains will be either Class 50 Ductile Iron Pipe, according to AWWA Standards section C100, or DR 18 Polyvinyl Chloride Pipe, according to AWWA Standards section C900. All water mains larger than twelve-inches shall be constructed of ductile iron pipe. C900 PVC mains will be colored blue, throughout the entire composition of the pipe. The City may entertain or direct changes to these material standards where pressure considerations or ground conditions warrant modification.

The City has standardized on five nominal pipe sizes for mains 24-inch and smaller. These include 8,12,16, 20, and 24 inch diameter pipe. Pipe selection shall be based on this standardization and these velocity limitations.

Water mains will be sized to meet the following flow criteria:

- 1) In residential areas, velocity shall be less than four and one-half (4.5) feet per second, during the peak usage hour, calculated using the saturation build-out ERUs.
- 2) In commercial / industrial areas, velocity shall be less than seven and one-half (7.5) feet per second, during fire flow on the peak usage day (at saturation build-out ERUs).
- 3) Water mains in residential areas will be a minimum of eight-inch (8") nominal diameter.
- 4) Water mains in areas serving commercial/industrial zonings will be a minimum of twelve-inch (12") nominal diameter.
- 5) Pipe size selection will not decrease the residual pressure within the existing distribution system below 20 pounds per square inch, during a fire situation or 42 pounds per square inch during normal usage periods.

Water main extensions that will be dedicated to the City will be installed so that the main extends a minimum of twenty lineal feet past the development to be served.

Mains will be placed and constructed as indicated on the approved engineered plan. Back filling, compaction and surface restoration will be as required by the Agency having jurisdiction of the right-of-way.

7-5.1.1 Tapping Main Lines

When tapping existing water main lines, the contractor shall use a Romac SST Tapping Tee or approved equivalent. Ductile Iron tapping sleeves are not acceptable for use, except on Ductile Iron pipe.

When tapping existing water main lines, the contractor shall make provisions to continuously flush and purge water through the non-pressurized side of the tapping valve (toward the bottom), or through the tapping machine. Using a corporation stop on the testing tap on the tapping sleeve is not acceptable. When working with asbestos pipe, refer to Appendix 7-A for proper handling. The contractor is responsible to dispose of contaminated water and asbestos pipe in accordance with DEQ regulations.

The purpose of this procedure is to prevent the fouling of valves, regulators, meters and other equipment with chips and to prevent the unnecessary addition of asbestos and other debris to drinking water.

City personnel must be present any time a tap is made on the City's existing water main lines.

7-5.1.2 Working with Asbestos Pipe

See Appendix 7-A.

7-5.2 Distribution Pumping Plants (Booster Stations)

Specific service areas or pressure zones may require the installation of a pumping plant to provide flow capacity or adequate water pressure. Design and installation of booster stations, when required, will be the responsibility of the developer. The City will accept booster stations as part of the dedicated infrastructure if the proposed station serves a development of 25 ERUs or more. In developments of less than 25 ERUs, water pumping and delivery will be operated as a private water-delivery system. Private systems will require a "master meter" at the City "point of service" upstream of the pumping station and appropriate cross-connection control devices. If water pressure can be maintained above 20 pounds per square inch at all "points of service" within a development, the City will consider allowing privately operated booster pumps (residential) at each service location.

Booster station design is specific to the distribution service area and the hydraulic conditions of the adjacent water system. Any development that proposes to dedicate a booster station to the City shall submit the detailed design for review and approval prior to the issuance of the Site Construction Permit. The design shall include demand and hydraulic calculations and all materials specifications necessary for the City to verify that the proposed facility meets the City's flow and technical requirements. The developer and its engineer are encouraged to contact Water Division staff early in the development process to discuss booster station design and construction alternatives.

Modeling will be required when a booster pumping station is necessary. Modeling will evaluate both existing system characteristics and system characteristics after the proposed booster station installation. If the additional flow volumes created by the booster station result in conditions that exceed the limits stated in Section 7-3.3 or 7-5.1 above, the developer will be required to provide water production, storage and distribution facilities sufficient to offset increased demand.

In order to maintain water supplies during emergency situations, the City will require generator "back-up" power at each booster pump location. Generators will be sized to fully power all pumps and associated facilities. Generators will be diesel powered and capable of operating at least 48 consecutive hours without re-fueling. The fuel tank will be mounted within the unit (no free standing tanks).

7-5.3 Valves

All water mains twelve-inch and smaller will be fitted with resilient wedge epoxy lined and coated gate valves, according to AWWA Standards section C500. Substitution of butterfly valves will only be permitted when field conditions require the main to be installed with "minimum cover." In these cases gate valves may not allow adequate "surface to operator nut" clearance.

Water mains larger than twelve-inch will be fitted with either gate or butterfly valves, with resilient valve seats and epoxy lining and coating, according to AWWA Standards section C500.

Isolation valves will be installed on all City mains at intervals no greater than 500 linear feet. At water main intersections, valves will be installed as detailed on the engineered plan.

Submittal data will be required for all valves installed in the City system.

See Standard Drawing 7-100 to 7-125 and the approved engineered plans for installation details and requirements.

7-5.4 Services

All water, fire and irrigation services will be installed by the developer at the time of original construction. See Standard Drawing 7-100, 7-100(a, b & c), 7-105 and the approved engineered plans for installation details and requirements. Where existing mains are in place, City personnel will install services sized two-inch and smaller in those area currently served by existing City water mains. The developer will install services larger than two-inch. Water services (other than fire services) larger than 2-inch will require a 2-inch lockable meter bypass for exclusive use by City Water Division staff during meter maintenance. Materials for services larger than two-inches shall correspond to requirements for mains and appurtenances.

7-5.5 Fire Hydrants

All fire hydrants will be installed by the developer at the time of original construction. All fire hydrants will be Kennedy K-81 D.

See Standard Drawing 7-110 and the approved engineered plans for installation details and requirements.

7-5.6 Pressure Zone Control

If a pressure reducing valve (PRV) is required within a development to provide appropriate residential pressure, the developer will design and install an approved PRV station as part of the water facilities provided. PRV station design and hydraulic capabilities are specific to the distribution area to be served. The PRV station design shall be submitted to the City for approval prior to the issuance of the Site Construction Permit. The submittal shall include all engineering calculations necessary for the City to verify that the station meets the City's hydraulic and material requirements. In addition, the submittal should address any anticipated hydraulic impacts on the existing water system.

Flow modeling may be required when a PRV station is necessary. The modeling effort will evaluate both existing system characteristics and system characteristics after the proposed PRV installation. If the additional flow volumes created by any proposed development result in velocities that exceed those stated in Section 7-5.1, the developer will be required to provide larger or additional water distribution facilities.

See Standard Drawing 7-125 and the approved Engineered Plans for installation details and requirements.

7-5.7 Air-Vacuum Control

An air-vacuum control (AVC) device is required on any City Water main where a "high spot" exists at any point between lower portions of the main. A "high spot" is any location at which the main rises more than one-half (.5) times the nominal pipe diameter, and then descends to the previous elevation.

See Standard Drawing 7-120 and the approved engineered plans for installation details and requirements.

7-5.8 Flush Outs

A flush out is required on all dead end portions of City mains. A fire hydrant may be installed instead of a flush out at the end of a cul-de-sac.

See Standard Drawing 7-115 and the approved engineered plans for installation details and requirements.

7-5.9 Backflow Control

All services that present a cross contamination risk to the public water supply must be equipped with a backflow prevention assembly approved by the Oregon Health Division. Designers are to refer to the current edition of the "City of Klamath Falls: Standard Guidelines for Backflow Prevention Assemblies" manual for information.

See the approved engineered plans for installation details and requirements.

7-5.10 Appurtenances

All fittings needed to provide a fully functional water distribution system, not specifically covered in these specifications are to be manufactured and installed according to the latest edition of the AWWA Standards.

7-5.11 Disinfection of Facilities

Following completion of new facilities, including wells, valves, pumps, water mains and service connections, which will be in contact with the water delivered to users, said facilities shall be disinfected before they are placed into service. Disinfection shall be by chlorination according to Oregon Administrative Rules 333-061-0050(10) and AWWA Standards C651 through C654. Disinfection shall include but not be limited to the introduction of a chlorine solution with a free residual of 25mg/l into the facility in a manner that will result in a thorough wetting of all surfaces. The solution shall remain in place for 24 hours. After the 24-hour period, the free chlorine residual must be checked and found to be 10 mg/l or greater. The chlorine solution shall be drained and the facility flushed with potable water. A minimum of one sample shall be collected from the facility for microbiological analysis. Should any test fail, the facility shall be flushed, rechlorinated and rechecked until a sample free of coliform organisms is obtained. Other disinfectants may be used if demonstrated that they can also achieve the same results.

7-6 Facilities, Infrastructure and Property

7-6.1 Site Enclosures

All City Water wells, reservoirs, pump stations and buildings will be contained within a limited access enclosure. Enclosures will be (minimum) six-foot tall, nine-gauge, chain link fencing with a heavy-duty top rail and 12.5-gauge stranded bottom tension wire. Enclosures will be equipped with at least one 16-foot "drive through" double gate and one 36-inch "walk through" gate. When appropriate, enclosures will include three-wire "anti-climb" top barrier. Fences (or other enclosures) will be positioned so that a service truck, with a standard 160-inch wheel base, can travel around all buildings or facilities without reversing direction.

Site enclosure requirements may be altered depending on the specific usage or location of the property or facility. Additional costs associated with requirements that are more stringent will be the responsibility of the developer.

7-6.2 Buildings

All City water buildings and structures that house mechanical, electrical, electronic or other temperature and humidity sensitive equipment shall contain central climatic control apparatus. Atmospheric conditions inside the structures shall be maintained according to the recommendations of the equipment manufacturers. No

climatic control equipment will be installed without approval of the City. Please see SECTION 9 of these Standards.

7-6.3 Access

All City Water properties and facilities shall be accessible by way of an improved roadway connecting to a public right-of-way. The minimum requirements for access driveways outside the City limits include: a minimum width of 20 feet; base course of at least eight inches of 1 ½ inch minus compacted to 95% of AASHTO T-99; surface course of at least 3 inches of "¾ inch minus" compacted 95% of AASHTO T-99 and drainage that meets the requirements of SECTION 4 of these Standards. The minimum requirements for access driveways within the City limits include a minimum width of 20 feet; base courts of at least 6 inches of 1 ½ inch minus, compacted to 95% of AASHTO T-99, asphalt paving 'B' mix (3 inch thickness, minimum), and drainage that meets the requirements of SECTION 4 of these Standards.

All access driveways shall be located in areas wholly controlled by the City through a dedicated easement. Shared usage will be permitted, but the access needs and requirements of City will have precedence over all others. All easements or private usage agreements will be recorded with the appropriate governmental authority and will be non-revocable.

7-6.4 Property

All City Water buildings or other structures (not located in rights-of-way) will be located on property deeded to the City. Easements or private usage agreements will not be considered as viable alternatives to City ownership. Water system improvements required as a condition of public dedication of infrastructure will be constructed on property that is deeded to the City. Property will be free of encumbrances, as reported in a title search provided by the developer and approved by the City attorney.

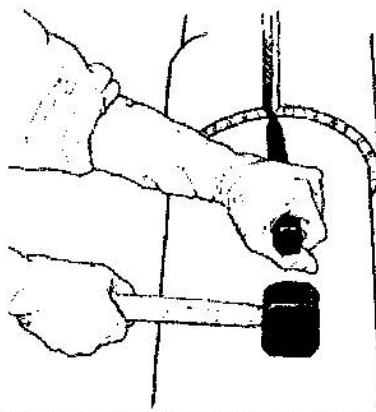
EXHIBIT 7-A

8. USING HAMMER AND CHISEL TO REMOVE COUPLING FROM AC PIPE IN ALL SIZES.

Replacement of damaged pipe necessitates excavation, exposure and removal. AC coupling removal may be accomplished by gradually splitting the coupling lengthwise using a chisel and hammer. After the top of the coupling has been split, a crowbar or similar tool is used as a lever to split the bottom of the coupling.

KEEP MATERIAL WET AT ALL TIMES.

DO NOT blow out with compressed air, dry sweep, or vacuum **with a non-HEPA rated vacuum cleaner!**



DEQ and Oregon OSHA have carefully evaluated the above procedures and determined that they can be used safely when handling and repairing AC pipe.

REMEMBER, DEQ regulations require that all asbestos-containing materials be kept wet during removal and disposal in accordance with the asbestos disposal regulations. Exceptions to these requirements must be approved prior to starting an asbestos removal project.

EXHIBIT 7-A

REMOVING NONFRIABLE ASBESTOS (AC) WATER PIPE

PART I GENERAL

1.01 SUMMARY

Exposure to asbestos can result in severe health impacts and the Department of Environmental Quality (DEQ) regulates the removal, handling and disposal of asbestos-containing materials (ACM) during construction, remodeling, and demolition. This section outlines handling procedures for working with water pipe that contains asbestos. For a complete list of Oregon DEQ regulations involving the removal of asbestos materials, visit the DEQ website at <http://www.deq.state.or.us/ag/asbestos/Contractors.htm>.

PART 2 PRODUCTS

NOT USED

PART 3 EXECUTION

3.01 GENERAL

When handling AC pipe, make sure the material stays in a nonfriable condition. Friable asbestos material will easily release fibers when crushed. Nonfriable asbestos material holds the asbestos fibers within a solid matrix and will not allow asbestos fibers to release easily, unless mishandled, damaged, or in badly weathered condition. In most cases, AC pipe is considered nonfriable. Nonfriable asbestos materials in good condition are exempt from some DEQ rules. You do not need to be a DEQ licensed asbestos contractor or DEQ certified asbestos worker to do nonfriable removal. If you follow the procedures in this guide, the AC pipe should remain in nonfriable condition.

Nonfriable material must be handled, transported, and disposed of in a way that prevents it from becoming friable and releasing asbestos fibers. For more information about the asbestos rules or if you have questions contact the DEQ regional office:

Easter Region Bend at (541) 388-6146, ext. 226

The Oregon Occupational Safety and Health Division (OR-OSHA) has rules about worker training, building surveys, and the safe handling of nonfriable asbestos. (See OAR 437, Division 3, Construction.) Contact OR-OSHA at (503) 378-3272 for current rule and policy information.

3.02 OPERATION PROCEDURES

A. FOR AC WATER PIPE TO BE CONSIDERED NONFRIABLE, IT MUST BE REMOVED IN WHOLE SECTIONS.

You cannot cause the AC pipe to shatter, crumble, be pulverized, or release asbestos fibers. You cannot sand, saw, grind, chip, or use power tools on AC pipe. If you use this guide, licensing as a DEQ asbestos abatement contractor and DEQ worker certification are not needed.

1. File a DEQ nonfriable notification and pay the nonfriable fee as outlined in OAR 340-248-0260.

EXHIBIT 7-A

2. Keep the material wet while you remove it. You can use a water hose, garden sprayer, spray bottles, or any method that keeps the material wet. Wetting prevents fiber migration during removal.
3. Pull the pipe up out of the ground in easy to handle lengths (3 feet to 5 feet), using DEQ approved procedures.
4. Place the pipe in leak-tight containers with a warning statement "DANGER ASBESTOS-CONTAINING MATERIAL". The asbestos-containing waste material (ACWM) must remain wet until disposed of at a landfill authorized to handle asbestos waste. Fill out a DEQ ASN-4 waste shipment report for transport and give it to the landfill upon arrival. DEQ advises you to contact the landfill before you start your project so you can find out what that landfill's disposal needs are. Many landfills require asbestos to be specially packaged and labeled. Nonfriable asbestos waste may not be used as clean fill and DEQ rules do not allow on-site burial of AC pipe, unless the reason for this burial meets specific exception conditions!

NOTE: DEQ knows that some breakage and damage will occur during this process. However, that breakage will be minimized if you follow this guide.

B. USE THE FOLLOWING PROCEDURES WHEN THE REMOVAL RESULTS IN THE AC PIPE BECOMING FRIABLE.

If AC PIPE is shattered, damaged, or badly weathered, it will become friable and release dust and asbestos fibers. A DEQ licensed asbestos abatement contractor using DEQ certified workers must remove all friable asbestos materials.

All asbestos abatement rules under OAR 340-248-0010 through 0290 must be followed, including the following:

1. File a friable asbestos abatement notification And fee as outlined in OAR 340-248-0260
2. Hire a DEQ licensed asbestos abatement contractor to remove the asbestos for you.

The following information was excerpted from the American Water Works Association guideline for handling AC pipe. This information is modified to make it compatible with the DEQ asbestos removal regulations. There may be other removal and handling procedures employing non-power options that are equally effective and also meet DEQ asbestos requirements.

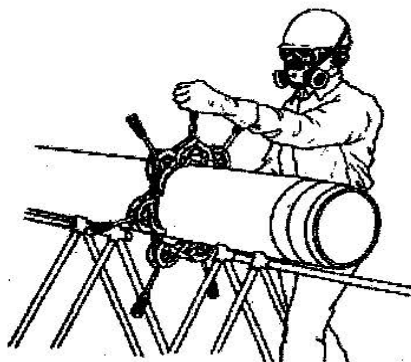


EXHIBIT 7-A

AMERICAN WATER WORKS ASSOCIATION RECOMMENDED WORK PRACTICES FOR CUTTING AND SPlicing CEMENT WATER PIPE

1. USING CARBIDE TIPPED BLADES TO CUT AC PIPE, IN SIZES FROM 3 INCH THROUGH 24 INCH.

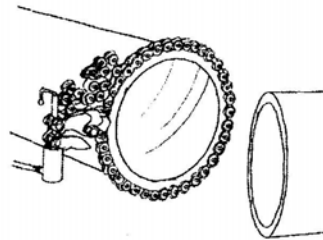
Blade cutters are frame adjustable to the circumference of the pipe and have a number of selftracking rollers that align one or more carbide-tipped cutting blades. Because of the relatively low mechanical input and clean cutting action, hand operated blade cutters do not produce significant amounts of airborne asbestos dust.

KEEP MATERIAL WET AT ALL TIMES

DO NOT blow out with compressed air, dry sweep, or vacuum with a non-HEPA vacuum cleaner!

2. USING SNAP CUTTERS TO CUT AC PIPE IN SIZE RANGES 3 INCH THROUGH 24 INCH.

Snap cutters ("squeeze-and-pop" equipment) operate by means of cutting wheels mounted in a chain wrapper around the pipe barrel. Hydraulic pressure, applied by means of a remote, pneumatically, or manually operated pump, squeezes the cutting wheels into the pipe wall until the cut is made. This type of cutting minimizes the release of asbestos fibers.

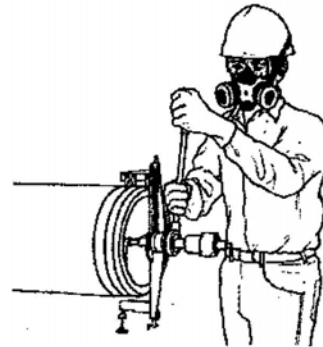


KEEP MATERIAL WET AT ALL TIMES.

DO NOT blow out with compressed air, dry sweep, or vacuum **with a non-HEPA rated vacuum cleaner!**

3. USING MANUAL FIELD LATHES TO MACHINE AC PIPE IN ALL SIZES

Manual field lathes are designed to end-trim and re-machine rough pipe barrels to factory-machined end profiles. The lathe consists of an adjustable, self-aligning arbor inserted into the pipe bore (which acts as a mandrel upon which the turning handle operates), a screw-fed turning frame, carbide machining blades, and manual (hand or ratchet) turning handles.



KEEP MATERIAL WET AT ALL TIMES.

DO NOT blow out with compressed air, dry sweep, or vacuum **with a non-HEPA rated vacuum cleaner!**

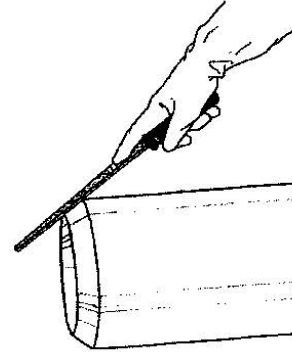
EXHIBIT 7-A

4. USING A MANUAL RASP TO MACHINE AC PIPE IN ALL SIZES.

Short lengths of AC pipe, machined-end exclusively (MEE) and machined overall (MOA), can be cut to make closures and repairs and to locate fittings exactly. Field-cut ends may be rebeveled with a coarse wood rasp to form a taper approximating the profile of the factor-beveled end.

KEEP MATERIAL WET AT ALL TIMES.

DO NOT blow out with compressed air, dry sweep, or vacuum with a non-HEPA rated vacuum cleaner!



5. WET TAPPING AC PRESSURE PIPE IN ALL SIZES.

Pressure or "wet" tapping for service connections is performed in the trench while the pipe is under pressure. The equipment (manual driven) is affixed to the pipe by means of a chain yoke. A combination boring-and- inserting bar drills and taps the pipe wall and inserts a corporation stop or pipe plug. The pressure chamber, which protects against water leakage, also catches the asbestos-cement chips, so this is essentially a dust-free operation. To minimize (1) the fouling of valves, regulators, meters, and other equipment with chips and (2) unnecessary addition of asbestos to drinking water, provisions shall be made for continuous flushing through the tapping equipment with positive purge or "blow-off" features.

KEEP MATERIAL WET AT ALL TIMES.

DO NOT blow out with compressed air, dry sweep, or vacuum with a non-HEPA rated vacuum cleaner!

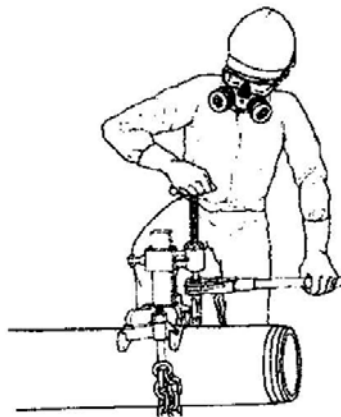


EXHIBIT 7-A

6. DRY TAPPING AC PRESSURE PIPE IN ALL SIZES.

Non-pressure or "dry" tapping for service connections may be performed in or out of the trench. The equipment is affixed to the pipe by means of a chain yoke. Separate drills and taps or a combination tool is used to drill and tap the pipe wall. Remember, always keep the pipe wet during these processes. Corporation stops or other connections may then be affixed to the pipe. To minimize (1) the fouling of valves, regulators, meters, and other equipment with chips and (2) the unnecessary addition of asbestos to drinking water, all dust and cutting should be removed from the pipe's interior by flushing with water, wet mopping, or vacuuming with a HEPA rated vacuum cleaner.

KEEP MATERIAL WET AT ALL TIMES.
DO NOT blow out with compressed air, dry sweep, or vacuum with a non-HEPA rated vacuum cleaner!



7. USING CHISEL AND RASP TO HOLE CUT AC PIPE IN ALL SIZES.

Holes may be cut into AC pipe with a hammer and chisel. The edge of a plumber's wood chisel is used to cut completely around the hole outline, about $\frac{1}{4}$ in. (7 mm) from the prescribed line. The operation is repeated and the cut deepened until through. The edges of the hole are then dressed with a coarse wood rasp. When cutting holes in AC pipe products, all dust and cuttings should be removed from the pipe or duct interior after the cutting operation. Removal may be accomplished by flushing with water, wet mopping or vacuuming with a HEPA rated vacuum cleaner.

KEEP MATERIAL WET AT ALL TIMES.

DO NOT blow out with compressed air, dry sweep, or vacuum with a non-HEPA rated vacuum cleaner!

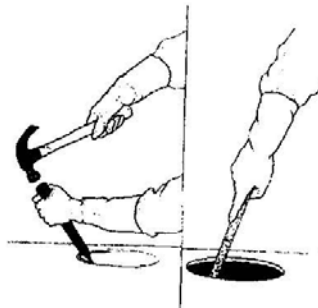


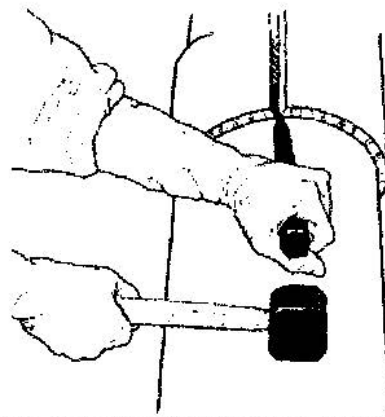
EXHIBIT 7-A

8. USING HAMMER AND CHISEL TO REMOVE COUPLING FROM AC PIPE IN ALL SIZES.

Replacement of damaged pipe necessitates excavation, exposure and removal. AC coupling removal may be accomplished by gradually splitting the coupling lengthwise using a chisel and hammer. After the top of the coupling has been split, a crowbar or similar tool is used as a lever to split the bottom of the coupling.

KEEP MATERIAL WET AT ALL TIMES.

DO NOT blow out with compressed air, dry sweep, or vacuum **with a non-HEPA rated vacuum cleaner!**



DEQ and Oregon OSHA have carefully evaluated the above procedures and determined that they can be used safely when handling and repairing AC pipe.

REMEMBER, DEQ regulations require that all asbestos-containing materials be kept wet during removal and disposal in accordance with the asbestos disposal regulations. Exceptions to these requirements must be approved prior to starting an asbestos removal project.

SECTION 8 STREETS AND RELATED WORK

8-1 General Requirements

All work performed in the design, preparation of plans, and construction or improvement of City streets and all appurtenances, whether public or private, shall be the responsibility of the developer or the developer's representative and performed to the satisfaction of the City. All work shall be completed in accordance with the plans and specifications approved by the City for the work.

It is emphasized that no permits will be issued to start work until plans for that work are approved and necessary bonds have been provided. Any revisions to the approved plans shall first be reviewed by the design engineer and then submitted for approval to the City before constructing. See individual utility sections of these standards for more specific record drawing requirements.

8-1.1 Development Permit

A road system concept will be submitted to the City with the Development Permit Application for all proposed development that intends to dedicate the road and street infrastructure to the public. The planning level concept shall include the proposed layout of initial, phased, and ultimate build-out of the street system, location(s) of snow storage areas, fire access and drainage concepts. The concept shall also include general location(s) of proposed connection to the existing City street system, preliminary grades of the road network and proposed pedestrian and vehicular safety improvements. The concept shall also identify the anticipated location of contractor's construction staging area(s).

This information will assist the City in confirming that the surrounding street network has adequate capacity to support the proposed development, assess whether a comprehensive traffic study is warranted and assist in the City's determination if the site presents the potential for erosion and road stability problems. In addition, the information will be used to determine whether the proposed development shall assume the financial responsibility for any public safety improvements necessary to accommodate the proposed development.

8-1.2 Site Construction Permit

Prior to the City's issuance of the Site Construction Permit, design calculations, soils reports and construction documents shall be submitted to the City for review and approval for any proposed public dedication regardless of development size. The submittal shall include a design stamped by an engineer licensed in Oregon and include all information necessary for the City to verify that the proposed facilities meet all design criteria defined in these standards. The plan will include detailed notes describing all pertinent construction phases, areas of responsibility, standard references and specific instructions that will affect the successful completion of the project. The plan shall meet the City's design and drafting standards.

The Site Construction Permit will not be granted until the City has been satisfied that all requested design modifications have been addressed by the applicant and that all required easements and rights-of-way have been granted to the City. The design submittal shall include all drawings, specifications and supporting calculations needed to verify that the proposed street improvement and/or road connections align with the road system concept approved during the City's Development Permit process and that the design meets the City's standards as specified herein. All proposed agreements between the applicant and the City regarding cost sharing, advance financing shall be signed by all parties prior to the issuance of the Site Construction Permit. The City will not accept any road or street improvements that an applicant intends to

dedicate to the public unless the improvements are reviewed and approved by the City prior to the start of construction.

8-1.3 Standards

The City may augment its Standards with the latest editions of the following design documents.

- American Association of State Highway and Transportation Officials (AASHTO) "Policy on Geometric Design of Highways and Streets."
- ODOT/APWA Standards
- Oregon Bicycle and Pedestrian Plan
- Klamath Falls City Code
- Klamath Falls Community Development Ordinance (CDO)

The City may also alter its design and construction standards pertaining to traffic control device placement and use with the latest editions of the recommended policies, procedures and standards of the following (in order of preference):

- Oregon Temporary Traffic Control Handbook
- Federal Highway Administration "Manual on Uniform Traffic Control Devices" (MUTCD) with any modifications from the Oregon Department of Transportation.
- The Institute of Traffic Engineers (ITE) Trip Generation Manual and design manuals.
- Illumination Engineering Society (IES) Design Manual.

8-2 Traffic Studies

All proposed development(s) will submit a traffic analysis that meets the requirements outlined in Section 12.

8-3 Roadway Classification

The City's roadway classifications are shown in Standard Drawings, Section 11. Criteria for minimum right-of-way, roadway widths and other design criteria are listed for each classification. Additional right-of-way and traffic lanes may be required to accommodate turning movements at intersections and as identified through traffic studies for proposed projects.

8-4 Rights-of-Way/Easements

Dedicated rights-of-way are required for all public street and roadway improvements. All portions of the traveled way, curb, gutters, sidewalks, medians, bike lane(s), drainage facilities and other required improvements shall be located within the right-of-way.

Where existing right-of-way width is not sufficient to construct the required improvements, the developer shall obtain the necessary additional right-of-way and arrange for dedications to the City according to a form prescribed by the City attorney. Generally, a statutory warrantee deed will be required and must be accompanied by a current title report for the property in question.

Easements for the purpose of construction, access, maintenance, sight distance preservation, roadway slopes, or for utility line and storm drain installation may be required, in addition to required right-of-way in conjunction with street and roadway improvements. It shall be the applicant's responsibility to obtain necessary easements and provide recorded copies of such easements to the City, before the issuance of the site construction permit.

Permanent easements for access, maintenance, and construction are required for all public and private street systems serving more than one property located outside of public right-of-way. Legal descriptions for easements shall be submitted with a professional land surveyor's stamp thereon. A current title report covering the properties to be encumbered by the easements shall accompany said description.

When off-site easements and/or on-site easements for extension of approved comprehensive street plans are required, they shall be approved and recorded prior to start of construction. The same conditions shall apply regarding legal descriptions and title reports.

8-5 Design Standards

8-5.1 Bike Lanes

Bike Lanes standards are to conform to AASHTO/STD as shown in Drawings (see Section 11, Standard Drawings). Applicant shall dedicate to the City the additional right-of-way and easements necessary to comply with the standards for bike lanes, trails and paths.

8-5.2 Utilities

The City has adopted a common utility trench/T-patch requirements (when applicable) on new construction within the right-of-way (see Section 11, Standard Drawings). Deviations from the Standard may be approved subject to review and approval by the City. The Applicant shall arrange for underground utility locations to be marked and surveyed prior to the City's design approval and the issuance of the Site Construction Permit. All utility information shall be included on the design submittal. The applicant's engineer/surveyor shall also research available utilities record information for use during the design, permit and construction process.

8-5.3 Streets

8-5.3.1 General Design Criteria

Continuation or appropriate projection of existing streets in surrounding areas shall be provided; or

Conformance to a plan for the neighborhood approved or adopted by the City to meet a particular situation where topography or other conditions make continuance or conformance to existing streets impracticable.

Where a new street or development abuts or contains an existing or proposed arterial or collector street, the City may require a common access street, to limit traffic impact to that street.

Non-arterial streets shall be designed such that their use by through-traffic will be discouraged.

A tangent at least one hundred feet long shall be included between reverse curves on arterial and collector streets, and shall have minimum tangent of 50 feet for local streets.

A Cul-de-sac is not an acceptable City street standard. The intent of not allowing cul-de-sacs is to promote connectivity and circulation for pedestrians and vehicles as well as aid in snow plowing, storage and removal. In such instances where the applicant requests the use of a cul-de-sac, approval must be obtained by both the Community Development Department and Public Works Engineering Division. Situations warranting approval of a cul-de-sac might include site constraints such as topography and/or adjacencies to rail lines, water bodies or restricted access roadways.

The maximum acceptable grade for any new street to be dedicated to the public is ten percent (10%). The minimum acceptable gutter grade shall be no less than 0.5%. Landings shall not have a grade greater than four percent (4%). A minimum landing length of 100 feet shall be provided at each intersection.

Curb lines at street intersections shall be rounded with a radius providing a minimum clearance and ADA access within the public right of way or of a greater radius where the City may deem it necessary. The City may permit comparable cutoffs or chords in place of rounded corners.

8-5.3.1.1. Unimproved Street Section

Unimproved street sections do not meet City of Klamath Falls standards. The City will not accept any unpaved roadways. Unimproved streets that are proposed may be considered by the City's variance process only with very compelling justification and only as an interim measure. Proposed (by Variance) unimproved street sections shall meet State and Local Fire Code requirements, must have at least 20-feet of unobstructed width, have adequate turning radius, meet all weather design requirements and have written acceptance by the local Fire Marshall regarding Fire Code only. Temporary services may include, but are not limited to, aggregate treatments and dust inhibitors to bind and control dust and particulates. All authorized unimproved street sections will be the property owner/developer's responsibility for annual maintenance and snow removal.

8-5.3.2 Horizontal/Vertical Alignment

Alignment of roadways within the City shall be in conformance with the guidelines of the American Association of State Highway and Transportation Officials (AASHTO) "Policy on Geometric Design of Highways and Streets" and the Oregon Department of Transportation "Design Manual."

8-5.3.3 Structural

Structural sections of roadway appurtenance are shown on Standard Drawings (See Section 11, Standard Drawings). The City may require the final lift of asphalt to be bonded for and delayed for up to one year to accommodate weather and/or other encumbrances that may impact the final quality of construction. A geotechnical study and subsequent recommendations will be required for any proposed new road construction, widening of existing roadways or major repair and overlay work. The geotechnical study must be performed by an OR licensed Geotechnical Professional Engineer (OAR 820-010-0450 (j) - Geotechnical; not 820-010-0450 (d) - Civil unless proficient in soils studies and roadway base section design), an OR Registered Geologist (RG) or an OR Certified Engineering Geologist (CEG). The pavement section design, based on a site specific soils report, must be prepared by a Civil Engineer proficient in soils studies and street section design. The developer shall be responsible for providing such reports, prepared by a professional engineer licensed in the Oregon, for review by the City. Modifications to the minimum road structural sections may be required to address site specific soil conditions, drainage and

vehicle loads. Where higher than normal truck traffic is projected, the developer's geotechnical engineer should evaluate the adequacy of the proposed section and recommend any additional specific measures necessary to provide a minimum 20 year design life for the new pavement section. The roadway section Design Engineer may not simply default to the City's minimum road section requirements when specifying any roadway section; the City's minimum road section requirements are minimums, not defaults.

8-5.3.4 Sight Distance

Standard Drawings (see Section 11, Standard Drawings) show the sight distance triangle. The area within this triangle shall be subject to restrictions necessary to maintain a clear view on the intersection approaches. Driveways shall also observe the sight triangle restrictions, including landscaping and placement of view obstructions.

Other factors such as vertical and horizontal curves and roadway grades also need to be taken into account. Such factors may allow necessary modification to the intersection sight distance requirements.

Sight distance shall be measured using the methods described in the AASHTO Manual, *A Policy on Geometric Design of Highways and Streets*.

The vertical clearance area within the sight distance triangle shall be free from obstructions to a motor vehicle operator's view between a height of 3.5 feet and 10 feet above the existing surface of the street.

8-5.3.5 Intersections

Every intersection shall be designed to meet functional standards of the highest classified street forming a part of the intersection. All elements of the intersection, including turning lanes and channeling islands, shall be designed so that a design vehicle will not encroach onto curbs, sidewalks, traffic control devices, channeling islands, or center divisional medians, or encroach into the travel lanes of opposing traffic flow.

Centerline offsets for arterial and collector street intersections shall be three hundred feet, and one hundred twenty five feet for local streets. Streets will be designed to intersect at right angles.

8-5.3.6 Curb Return Radii

For the intersection of two local streets, the minimum allowable curb radius shall be 25 feet, which is to be measured from the radius point to the face of curb. For the intersection of a local street with any collector or arterial, the minimum radius shall be 30 feet. On all other street intersections, the minimum allowable radii shall be 30 feet.

Radii of 40 feet or more shall be provided where large truck combinations and buses turn frequently. Radii of 40 feet or more should be designed to fit the paths of appropriate design vehicles. Larger radii are also desirable where speed reductions would cause problems.

8-5.3.7 Street Ends

Hammerhead designs are required on all temporary street ends or where a cul-de-sac has not been designed or provided. The turn-around design shall be subject to the review and approval of the Fire Marshal and City Public Works Department. Structural section for turn-

around shall support a standard fire truck. Temporary surfaces may include, but are not limited to, temporary asphalt paving and will be determined on a case-by-case basis.

8-5.3.8 Driveways

1. General

A safety island per City Code 8.570 of full height curb shall in all cases be provided between driveway approaches under one ownership or where practicable under separate ownership. On any frontage in excess of one hundred feet, each hundred feet or fraction thereof is considered under separate ownership.

Any driveway approach in excess of the maximum lengths set forth in this subsection must receive the approval of the Public Works Department prior to construction.

No driveway approach wings shall project beyond the extension of the side property line to the curb, unless the owner of the adjacent property is a co-signer of the Site Construction Permit. Minimum distances, as prescribed per City Code, of full height curb must be in place between driveways serving any one property frontage unless approved by the City. In cases where driveway approaches are constructed on corner lots, no curb cut shall be constructed closer than 20' from the end of the curb return at the curb line. No portion of any driveway approach, including end slopes, shall be permitted closer than twenty feet to the end of the curb return.

Driveway approaches located within five feet of the existing curb return at an alley intersection may be merged with the alley intersection pavement, thus requiring the removal of the existing curb return. The total apron length plus the alley width, measured at the curb line of the apron to the opposite alley line shall not exceed 40 feet.

City street rights-of-way may not be used for private residential or commercial purposes. A permit for the construction of driveway approaches shall not be issued unless vehicles to be served or serviced can be parked entirely within the private property lines.

All existing driveway approaches not meeting current standards shall be reconstructed by the owners of the property served by such approaches to conform to these standards upon approval of any new development.

In reconstructing and remodeling the driveway approaches to conform to the provisions of this chapter, curbs shall be replaced according to the ordinance of the City and in accordance with the specifications given by the City.

2. Commercial/Industrial

The City shall have the authority to restrict the number, size and location of access driveways. Direct access to a main arterial will not be granted if access through a minor or collector arterial is available. The City encourages all proposed commercial and industrial development to explore common use driveways with adjacent property owners on principal arterials

On local, collectors, arterials and alleys where on-street parking is limited, additional off-street parking space (s) may be required for any on-street spaces eliminated by proposed driveway(s).

Commercial driveways shall not be located within 150 feet from the approach to an arterial intersection and shall not be closer than 100 feet on a collector. Both shall be signed and marked "Right Turn Only" unless otherwise approved by the City.

Commercial Driveway Width and Number of Driveways: Refer to City Code 8.570.

The minimum width of driveway shall be per City Code. The maximum recommended grade is 4% however grades up to 10% may be allowed subject to the approval of the Fire Marshal and City. Vertical curves should be used for smooth transitions at significant grade differentials.

3. Residential

Access into residential properties may not be less than ten (10) unobstructed feet. Paved access to two (2) lots shall be sixteen (16) feet minimum and twenty-four (24) feet maximum width.

A thirty (30) foot wide private access easement shall be created for driveways/roads serving three (3) or more residential lots. The access shall comply with the minimum emergency paved access standards per Fire Code (i.e. 20-foot wide paved access, 2-foot shoulders on each side, maximum weight load capability, etc.). Any driveway/road exceeding 150 feet in length shall terminate in a hammer or cul-de-sac Fire Code design.

4. Concrete Driveways/Concrete Aprons

Driveway and alley returns shall be designed in accordance with these specifications, the ODOT or APWA Standard Specifications and Standard Drawings (See Section 11, Standard Drawings).

Materials shall meet the requirements of the following sections of ODOT or APWA standard specifications. The concrete mix shall be as specified for 4000 psi compressive strength @ 28 days, 6 sack concrete (typical) and the slump of the concrete shall not exceed 4 inches. (See Section 11, Standard Drawings)

All aggregate materials for concrete installations shall meet the requirements of ODOT/APWA standard specifications. Driveway aprons shall be constructed per Standard Drawings (See Section 11, Standard Drawings) as applicable. The minimum thickness of the driveway apron shall be 6 inches residential placed over 3 inches of $\frac{3}{4}$ " - 0 State Spec. compacted to 95% maximum density per ASSHTO T-99 over compacted sub-grade, 8 inches of reinforced concrete (See Section 11, Standard Drawings) for all commercial/alleys placed over a minimum of 4 inches of 1 $\frac{1}{2}$ " - 0 State Spec. compacted to 95% maximum density over a compacted sub-grade. In all cases, sub-grade and rock grade shall be approved by the City prior to concrete being placed. Driveway aprons over 15 feet wide shall have an expansion joint placed in the center of the apron. Type "C" curb (reconstruction/replacement only) and gutter design are required to have 6" thick sidewalks throughout the project. Asphalt between curbs and sidewalks will not be allowed in planter strips or between driveway aprons and sidewalks (except as authorized by Permit).

In locations where a new driveway is to be constructed and the sidewalk, curb and gutter already exist, existing curb, gutter and sidewalk must be totally removed and replaced to driveway standards. It is not permissible to "knock-off" existing curb and install driveway apron, the total curb and gutter section must be removed to the nearest expansion joint, and replaced to driveway standards.

New driveways installed in areas where curb and gutter improvements are not existing, and not required to be installed, shall be paved from the existing edge of pavement to the right of way regardless of whether the remainder of the driveway on the private property is paved.

5. Curbs

A. Curb and Gutter Sections

The standard curb and gutter section shall be Type A, see Section 11 Standard Drawings. Type A standard curb and gutter is intended for use on both public and private roadways. Curb sections other than Type A will require variance approval. Curb sections intended for use in parking lot areas, temporary road sections and other locations are subject to the review and approval of the City.

Type C curbs will require developers/homeowners to apply for an encroachment permit for paving in the landscape area and, as a condition of the encroachment permit, if granted the City may require additional landscaping in the landscape strip. Type C curbs are for reconstruction/replacement only; Type C curb will not be approved for new construction/new development.

All curb and gutter shall be Portland cement concrete and shall meet the requirements of the ODOT or APWA Standard Specifications (see sec.00755.13). Concrete mix for curbs shall be Typical 4000 psi. Slump of the concrete shall not exceed 4 inches. All new curb and gutter shall be placed over not less than 3 inches of 1 1/2" - 0 State Spec. top course compacted to 95% maximum density.

B. Curb Ramps

Curb ramps shall be provided at all pedestrian crossings with curb sections. It is required that when a ramp is constructed giving handicap access to the roadway area, the corresponding ramp at the opposite side of the roadway may also be required. Exact locations at each curb return will be determined in the field prior to construction.

Curb ramps shall be constructed in accordance with the Standard Plan Drawings. Curb ramps shall be constructed where shown on the drawings or as directed by the City. This work shall include curb ramps installed in new sidewalks and curb ramps to be installed in existing sidewalks. Existing sidewalks shall be neatly saw-cut full depth prior to construction of curb ramps.

Curb ramps shall be constructed separately from the sidewalk to produce a definite break line between the ramp and the sidewalk. A 1/2 inch non-extruded joint material shall be installed between the curb ramp and the sidewalk with edging. Curb and Gutters shall be isolated by isolation joint material on all sides.

Truncated Domes shall be an ADA compliant type set into fresh concrete.

6. Alleys

The City will not accept the public dedication of any proposed alley. Alleys shall remain private and alley easements shall be provided to the City for any utilities proposed in those alleys.

8-5.4 Traffic Control Signing and Striping

All traffic control devices, signing, striping and other pavement delineation shall utilize the most current version of the Manual on Uniform Traffic Control Devices (MUTCD) as a guideline when preparing designs and traffic control plans. It shall be the developer's responsibility to furnish all materials and labor as necessary to install all traffic control to satisfy project requirements. All required signage (traffic control and street name signs), striping, and other delineation, shall be shown on the design plan prior to approval. All painted lines, legends and delineations will be a minimum of 30 mils thick after two applications with glass reflector beads on second application. All line removal shall be sandblasted unless prior approval from the Streets Manager has been authorized. All signals shall be equipped with pre-emption that is compatible with the equipment used by the fire department (511, 562 series 3M opticom / ODOT Standard). (See Section 11 Standard Drawings – 100 series General Notes Streets) All temporary traffic control plans shall be in compliance with the MUTCD and the Oregon Temporary Traffic Control Handbook and approved by the City prior to use.

8-5.5 Street Illumination & Electrical Power

(See SECTION 9)

8-5.6 Fire Department Access

As required by the City and the State Fire Marshal, every building constructed shall be accessible to the Fire Department, both during and after construction, by way of access roadways approved by the City Streets Manager and State Fire Marshall. The access roadway shall have at least 20 feet of paved unobstructed width, shall have adequate roadway turning radius, and be capable of supporting the imposed loads of fire apparatus. The minimum allowable vertical clearance shall be 14 feet.

8-5.7 Guardrails & Hand Rails

Guardrails shall be provided where necessary to conform to requirements of the Americans with Disabilities Act (ADA) and to protect pedestrians from vehicular traffic.

Surfaces which are reasonably accessible to vehicles that are located above or adjacent to rockeries or walls in excess of 30 inches in height shall be protected by an approved guardrail system.

Roadway guardrails shall be provided at locations determined during the project design and plan review process and shall conform to ODOT/APWA Standard Plan C-1, Beam Guardrail Type 1. End anchors shall conform to ODOT/APWA Standard Plan C-6, Beam Guardrail Anchor Type 1. Alternative methods proposed by the developer/contractor for providing roadway vehicle and pedestrian protection will be considered by the City on a case by case basis.

8-5.8 Mailboxes

Mailboxes are the responsibility of the property owner. All mailboxes will be mounted on ODOT style stands. The location shall not inhibit pedestrian accessibility and general street maintenance operations including snow removal operations.

8-5.9 Improvement in Area of Limited Street Improvements

Paving between the property line and the street pavement may meet the street pavement at a point ahead of the curb opening in order to provide for safe deceleration of vehicles turning into

the applicant's premises. If applicant's paving is extended beyond the property line into a street right-of-way at an intersection or crossroad, the City may require the applicant to construct a suitable traffic island or curb to provide for the protection of such municipal facilities as may be necessary.

8-6 Monuments

Monuments shall be located at all centerline intersections of intersecting streets. Curved streets shall be monumented at centerline PI's (point of intersection), if it falls within the street pavement, otherwise the PC (point of curvature) and PT (point of tangency) of the curve shall be monumented.

It shall be the responsibility of the applicant to furnish all materials and install monuments and castings in accordance with the drawings and where directed by the City. All survey work shall be performed by a professional land surveyor licensed in Oregon. The monument disc shall be furnished and installed by the contractor per Standard Drawings (See Section 11, Standard Drawings).

Preliminary and final surveying, shall be furnished by the developer/contractor at no expense to the City. It is required that, as a minimum, survey stakes be set for new curb and gutter construction, for both horizontal and vertical control. Water, storm drain, or sanitary sewer mains which are to be constructed in easements, are to have survey offset stakes set prior to starting work. Any deviation from that staked line must be left uncovered and resurveyed to realign easement as required and for as-built "construction corrected record" information.

Monument casing shall be 4000 psi, 6 sack concrete or commercial concrete per Section 6-02 of the ODOT/APWA Standard Specification and the monument case and covers shall be gray iron casting conforming to the requirements of AASHTO M 105, Class 30B. The cover and seat shall be machined so as to have perfect contact around the entire circumference and full width of bearing surface.

It shall be the developer's/contractor's responsibility to provide the surveying required to establish or perpetuate land corner monument casing as may be required on the project and filing reports with the county surveyor.

8-7 Rockeries and Rockwalls

Rockeries or rock walls with facing height of 4 feet or less shall be designed in accordance with Standard Drawings (See Section 11, Standard Drawings) if used for erosion control or the containment of cuts and embankments. Rockeries 4 feet and over in height must be designed by a structural engineer licensed in Oregon. Additional geotechnical analysis and recommendations may be required for use in design and construction. All rockeries or rock walls shall be designed with footing drain systems and daylighted to a location approved by the City. Drain pipe shall be perforated high density polyethylene smooth interior pipe.

8-8 Street Cuts

The City street cut policy has been established to ensure the integrity of new and/or upgraded infrastructure. Limitations have been set as follows:

- A) All newly constructed streets shall not be cut for a period of not less than 10 years from final construction acceptance by the City. (For all intended purposes streets that are fully reconstructed shall be regarded as new construction).

- B) All resurfaced streets shall not be cut for a period of not less than 5 years from final acceptance of the last paving project on the street in question.
- C) All surfaced streets that are cut will require, at a minimum, a "T-Patch." See Section 11 Standard Drawings.
- D) All excavations of street sections shall be saw cut just prior to paving, and protected from any raveling until paving, to provide a clean edge for new asphalt.
- E) No less than two (2) foot pavement edge strips from the outside edge of the trench patch will be allowed; if a trench patch edge comes within two feet of pavement edge, the street section must be replaced from the trench patch to the edge of pavement.
- F) All street cuts must be repaired in compliance with City "Street Cuts and Placement of Asphalt/Concrete" Guidelines date May 10, 2010 (or newest edition).

The City may consider cuts under emergency conditions; however the applicant will be required to propose for approval by the Streets Manager asphalt limits and roadway structural section to meet the structural and aesthetic equivalent of the street being cut.

8-8.1 Asphalt Concrete Pavement & Pavement Patching

Asphalt concrete paving and the patching of various types of pavement cuts, shall be in accordance with these Specifications and the ODOT/APWA Standard Specifications and Standard Drawing (See Section 11, Standard Drawings.) A pre-paving conference shall be pre-scheduled and held on-site with the City Inspector at least five (5) working days prior to any paving to be performed and/or accepted.

8-8.1.1 Materials

All materials shall conform to the requirements specified for material in other sections of the ODOT Standard Specifications -00744 Minor, OR. APWA Standard Specifications as follows:

- a) Asphalt concrete pavement shall conform to ODOT/ APWA Standards and or the requirements of the Public Works Department.
- b) Asphalt mix design shall be pre-approved by the City and include Level II, ½-inch dense mix with PG 64-28 or PG 70-28 oil depending on street classification.
- c) Paving mix design shall include level and binder with no more than 20% reclaimed asphalt pavement (RAP) and will be submitted prior to project approval.
- d) Material Testing will be coordinated with the City inspector and as per ODOT specification – 00744 Minor Hot Mixed Asphalt Concrete.
- e) Asphalt concrete pavement patch shall match the existing material that is in place.
- f) Asphalt for temporary patch shall meet the requirements ODOT/ APWA Standards and approved by the Public Works Department.
- g) Tack coat shall be emulsified asphalt grade CSS-1.
- h) Crack sealing will be approved by the Public Works Department prior to replacement.

- i) Geotextile fabric for pavement reinforcement shall be submitted by the developer/contractor to the City for review and final approval prior to placement.
- j) Asphaltic binder for use with geotextile fabric shall conform to the manufacturer's recommendations for the fabric used. .

Aggregate

- k) Subbase Aggregate – Subbase Aggregate shall be 1 ½"-0 aggregate in conformance with ODOT Standard Specification 02630
- l) Base Aggregate – Base Aggregate shall be ¾"-0 aggregate in conformance with ODOT Standard Specification 02630
- m) Granular Trench Backfill – Granular Trench Backfill shall be ¾"-0 aggregate in conformance with ODOT Standard Specification 02630
- n) Controlled Density Fill – Controlled Density Fill (CDF) shall conform to ODOT Standard Specification 00442 (100 PSI @ 28 days).
- o) Portland Cement Concrete pavement patch shall be 4000 psi, 6 sack in accordance with ODOT/APWA Standards

8-8.1.2 Construction

The placing and compaction of the trench backfill and the preparation and compaction of the sub-grade shall be in accordance with the various applicable sections of the ODOT, OR. APWA Standard Specifications except as modified by these Specifications. Control density fill 1 Sack Mix is the desired mixture unless approved by the City.

Compaction of the sub-grade shall be completed prior to the required asphalt work or patching as determined in the ODOT/ APWA Standards.

Pavement patching shall be scheduled to accommodate the demands of traffic and shall be performed as rapidly as possible to provide maximum safety and convenience to public traffic.

Before the pavement patch is to be constructed the pavement shall be saw cut so that the marginal edges of the patch will form a rectangular shape with straight edges and vertical faces.

When required, cold planing along the edge of existing roadways and at interfaces with existing pavements, shall be completed to the widths and depths established in the plans and specifications. The cold planing should be completed prior to trenching, when feasible, so the remaining pavement patching and overlays can be completed in a uniform manner.

Geotextile fabric materials, when required in the plans and specifications, shall be placed and constructed according to the manufacturer's recommendations. Only contractors experienced in the placement of the material shall be responsible for placement.

8-8.1.3 Asphalt on Granular Base

After the crushed surfacing top course sub-grade has been leveled and compacted, Asphalt Concrete Pavement shall be placed to the thickness indicated on the plans. Asphalt shall be compacted to minimum 92% of maximum density.

8-8.1.4 Portland Cement Concrete Patching

Streets which have Portland cement concrete pavements surfaced with asphalt concrete shall be patched as shown on Standard Drawing (See Section 11, Standard Drawings). After crushed surfacing top course sub-grade for the pavement has been constructed and compacted to line and grade, the cement concrete pavement patch shall be placed and struck off to a thickness of 1 inch greater than the existing pavement or 8 inch minimum, whichever is greater. All work shall be in accordance with ODOT/APWA Standards Specifications, except as modified by the Specifications and Standard Drawing (See Section 11, Standard Drawings).

The cement concrete portion of the patch shall be 5000 psi, 6 sack and meet existing PCC finish. The thickness shall be 1 inch thicker than the existing concrete base or 6 inches whichever is greater. The top surface of the concrete patch shall match the top surface of the existing concrete base; in no case shall the top of the concrete be higher than the top of the existing concrete base. Joints shall be placed to match existing or as directed by the engineer.

Through joints and dummy joints shall be placed to match existing or as directed by the City. The surface of the concrete patch shall be finished and brushed with a fiber brush to improve bonding with the asphalt overlay. Approved curing compound shall be placed on the finished concrete immediately after finishing.

8-8.1.5 Temporary Pavement Patching

The contractor shall furnish, place and maintain temporary pavement patching, at locations as directed by the City, until such time as a permanent pavement patch can be made. Generally, the permanent patch shall be completed within two weeks of the completion of trenching and road repairs, unless an extension is granted by the City.

Temporary pavement patch shall consist of asphalt cold mix compacted to at least 90% of maximum density as determined by the City. Other temporary material may be considered by the City.

Temporary asphalt patching shall be required where roadway or walk is needed for vehicular or pedestrian traffic during the construction period, until permanent pavement and sidewalks can be constructed.

In the event that the temporary surface subsides after the initial placement, additional cold mix and crushed surfacing shall be applied to maintain the surface. It is the contractor's responsibility to monitor and maintain the area for settling until the area has been completely repaired and accepted by the City. All temporary patching will be "cold patched" with a 3-inch minimum compacted mix.

8-8.1.6 Trenching Longitudinal to Travel Lanes

All Utilities that are within the right-of-way section and longitudinal to the roadway shall be backfilled with CDF or Compacted 3/4 - 0 State Spec. as approved by the City to the

pavement patch level or sub-grade, whichever applies. All aggregate materials shall meet the ODOT/APWA Standards Specifications. *If ¾" – 0" State Spec. is chosen, the contractor shall be responsible for obtaining compaction tests from a certified laboratory.* All utility cuts outside of the right of way, such as gas, telephone, power and cable TV shall be backfilled with approved fill.

8-8.1.7 Trenching Transverse to Travel Lanes

Utility trenching that crosses transversely to the roadway alignment will not be permitted unless it can be shown that alternatives such as bore jacking, auguring or tunneling are not feasible or unless the utility can be installed just prior to reconstruction or an overlay of the road. Should an open cut be approved, the trench shall be backfilled with controlled density fill and T-Patched. One lane shall remain accessible to emergency vehicles at all times unless previous arrangements with the City have been approved.

Pavement restoration of transverse trenching for all underground utilities including water, sewer, power, gas, etc. shall be "T patched" (See Section 11, Standard Drawings) and meet existing pavement thickness of the affected areas of the street. The limits of paving shall be as determined by the City on a project specific basis.

8-8.1.8 Boring, Jacking, Augering or Tunneling

The developer/contractor shall be liable for damage to any existing facilities as a result of the boring, jacking, auguring, or tunneling installation work. Prior to boring, all existing utilities being crossed will be potholed. Potholing will be done by approved methods, such as vacuum truck set up. Casings or carrier pipes may be required to protect the integrity of the road system if soil and/or load conditions are of concern to the City. Approvals from other agencies or companies may be required for the proposed work. The developer/contractor shall obtain all necessary permits, approvals and easements as may be necessary and shall provide copies to the City during the permit review process.

8-9 Underground Utilities

8-9.1 General

When trenching through existing pavement, open cuts shall be saw cut with neat straight lines. T-Patching is required and the cut shall be made one foot wider on both sides of cut. Saw cutting will be required prior to re-patching or any overlay.

Cold mix shall be used for all temporary pavement patches. Steel plates may be used only when Cold mix patch is unavailable or when re-entry is anticipated within 24 hours. All temporary patches are the responsibility of the permittee. Other temporary materials may be approved by the City.

Permanent pavement patch shall be as specified on Standard Drawing (See Section 11, Standard Drawings). Where trench excavation equals or exceeds a depth of 4 feet, the developer/contractor shall provide, construct, maintain and remove, as required, safety systems that meet the requirements of the Oregon OSHA. The trench safety systems shall be designed by a qualified person, and meet accepted engineering requirements.

8-9.2 Trenching

The developer or its agent shall furnish, install, and operate all necessary equipment to keep excavations above the foundation level free from water during construction, and shall de-water

and dispose of the water so as not to cause injury to public or private property or nuisance to the public. Sufficient pumping equipment in good working condition shall be available at all times for all emergencies, including power outage, and shall have available at all times competent workmen for the operation of the pumping equipment.

Water jetting or settling of backfill in trenches is not permitted.

The developer/contractor shall not interfere with any existing utility without the written consent of the City and the utility company or person owning the utility. If it becomes necessary to remove an existing utility, this shall be done by its owner. No utility owned by the City shall be moved to accommodate the developer/ contractor unless the cost of such work is borne by the developer/contractor. The cost of moving privately owned utilities shall be similarly borne by the developer/contractor who must provide appropriate bonding.

The developer/contractor shall support and protect by timbers or otherwise all pipes, conduits, poles, wire or other apparatus which may be in any way affected by the excavation work, and do everything necessary to support, sustain and protect them under, over, along or across the work. In case any of the pipes, conduits, poles, wires or apparatus should be damaged, they shall be repaired by the agency or person owning them, and the expense of such repairs shall be charged to the developer/contractor, and his or its their bond shall be liable therefore.

The developer/contractor shall be responsible for any damage done to any public or private property by reason of the breaking of any water pipes, sewer, gas pipe, electric conduit and other utility, and its bond shall be liable therefore. The developer/ contractor shall inform itself as to the existence and location of all underground utilities and protect the same against damage.

The developer/contractor shall at all times and at its own expense preserve and protect the public from injury and protect any adjoining property.

8-9.3 Public Safety

The developer/contractor shall erect such fence, railing or barriers about the site of the work to prevent danger to persons using the city street or sidewalks, and such protective barriers shall be maintained until the work is completed or the danger removed. At twilight there shall be placed upon such place of excavation and upon any excavated materials or structures or other obstructions to streets suitable and sufficient lights which shall be maintained throughout the night for the entire construction period. It is unlawful for anyone to remove or tear down the fence or railing or other protective barriers or any lights provided on them for the protection of the public.

The developer/contractor shall not permit any excavation to remain unguarded or open and shall not have any machinery, equipment or other device having the characteristics of an attractive nuisance likely to attract children and hazardous to their safety or health. All work within Public ROW or Private Development which will be dedicated to the Public shall be performed in full compliance with OSHA requirements.

8-9.4 Backfill

Suitable native material excavated during trenching can be used for trench backfill in trenches outside of and not directly in roadways. Trench backfill will be in accordance with ODOT/APWA Standards. Unsuitable backfill material shall be removed from the site and hauled to an approved disposal site. The Contractor shall provide the City with the location of all disposal sites to be used and also copies of the permits and approvals for such disposal sites.

Imported material shall meet the requirements of the ODOT/APWA Standard Specifications and Standard Drawings Section 11.

8-9.5 Compaction

Trench backfill shall be spread in layers and compacted by mechanical tampers of the impact type approved by the City. The backfill material shall be placed in successive layers with the first layer not to exceed 8" - 12" above the pipe, and the following layers not exceeding 12 inches in loose thickness, with each layer being compacted to the density specified below:

1. Improved areas such as streets and sidewalks shall be compacted to at least 90% of maximum dry density to within 3 feet of sub-grade. The last 3 feet shall be compacted to at least 95% of maximum dry density in accordance with ASTM D698. (Ref. Sec. 301.3.09 APWA)
2. Testing Interval 3' vertical, 50' length with a 2 test minimum.

8-10 Portland Cement Concrete Sidewalks

Sidewalks, curb ramps, and bus shelter pads, including excavation for the depth of the sidewalk and sub-grade preparation shall be concrete designed in accordance with Standard Drawings (See Section 11, Standard Drawings). Sidewalks constructed adjacent to City streets/roadway shall provide handicap access, including ramps, landings and handrails as necessary.

Sidewalk Drains shall be provided. Concrete Steps shall be provided where necessary. Subdivisions with Type "C" curb and gutter are required to have 6" thick sidewalks. Sidewalks shall meet the required designs of the current ADA and Oregon Bike/Pedestrian Plan.

A minimum distance of 5 feet is required from the back of curb to any obstruction on or within the sidewalk unless otherwise noted. Mailboxes shall be set at locations approved by the Postmaster. Sidewalk minimum widths shall be as follows:

Local streets – 5 ft wide
Collector streets – 6 ft wide
Arterial Zoned Commercial - 8 ft wide

Other Arterial – 6 ft wide

Within area requiring downtown scoring pattern – 8 ft wide

The City reserves the right to require a deviation from this standard to match existing adjacent conditions

Materials shall meet the requirements of the following section of ODOT/APWA Standard. The use of calcium chloride as an admixture is prohibited.

The curb and gutter section shall be placed prior to the placement of the sidewalk section unless otherwise directed by the City. (See Section 11, Standard Drawings). Base shall be approved by the City prior to concrete being placed. Generally, ¼ inch deep V-grooves are to be placed on 5 feet centers, but at the discretion of the City. This may be changed to make for a better match with the surrounding area (City Pattern in Downtown Core).

Contraction joints shall be placed to match those placed in curbs if new sidewalk is placed adjacent to an existing curb and gutter. In all other cases the maximum spacing on contraction joints shall be 15 feet center to center. Dummy joints shall be ½ inch by 1½ inch on 5 foot centers. Through joints shall be ½ inch by 4 inches.

Where there is insufficient suitable native material on the project site, the contractor shall furnish, place and compact non-native granular 3/4"-0 state spec. All sidewalks shall be constructed over a minimum 3" inches of crushed surfacing top course meeting the requirements of Section 8-21.5 of these Specifications and of the ODOT/ APWA Standard Specifications compacted to 95% of maximum density per ASTM D698.

Contraction and construction joints for sidewalks shall conform to the applicable requirements for through joints. The top edge shall be 1/8 inch below the finished surface of the sidewalk. At no time will joint spacing exceed 15 feet.

8-11 Parking

On-street diagonal parking on all newly constructed Streets will not be permitted. Off street parking lots shall be constructed in conformance with the requirements for number of stalls and landscaping as established in the City's Community Development Ordinances (CDOs). ADA parking requirements are established in City Code as are loading space requirements.

Aisle widths may be required to be widened if multiple utility lines are located within the aisle corridor. (See ODOT Disabled Parking Standards).

Handicap parking stalls shall meet the requirements of State of Oregon, ADA, and Public Buildings – Provisions for aged and Handicapped. Safe, convenient handicap access is required from the street to all buildings on any proposed site.

SECTION 9 ELECTRICAL, CONTROLS, INSTRUMENTATION, LIGHTING AND TRAFFIC SIGNAL STANDARDS

9-1 Purpose

The purpose of these standards are to provide contractors, professional engineers and developers the City's minimum standards for all electrical installations, repairs and modifications to infrastructure owned by or those that will be dedicated to the City.

9-2 Summary

These standards shall apply as minimum requirements for work performed on infrastructure covered within this section. Deviations from these standards must be approved prior to the issuance of the site construction permit by the City.

9-3 Definitions

1. Automatic: Change of run state (starting, stopping, speed control, etc.) without manual action. Sometimes referred to as "Auto."
2. Manual: Change of run state only upon manual action. Sometimes referred to as "Hand."
3. PLC: Programmable logic controller.
4. HPS: High pressure sodium
5. Electronic Ballast: newer technology replacing magnetic ballasts
5. Luminaire: Street light fixtures
6. P/C: Photo cell which controls luminaries

9-4 Permits

All electric work performed for the City is required to have an electrical permit issued by the County Building Department. All plans will be reviewed and approved by the City prior to commencement of work. All inspections and sign-offs for these permits will be performed by the Klamath County Building Department. Copies of these permits, and final sign-off of permits will be furnished to the City for all projects where the new infrastructure will be dedicated to the City or existing City owned infrastructure is modified.

9-5 Electrical

All electrical work performed will comply with the National Electrical Code (NEC). All electrical work will be performed by a licensed electrician.

9-6 Controls

9-6.1 Standardization

The City has standardized on the Allen Bradley brand of automation equipment and has standardized on other various brands and models of control components to maximize the City's efficiency in operating and maintaining its systems. The City will entertain alternative proposals

for control systems, equipment and components in an effort to encourage competition and innovation. However, the City will make the final decision as to whether or not the proposed new control system or components are acceptable. All equipment proposed requires pre-approval by the City prior to use.

9-6.2 Telemetry

All new control systems must be capable of connecting to the existing City radio telemetry network, consisting of:

1. Allen Bradley SLC 500 or MicroLogix 1100 or 1400 PLC
2. Data Linc SRM 6000 radio modem

9-6.3 UPS

All Micro Processor based control systems shall include an Uninterruptible Power Supply (UPS).

1. The City standard is panel mounted, 2 hour minimum run time for PLC and radio, to be pre-approved by the City..

9-6.4 Power monitors

All new control systems dealing with three-phase power shall include a three phase power monitor.

1. The City standard is Diversified brand SLA-440-ALE for 440v power.

9-6.5 Operations

All new control systems shall be capable of manual or automatic operations by means of a selector switch with hand, off, & auto positions (H-O-A). The hand position shall cause the pump, etc. to operate independently of any Micro Processor based control.

9-6.6 Sensors

Any analog wet well level sensing means (ultra-sonic, bubbler, transducer, etc.) shall include a digital backup (float switch, inductive probe, etc.) for emergency control and alarming.

9-6.7 Variable Frequency Drives

Allen Bradley 700 Series variable frequency drive (VFD), including a line reactor.

9-6.8 Voltage

All new control systems shall be 120v AC.

9-6.9 System Design

New control systems shall include full schematics, process and instrumentation diagrams (P & IDs), and both paper and electronic copies of any PLC programs. As-built copies of all of the above shall be submitted a minimum of 10 days prior to City acceptance of any facility. An on-site facility orientation meeting shall also be scheduled and occur prior to City acceptance of any facility.

9-7 Instrumentation

9-7.1 Requirements

All instrumentation shall produce 4-20mA signals where applicable.

9-7.2 Operation/Maintenance Manuals

All instrumentation used shall include all manuals and schematics and be provided to the City upon dedication of the system.

9-8 Street Illumination

9-8.1 Street Lighting Required

All new developments and subdivisions are required to provide street lighting compatible with City standards.

9-8.2 Luminaire Types

All luminaries shall be General Electric HPS cobra heads with photocell receptacles in all heads. Photocells shall be provided as required per design. Decorative, and others, may be acceptable if approved by the City. If other than General Electric Cobra Heads are used, the City will require a 2-year warranty and replacement parts required for maintenance. If other than GE Cobra Heads are used, replacement parts must be provided prior to acceptance equal to 10% (1 complete set minimum; 5 complete sets maximum) of all poles, fixtures, ballasts, globes, lenses, etc. installed within the project.

9-8.3 Poles

New street lighting systems shall be spun aluminum poles mounted on concrete bases. Other poles will be considered by the City provided the applicant submits a variance request in writing and the City approves such variance prior to the issuance of a Site Construction Permit. Any decorative poles must be powder coated to have a variance approved. Wood poles are not acceptable if the lighting system is to be dedicated to the City unless pre-approved as needed due to overhead power.

9-8.4 Wiring

All wiring for street lighting shall be installed underground in conduit. All wiring is required to be placed in the right-of-way or easement.

9-8.4.1 Disconnect Location

Circuits feeding street lighting shall have a disconnection means outside of PP&L transformers and utilize an unmetered single direct burial pedestal such as the Milbank U5200-XL (or preapproved equal) for main breaker and photocell and fuse location.

9-8.5 Luminaire Size

Residential streets	100 watt HPS
Collector streets	200 watt HPS
Arterial streets	400 watt HPS

9-8.6 Placement of Luminaires

A design report and coverage report, prepared by an OR licensed Engineer, must be furnished for any proposed street lighting. The design and coverage report shall include a wiring sheet as a separate color and layer from any other utility. A minimum of items to be included in the design report are:

- Minimum, maximum and average foot-candle coverage
- Coverage grid points based on a 15-foot by 15-foot grid to include the area from back of walk to back of walk
- Pole placement should typically be from 150-feet to 200-feet depending on coverage report minimum values

The power source and common photo cell locations must be shown for all grids. Spacing of luminaires will be in accordance with current (10th Edition – 2011 or later) IES (Illumination Engineering Society) standards for coverage. Street lights shall be placed in the right-of-way or utility easement within 5-feet from property lines and at property corners whenever possible. If poles are not located within 5 feet of property lines, driveway locations must be shown on the plans. Heights of luminaires shall be 25' for local (residential) and collector streets, and 30' for major (arterial streets).

9-8.7 Developer's Responsibility

It will be the responsibility of the developer and contractor to install the street lighting system. Two (2) copies of complete detailed street lighting plans, including, but not limited to, types of lights, sizes of lights, location of lights, location of controls, size of conduit, location of conduits, size of wire, location of disconnection means, and type of disconnection means must be supplied to the City at the time of plan review for City and Pacific Power review if the system will be dedicated to the City. The system must be inspected and signed off by the Klamath County Building Department after installation is complete. Ownership of the street lighting system will only be transferred to the City after the County Building Department signoff and after the City has completed its final inspection. The City will not contact PP&L to have any street lighting energized in the City's name. All street lighting must be fully energized by the developer, pass final inspection by the County Building Department and have a "green tag" and the entire development accepted by the City prior to the power being transferred in the City's name.

9-9 Traffic Signals

All traffic signals shall be designed and installed in accordance with Oregon Standards Specifications for Construction and the Oregon Standard Drawings. The City of Klamath Falls uses pre-approved traffic cameras instead of loop detectors for most signals.

The website links listed below provide access to the latest editions of the traffic signal design documents:

Oregon Signal Design Manual:

www.odot.state.or.us/ffp/hwy/traffic/Signal_Design_Manual.pdf

Oregon Standard Specifications:

http://egove.oregon.gov/ODOT/HWY/SPECS/2002_std_specs.shtml

Oregon Standard Special Provisions:

http://egov.oregon.gov/ODOT/HWY/SPECS/special_provisions.shtml

Oregon Standard Drawings:

http://egov.oregon.gov/ODOT/HWY/ENGSERVICES/traffic_drawings.shtml

All traffic signal designs shall be prepared by or under the direct supervision of a Professional Traffic Engineer registered in Oregon or a Professional Engineer registered in Oregon qualified to perform traffic engineering as defined by OAR 820-040-0030. The engineer must have background and experience in designing traffic signals. Each traffic signal design shall be signed and sealed by the Professional Engineer prior to advertising the project requesting bids from prospective contractors.

SECTION 10 DRAFTING STANDARDS

10-1 Purpose

The purpose of this section is to provide a minimum standard for the graphical representation of proposed improvements and final “record drawings” for all projects submitted to the City including land development projects with dedicated infrastructure.

10-2 Summary

These drafting standards include, but are not limited to: sheet size and layout, layering, line types and weights, lettering fonts, title block content, title block layout, general notes, general use symbols and construction notes. The objective is to establish a graphical standard that will facilitate the incorporation of newly developed systems into existing City records. Any land development with dedicated infrastructure must submit drawings in accordance with these standards.

Submittals of final drawings shall have standard borders, title blocks and symbols. Sheet sizes, title blocks for those sizes and standard drawing symbols are available from the City in paper format or in electronic format for AutoCAD and as PDF electronic files. Electronic copies of these standards are available from the City’s Internet Web-site, Engineering section.

10-3 Definitions

Capital Improvements – Projects that will add to or improve the capacity or efficiency of a City system (whether constructed by contract or in-house.)

Construction set – scalable drawings included in construction bid documents.

Dedicated infrastructure-utilities constructed privately that become the City’s responsibility after construction (including domestic water, sanitary sewer, geothermal loop, storm drain, streets, etc.)

Full size – the size of the physical sheet to be drafted on.

Full size set – those drawings that will be used to reproduce a construction set (usually printed half the size of a full size sheet).

Graphical standard-a consistent method of representing designs to the City.

Half size – the size of the physical sheet printed or reproduced at half of the original full size.

Scalable – graphical representations and models that can be accurately scaled using an architectural or engineering scale.

10-4 Media

10-4.1 Preliminary Drawings

Preliminary review drawings and sketches may be prepared on any type of material that is easily reproduced in-house (i.e. Xerox, velum, sepia, etc.) Line work should be of sufficient quality to reproduce clearly. The City will determine drawing size and number of copies for City review.

Capital improvement projects may have defined milestones such as 30%, 60% or 90% submittals, which are considered preliminary under this section. All other preliminary drawings are those not stamped nor signed by a registered architect, engineer or surveyor.

Land development projects with dedicated infrastructure will submit drawings as shown on the Site Construction Permit Flow Chart, which can be obtained from the City. These drawings must be on reproducible media and will be reviewed for conformity to these standards.

10-4.2 Final Design Drawings

Final design drawings for Capital Improvement projects shall be prepared on translucent velum, sepia or mylar with the appropriate professional stamp. Final drawings shall be full size unless approved by the City prior to submittal. Final submittal of the drawings shall include signed physical copies and digital copies formatted in AutoCAD, which is the current City adopted software program. The professional engineering stamp is not required in the electronic drawings.

Land development projects with dedicated infrastructure do not require City title blocks, but shall place the City supplied signature block on every drawing submitted (see Dwg. 10-100). These projects need only submit physical copies as a minimum. If CAD software has been used to develop the drawings, the City would appreciate a digital copy at the time of final submittal.

10-4.3 Record/As-built Drawings

All final record drawings shall be ink on polyester (mylar) base drafting film at least .003 inch thick and coated for drafting on both sides. Standard City title block and drawing format shall be used. (See Section 5 "TITLEBLOCKS" for Standard Title Block and Section 4 "DRAWING LAYOUT" for Standard Sheet Layout.)

The physical copies of the record drawings will be accompanied with the modified electronic copies for AutoCAD. Final record drawings shall be stamped or otherwise marked as such, indicating the date of their preparation.

Private development projects with dedicated infrastructure are required to submit record/as-built drawings on mylar and in electronic format.

10-5 Sheet Sizes

10-5.1 ANSI Drawing Sizes

In order to provide uniformity in the City's drawing file system, the City uses ANSI drawing sizes as standard. ANSI sizes are multiples of 8½ "x11" and permit uniform folding for filing, mailing and reproduction. Standard ANSI alphabetic sheet references are as follows:

- A = 8½" x 11"
- B = 11" x 17"
- C = 17" x 22"
- D = 22" x 34"
- E = 34" x 42"

10-5.2 City Drawing Sizes

Please note that the City uses only sizes A, B and D. Other sizes will not be accepted unless prior approval is obtained from the City. The City's standard full size sheet for design and drafting is 22" x 34" (D size). Sheet sized of those drawings included in construction bid documents are 11"

x 17" (B size). Sheet size and title block information is on Standard Drawing 10-100, 10-110 and 10-111. Copies of these borders are available from the City in electronic format for AutoCAD.

10-6 Drawing Layout

10-6.1 Cover Sheet Arrangement

Cover sheets should be arranged as shown on Dwg. 10-105. The Vicinity Map is defined as a map showing the closest street and/or street intersection for the purpose of aiding people in driving to the site. The cover sheet should contain a project title, a list of project drawings and a legend of line types and symbols used in the project. General notes and a list of abbreviations may be placed on the cover sheet as room allows.

10-6.2 General Drawing Sheet Arrangement

Drawings submitted to the City should conform to good drafting practices and recognized techniques. When exceptions or special conditions occur, the draftsman may adjust these arrangements as required to suit the drawing package, subject to the approval of the City. Drawing format should read left to right; top to bottom; plans to the left and top. Number and letters identifying details and sections should also read left to right, top to bottom. Dimensions shown on Dwg. 10-105 for separation between pictures are suggestions.

10-6.3 Plan and Profile Drawing Sheet Arrangement

Plan and profile sheets shall be divided into two sections horizontally. The upper half will be used for the plan view and the lower half will be used for the profile view. An electronic copy of the plan and profile sheet is available from the City.

10-7 Titleblocks

10-7.1 Preliminary Drawings

Preliminary drawings and sketches being submitted for review, comment or design approval should be drawn on a City title block. The following information should be provided in the title block as a minimum: project name, sheet content, designer's initials, drafter's initials, checker's initials, and discipline and drawing number. The City will provide a project number and a file number that should be provided in the lower right corner of the title block before submitting.

10-7.2 Final Design Drawing & Record/As-built Drawings

Final drawings being submitted shall be drawn on standard City title blocks, appropriately filled in stamped and signed. Standard Drawing 10-110 and 10-111 contain Standard Title Blocks for A, B and D size drawings. Copies are available from the City in electronic format for AutoCAD.

When submitting AutoCAD drawings to the City, files should be saved in the base AutoCAD software without ARX or proxy objects attached. ARX objects are created when using programs that interface with AutoCAD. If the City receives drawings with these objects attached, the drawings will be returned to be corrected and resubmitted at no extra cost to the City.

Private development projects with dedicated infrastructure are required to submit record/as-built drawings on mylar and in electronic format.

10-7.3 Revisions

For every submittal to the City for review or approval, a revision must be placed in the revision block in the upper right hand corner of the title block. Submittals prior to construction shall use alphabetic designations, the final design drawing set shall use revision 0 (zero), and submittals during the bid process, construction and after construction shall use number designations.

10-7.4 Discipline/Drawing Numbers

Each drawing should have a discipline/drawing number in the lower right hand corner of the title block when submitted. These numbers are based on industry standard letter designations for each engineering/architectural discipline and incrementally increasing numbers (numbers should start with 1 except for facility master drawings). Letter designations are as follows:

- A - architectural
- C – civil (including surveys)
- D – miscellaneous details
- E – electrical
- M – mechanical
- S – structural
- T – cover (title) sheet

Other discipline letters that do not fit within the above scheme may be used.

The City's wastewater treatment plant uses facility master drawings. These drawings are numbered by discipline and area of the plant represented by a set of numbers (i.e. M702, E467, etc.) The listing of areas is as follows:

- Control building – 100 thru 199
- Influent pumping station – 200 thru 209
- Primary tanks – 210 thru 219
- Process screening area – 220 thru 229
- Chlorine building – 400 thru 429
- Aeration basin – 430 thru 439
- Secondary clarifier – 440 thru 449
- Chlorine contact basin – 450 thru 459
- Blower building – 460 thru 469
- Gravity thickener – 500 thru 509
- Digester control building – 510 thru 529
- Digesters – 530 thru 539
- Hypochlorite building – 600 thru 629
- Effluent pumping station – 631 thru 639
- DAFT building – 700 thru 729
- Stormwater pumping station – 800 thru 819
- Sludge recycling – 850 thru 899

10-7.5 Digital File Information

Along with design and drafting information provided in the title block, information about digitally created drawings is needed. In the upper right hand corner is an area to fill in the electronic file name (i.e. AAA.DWG). The file name should be kept short but understandable to a non-engineering individual.

10-8 Layering (For Electronic Drawing Files)

10-8.1 General

The City has its own drawing layering system or will accept ANSI or current industry standard layering system if pre-approved. The City has attempted to keep the system as simple as possible in order to reduce the number of layers in the files maintained by the City. The system defined below is a format guideline except for those layers the City insists be used on projects with those exact components. Any drawings submitted to the City in electronic format shall, as closely as possible, adhere to this system.

In an attempt to describe the system, it is impossible to cover any and all features and situations that may arise. For the most part, the general categories should be easy to identify. Within these categories, text and line work should always be kept on separate layers. Beyond that, the draftsman may use his/her best judgment while attempting to keep the number of layers to a minimum. If a reasonable determination cannot be made, contact the City for assistance.

Some CAD programs auto-generate their own layers and layer names. The City will accept this layering convention with one caveat: the names of the layers must be recognizable to a draftsman that does not work with or use that software. An example from Land Desktop of an auto-generated layer name is P-STALB. This should be changed to P(roposed)-STATION(ing)-LABEL or something equivalent. Abbreviations can be used so long as a non-engineer would understand what that layer stands for.

Prior to submitting electronic files to the City, purge unnecessary layers from the files. This serves two purposes: 1) to eliminate possible proxy objects generated by high-end design software and 2) to limit the number of layers to only those used within the design/survey drawings. The reason for this is that AutoCAD lose its ability to alphabetize layer names when more than 200 layers are listed. Also, turn off, freeze or no-plot layers that are not plotted on the submitted physical drawing.

10-8.1.1 CATEGORY 1

Category 1 is reserved for base drawing features and legal information such as road centerlines, right-of-way lines, property lines, easement lines, etc. All lines may be included on one layer (I.E. 1-LINES), or might be segregated as to type (I.E. 1-R.O.W., 1-PROPERTY). Examples of line work layers: 1-PROPERTY, 1-R.O.W. Examples of text layers: 1-TEXT, 1-PROPT_TXT. Abbreviations should be easily understood.

10-8.1.2 CATEGORY 2

Category 2 is reserved for depicting existing surface features, including topography, buildings and underground features such as utility lines, storage tanks, etc. Examples of linework layers: 2-CONTR_MAJOR, 2-BUILDING, 2-WATER. Examples of text layers: 2-CONTR_TEXT, 2-WTR_TEXT. Use the Wipeout command when linework crosses text. If using a line type with embedded text for utilities, place on the line work layer. If using blocks with attributed text, place on the line work layer.

10-8.1.3 CATEGORY 3

Category 3 is broken into two groups: new design features on site/civil/survey plans and new design features on facility plans.

Group 1 – new site features on infrastructure utility drawings. This group will follow the same format as CATEGORY 2 (i.e. 3-CONTR_MAJOR, 3-WATER, 3-BLDG_TEXT, etc.)

GROUP 2 – new features on facility discipline drawings such as pump stations or the treatment plant. Line work layers will be based on the building system, mechanical system or electrical system. Examples of building systems: 3-CMU_WALL, 3-STEEL, 3-ROOF. Examples of mechanical systems: 3-HVAC, 3-EQUIP, 3-SEAL_WTR. Examples of electrical systems: 3-POWER, 3-SCADA. Text layers should have a corresponding line work layer.

10-8.1.4 CATEGORY 4

Category 4 is reserved for proposed and future improvements not part of a submitted design. This might be a project that would be phased over time or an indication that future improvements will be needed in certain area. The same general guidelines used in CATEGORY 2 and CATEGORY 3 for line work and text apply in the profile section. Examples include: 4-WATER, 4-PROPS_ROAD. Text in this category should be placed on its own layer.

10-8.1.5 CATEGORY 5

Category 5 is reserved for miscellaneous drawing features such as borders, title blocks, north arrows, scales, grids, trim lines, etc. Individual layers should be employed as necessary to facilitate drawing management and manipulation. Features placed in this category are ones that will not be transferred into City system-wide files. Examples include: 5-TTBLK_LINE, 5-TTBLK_TEXT, and 5-ENG_STAMP. Blocks with assigned attributes should be placed on the line work layer.

10-8.1.6 Layers by Pipe Diameter

If a utility project has multiple pipe diameters, include the pipe diameter in the layer name. If the range of pipe diameters is expansive, a range of sizes can be delineated in the layer names. The following is a pipe diameter range for use in naming layers:

- Pipes under 3"
- Pipes between 3" and 12"
- Pipes between 12" and 24"
- Pipes over 24"

The same general guidelines used in CATEGORY 3 apply in this section. See the Table in Section 10-8.2 for colors, representations and line widths. (Remove all other paragraphs in this section and insert these paragraphs).

10-8.2 Colors and Line Widths

The City uses a simple color system based on plotting requirements. The first seven primary colors of the AutoCAD palette (red through white) and colors 10-15 will be used to indicate new construction, colors 8 & 9 will be used to indicate existing features (surfaces, underground and utilities) and color 255 for objects that should be turned off prior to plotting (i.e. MVIEW frames, XCLIP boundaries, etc.). DO NOT place objects on the Defpoints layer for the purpose of hiding them during plotting. The Table below is a minimum guideline for establishing line widths related to colors and object representation.

Color	Representation	% Screen	Linewidth (in, min)	Remarks
Red (1)	Existing systems	0	0.020	use for showing existing features that need a light solid line
Yellow (2)	New construction	0	0.079	
Green (3)	New construction	0	0.118	
Cyan (4)	New construction	0	0.118	
Blue (5)	New construction	0	0.118	
Magenta (6)	New construction	0	0.118	
White (7)	New construction	0	0.118	
Light gray (8)	Background	35	0.118	use for background (i.e. XREF, contours) where a screen is needed
Dark gray (9)	Background	60	0.138	use for background (i.e. XREF, contours) where a screen is needed
White (255)	Objects to be turned off before plotting	0	0.118	

10-8.3 Line types

Line types will be related to legal description, utility or discipline system. The City primarily uses CONTINUOUS, DASHED, CENTER and HIDDEN2 as standard line types. Other line types are shown on Dwg. 10-115. Unique line types not addressed in these standards must be approved by the City project manager before final design submittal.

10-8.4 External Reference dependent layers

With the advent of external reference (XREF) files, the AutoCAD layering system has become more complex. All X-ref files should follow the basic layering rules as listed above in sections 10-8.1.1 thru 10-8.1.6.

X-refs are primarily used as a background to draw the new or future improvements. Colors assigned to XREF dependent layers will be the same as outlined in section 10-8.2. The VISRETAIN variable in the receiving file should be OFF.

10-8.5 Layer Features for AutoCAD 2000 and Beyond

With Autodesk's release of AutoCAD 2000 and in future upgrades, the plotting command allows the user to indicate to the plotter layers that should not be plotted but remain displayed in the electronic file. This is accomplished through the Layer Dialogue box. Also, individual layers can be turned on and off through unique paperspace viewports. Use of these techniques will be up to each individual; keep in mind that the City will be interested in using both the base CAD model as well as the finished, plotted drawings.

10-9 Lettering

10-9.1 General

While it is not the goal of the City to remove individuality from the drafting process, in order to maintain uniformity and simplicity, the City has established standards when it comes to lettering that may be used on drawings being submitted to the City.

10-9.1.1 Manual Drafting

In the case of hand lettering, readability becomes a prime concern. A drawing is considered readable if the lettering can be read when a drawing is printed full size or reduced in size. Text may be vertical or right-hand slant but, it must be one or the other on any given drawing. It may not be mixed within drawing sets.

For hand lettering, use "block style" letters a minimum of 1/8 (eighth) inch high and a line weight to be readable when the drawing is reduced. Hand lettering shall be uppercase only and consistent in quality and appearance.

When using Rapidigraph or Leroy templates, make letters a minimum of L100 (tenth) inch high. The preferable size is L120 (eighth) inch high. Lettering should be horizontally aligned as nearly as possible.

For mechanically produced or stick-on type lettering, the text font type shall be "Helvetica", a minimum 12 point size and a line weight to be readable when the drawing is reduced. Text on the drawing shall be uppercase only.

10-9.1.2 CAD Drafting

For CAD or other computer-produced drawings, the fonts shall be generally limited to those examples illustrated on Dwg. 10-120. For notes, call-outs, design information, General Notes, headings, section and detail identification and tabular data, the single line font ROMANS or SIMPLEX should be used. For use in the title block, the more complex fonts should be used. To draw special attention to specific items, the bold and italic fonts may be employed.

Font size and weight shall be sufficient so as to be readable when D size drawings are reduced to one-half size. Text height shall be a minimum of 0.10" (tenth inch) high. The preferred text height shall be 0.125" (eighth inch) high. Only CADD produced lettering will be allowed on CAD produced drawings.

Text types and fonts other than those shown on Dwg 10-120 shall be used only for special effects or conditions and subject to City approval. In no case shall the height of letters, hand, mechanically or CAD-produced, be less than 0.08 inches in height. In no case shall the width of mechanically produced or CAD lettering be less than 60%, nor, more than 150% of normal letter width.

When submitting CAD drawings with non-standard AutoCAD fonts, the shape (.SHX) file must be included in the submittal. Include fonts/shape files used in creating company logos that have been inserted into any CAD drawing being submitted.

10-9.2 Text Plotted at Other than Full Size ANSI D Drawing

When submitting documents printed a size different than full size, the text must be of a size and quality that can be easily read after the original document has been copied one time.

When submitting documents where ANSI sheet size A or B are the full size document, text shall be a minimum of 0.1 (tenth) inch for normal text and 0.15 (fifteenth) inch for bold text.

10-9.3 Underlining

All titles of details, sections, elevations and views should be underlined with a single line having the same weight as the lettering used. DO NOT use an object line to underline text.

10-9.4 Orientation

All lettering shall be done to facilitate reading from the bottom or right-hand edge of the drawing. However, in no case shall it be carried farther than ten degrees (10°) counterclockwise past vertical.

10-9.5 Dimensions

Repetition of dimensions should be avoided. However, dimensioning must be adequate to facilitate field interpretation. Dimensions pertaining to length and width shall be shown on the plans. Dimension pertaining to height and elevations shall be shown on profiles, sections and architectural elevations unless a special condition requires both horizontal and vertical dimensioning to make the drawing or detail clearly understood.

Dimension lines shall be located far enough from the drawing (plan, elevation or detail) so that the line work cannot be confused with that of the drawing. Dimension lines shall not be as strong as the objective drawing lines. They should be fine, crisp and printable. Avoid crossing dimension lines as much as possible. When crossing is unavoidable, break the longer of the lines at the point of crossing. (See Dwg. 10-125 for examples of leader breaks and suggested dimension styles.)

Dimension text shall be parallel to the dimension line and between the extension lines whenever possible. When using AutoCAD automated dimensions, if dimensions are too long to fit between extension lines, use the "best fit" feature in the dimension dialogue box. This will allow the drafter to "flip" the dimension text on either side of the extensions. When required, long dimensions may be located to the outside with a leader extension from text to dimension line. This technique should be used only as a last resort.

Fractions shall not be stacked (they should be parallel with the dimension line). This is done because the drawings will be reduced to one-half size periodically.

10-9.6 Leaders

The note end of the leader should terminate with a short horizontal bar at the mid-height of the lettering and should run to the beginning or the end of the note, never to the middle. Leaders should be drawn at an angle to contrast with the principal lines of the drawing. Thus, leaders are

generally drawn at 30, 45 or 60 degrees to the horizontal plane. When several leaders are used, they should be kept parallel, if possible.

The following should be avoided wherever possible:

- Long leaders
- Crossing leaders
- Leaders in a horizontal or vertical direction (except for short bar next to text)
- Leaders parallel to adjacent dimension lines.
- Leaders parallel to extension lines or crosshatching.

Annotations shall be left justified regardless which direction the leader is drawn from. When noting sections, details and elevations, annotations should be parallel for ease of reading (See Dwg. 10-125.)

10-10 Line Work

10-10.1 Manual Drafting

Manual drafting submitted to the City shall be of a quality similar to electronically produced drawings. Final record drawings submitted upon completion of project shall be ink on mylar. Minimum line weights are listed below:

Existing facilities or services	Rapidigraph pen 0
Text, leaders and dimensions	Rapidigraph pen 1
New facilities or services	Rapidigraph pen 2
Utilities smaller than 3"	Rapidigraph pen 1
Utilities 3" thru 12"	Rapidigraph pen 2
Utilities 12" thru 24"	Rapidigraph pen 3
Utilities greater than 24"	Rapidigraph pen 4

(Utilities are considered to be domestic water, sanitary sewer, storm drain, power, geothermal, cable tv, telephone, natural gas, etc.)

All line work should be completed on a single sheet of mylar. Overlays will not be accepted.

10-10.2 CAD Drafting

Consistent line weight is important for drawing uniformity. When submitting plan and profile drawings, the city would prefer existing facilities and services be screened back, when plotted. See the Table in Section 10-8.2 for minimum line weights by color, representation and screen percentage.

Polyline width, if drawn in model space and displayed in paper space, will vary in plotted widths depending on the model view scale factor. The widths listed in the Table in Section 10-8.2 are minimum plotted widths, not widths of polylines.

10-10.3 Screening Backgrounds

On plan drawings, lines and symbols used to depict existing topographic features and underground or overhead utility lines should be screened so that the difference between them and new construction is readily apparent. See the Table in Section 10-8.2 for minimum screen percentage. All line work shall be of sufficient width, weight and clarity so that it can be easily read from a print that has been reduced to one-half the size of the original D size drawing. All pencil lines shall be firm enough to show clearly on the media. Line types

The City receives drawings and plan sets from a number of sources. In order to maintain the uniformity necessary to quickly and easily recognize drawing features, the City uses a limited number of different line types. Examples of typical line types and general uses are shown on Dwg. 10-115. Examples of line types that may require associated design or flow information (i.e. underground line size, slope and direction of flow) are included, along with the required method of providing the necessary data. All line types used should be included in the drawing set legend.

In some rare cases, situations or circumstances may require use of other line types. Use of any line type common to a particular engineering discipline is acceptable with City approval and the line type definition found in the ACAD.LIN file is included in final/record drawing submittals.

Line types should be scaled so that they are easily recognizable but do not dominate the drawing or interfere with design features.

10-11 Standard City Symbols

10-11.1 Discipline-related Symbols

For the most part, the City will accept the drafting symbolism used by the company or draftsperson submitting the drawing, provided that the symbols are generally accepted in the discipline of that drawing. Non-standard discipline symbology is subject to the approval of the City. Exceptions to this are in sanitary sewer, storm drainage, domestic water supply and geothermal systems. In these systems, the City will require the use of the symbolism shown on Dwg. 10-130 and 10-131. This is necessary to facilitate incorporation of the new systems into the city-wide system drawings. All drawings submitted to the City will require a legend of all symbols used on that drawing or drawing set.

When new landscaping is required, tree symbols should differentiate between deciduous and conifer. They should also show tree size as DBH (diameter breast high) and, if available, kind (apple, fir, oak, etc.). Bush and hedge symbols should, likewise, differentiate between deciduous and evergreen.

For utilities other than those identified above, features (poles, vaults, manholes, pedestals, valves, etc.) should be identified as to utility type.

Symbols should be scaled on the drawing so that they reasonably represent the location and, to the extent possible, size of the actual feature.

10-11.2 General Symbols

10-11.2.1 North Arrows

A north arrow shall be displayed on all plan sheets. When several plans are on the same sheet, the orientation of each plan shall be indicated by a separate north arrow (small size)

placed on each plan. CAD blocks of north arrows are shown on Dwg. 10-135 with attributes and insertion point.

Magnetic north shall not be shown on drawings unless accompanied by variation and annual change.

When necessary, a second north arrow, representing reference or facility north, shall be used on architectural drawings.

10-11.2.2 Graphic Scales

Graphic scales are recommended on drawings submitted to the City. CAD blocks of graphical scales are shown on Dwg. 10-140 with attributes. If it is necessary to use more than one scale on the same sheet, group in the lower right-hand corner all graphical scales that apply. Place numerical scales under each plan, detail, section and elevation.

Use an engineer's graphical scale for all civil drawings and maps. Use an architectural graphical scale for all other discipline drawings.

Graphical and numerical scales should be selected so they can be physically scaled whether the drawing is plotted full size or reduced to half-size. Vertical scale for profiles should not exceed 1"=10' (i.e. 1" = 20' not acceptable).

10-11.2.3 Section-cuts, Section and Detail Callouts

Sections-cuts on plans shall be designated with letters and the drawing on which the section is drawn. Section-cuts can be repeated on the same plan provided the individual section-cuts are drawn on different drawings.

Details called on plans shall be designated with numbers and the drawing on which the detail is drawn. Detail numbers can be repeated on the same plan or section provided the individual details are drawn on different drawings.

CAD blocks of section-cuts and section and detail callouts are shown on Dwg. 10-145 and 10-150 with attributes and insertion point.

10-12 Standard City Hatch Patterns

10-12.1 General

The City uses a limited number of standard hatch patterns for the sake of simplicity and uniformity. A list of those used along with their general usage may be found on Dwg. 10-155. These should be scaled on drawings so that they are easily recognizable but do not dominate the drawing. If appropriate, they may be screened up to 50%, provided they still accomplish their intended purpose. Non-standard AutoCAD hatch patterns may be used if they are generally accepted for use in an engineering discipline. Include the hatch pattern in the drawing set legend. Submit the hatch pattern code from the ACAD.PAT file when submitting the final/record drawing sets.

10-13 Images, Pictures, Photographs

In the AutoCAD software, it is possible to insert pictures or photographs as background to be drawn over. When using these images, do not save the Windows file path. If any adjustment to the contrast, quality and size of the image, make note in the file what these settings should be.

10-14 Electronic File Submittals

When submitting drawings to the City, send all pertinent supporting files that were used. These include unique font shape files, CTB (color dependent plotting) files, XREFs, images (.tiff, .jpeg, .bmp), EXCEL spreadsheets, WORD documents, attached databases and programming files (such as LISP or Visual Basic) used in the viewing or plotting of a drawing. If a menu was developed and is required for the viewing or plotting of CAD drawings, submit those with the drawing set. The City prefers "e-Transmit" function of AutoCAD to package all files together.

SECTION 11 STANDARD DRAWINGS

Users of the Standard Drawings contained in this section may reference individual drawing(s) on their plans, or in their specifications. It is not necessary to include the actual drawing in the plan/specification set.

100 SERIES – GENERAL NOTES

1-100a-e General Notes

200 SERIES – COMMON

2-100a-b Standard Common Utility Trench
2-105 Trench Section
2-110 Standard Manhole
2-115 Standard Flat Top Manhole
2-120 Standard Thrust Blocks
2-125 Standard Manhole Bases

300 SERIES – GRADING AND EROSION CONTROL

3-100 Construction Entrance
3-105 Tire Wash
3-110 Sidewalk Subgrade Barrier
3-115 Plastic Sheetting
3-120 Slope Roughening
3-125 Gradient Terracing
3-130 Matting – Slope Installation
3-135 Matting – Channel Installation
3-140 Matting Staple Table
3-145 Diversion Dike/Swale
3-150 Pipe Slope Drain
3-155 Silt Fence
3-160 Bio Filter Bag
3-165 Straw Bale Sediment Barrier
3-170 Straw Bale Sediment Barrier – Semi Pervious
3-175 Inlet Protection – Type 1
3-180 Inlet Protection – Type 2
3-185 Inlet Protection – Type 3
3-190 Inlet Protection – Type 4
3-195 Inlet Protection – Type 5
3-200 Inlet Protection – Type 6
3-205 Check Dam - Rock
3-210 Straw Bale Check Dam
3-215 Sediment Trap
3-220 Settling Basin
3-225 Grading & Erosion Control – Standard Notes

400 SERIES – STORMWATER SYSTEM

4-100 SW Standard Manhole Ring & Cover
4-105 Standard Catch Basin
4-110 Catch Basin Frame + Grate Type G-2, Cast Iron
4-115 Precast Curb Inlet
4-120 Standard Ditch Inlet

4-125	Pipe Anchor
4-130	Pipe End Section Trash Rack
4-135	Pollution Control Manhole with Outside Drop
4-140	Pollution Control Manhole with Tee Overflow
4-145	Stormwater System Construction Notes

500 SERIES – WASTEWATER

5-100	Wastewater System Standard Manhole Frame & Cover
5-105	Drop Manholes – Single Line & Junction
5-110	Standard Lamp hole Riser
5-115	Standard Wye Service Lateral Connection
5-115a	Standard Wye Service Lateral Connection - Notes

600 SERIES – GEOTHERMAL

6-100	Geothermal Frame and Cover
6-105	Geothermal Extensions and Service Connections

700 SERIES – WATER

7-100	Water Service Connection Residential
7-100a-c	Water Service Connection – Residential Fittings & Boxes
7-102	Testing Plate
7-105	Water Service Connection – Greater than 2" & Fire Service
7-106	Water Service Connection Greater Than 2-inch
7-105a-b	Construction Notes – For Standard Drawing 7-105
7-110	Fire Hydrant Assembly
7-110a	Fire Hydrant Bollard Location Detail
7-115	Blow-Off Assembly
7-117	Future Connection for Lines Greater than 8"
7-120	Combination Air/Vacuum Valve
7-125	Typical P.R.V. Station
7-130	Air gap Backflow Protection
7-131	Air gap Backflow Protection Notes
7-135	Atmospheric Vacuum Breaker
7-140	Pressure Vacuum Breaker Assembly
7-145	Double Check Valve ½"-2" Below Ground
7-146	Double Check Valve ½'-2" Below Ground Notes
7-150	Double Check Valve Assy ½"-2" Above Ground
7-151	Double Check Valve ½"-2" Above Ground Notes
7-155	Double Check Valve Assy 2 ½"-10" Below Ground
7-156	Double Check Valve Assy 2 ½"-10" Below Ground Notes
7-160	Double Check Valve Assy 2 ½"-10" Below Ground Ames SS/SE Pattern
7-161	Double Check Valve Assy 2 ½"-10" Below Ground AMES SS/SE Pattern Notes
7-165	Double Check Valve Assy 2 ½"-10" Below Ground FEBCO N Pattern
7-166	Double Check Valve Assy 2 ½ " -10" Below Ground FEBCO N Pattern Notes
7-170	Double Check Valve Assy 2 ½"-10" Above Ground
7-171	Double Check Valve Assy 2 ½"-10" Above Ground Notes
7-175	Double Check Valve Assy 2 ½"-10" Below Ground AMES SS/SE Pattern
7-176	Double Check Valve Assy 2 ½ " -10" Below Ground

	AMES SS/SE Pattern Notes
7-180	Double Check Valve Assy 2 ½"-10" Above Ground FEBCO N Pattern
7-181	Double Check Valve Assy 2 ½"-10" Above Ground FEBCO N Pattern Notes
7-185	Detector Double Check Assy 2 ½"-10" Below Ground
7-186	Detector Double Check Assy 2 ½"-10" Below Ground Notes
7-190	Detector Double Check Assy 2 ½"-10" Below Ground AMES SS/SE Pattern
7-191	Detector Double Check Assy 2 ½"-10" Below Ground AMES SS/SE Pattern Notes
7-195	Detector Double Check Assy 2 ½"-10" Below Ground FEBCO N Pattern Notes
7-196	Detector Double Check Assy 2 ½"-10" Below Ground FEBCO N Pattern Notes
7-200	Detector Double Check Assy 2 ½"-10" Above Ground
7-201	Detector Double Check Assy 2 ½"-10" Above Ground Notes
7-205	Reduced Pressure Backflow Assy 1 ½"-2" Below Ground
7-206	Reduced Pressure Backflow Assy 1 ½"-2" Below Ground Notes
7-210	Detector Double Check Assy 2 ½"-10" Above Ground FEBCO N Pattern
7-211	Detector Double Check Assy 2 ½"-10" Above Ground FEBCO N Pattern Notes
7-215	Reduced Pressure Backflow Assy 1 ½"-2" Above Ground
7-216	Reduced Pressure Backflow Assy 1 ½"-2" Above Ground Notes
7-220	Reduced Pressure Backflow Assy 2 ½"-10" Below Ground
7-221	Reduced Pressure Backflow Assy 2 ½"-10" Below Ground Notes
7-225	Reduced Pressure Backflow Assy 2 ½"-10" Above Ground
7-226	Reduced Pressure Backflow Assy 2 ½"-10" Above Ground Notes

800 SERIES – STREETS

8-100	Standard Type A Curb
8-100a	Standard Type A Curb – Pinned to PCC Street
8-105	Standard Type B Curb
8-105a	Standard Type B Curb – Pinned to PCC Street
8-110	Standard Type C Curb
8-115	Extruded PCC Curb
8-120	Standard Curb End
8-125	Standard Cross Gutter
8-130	Typical Alley Intersection
8-135	Concrete Joints
8-140a	Public Sidewalk Curb Ramps - New or Reconstruction w/Type A or B Curb
8-140b	Public Sidewalk Curb Ramps - New or Reconstruction w/Type C Curb
8-145a	Public Sidewalk Curb Ramps

	New or Reconstruction w/Type C Curb
8-145b	Public Sidewalk Curb Ramps
	New or Reconstruction w/Type A or B Curb
8-150	Public Sidewalk Curb Ramps –
	Tapered Curbs Type A & B Curbs
8-155	Public Sidewalk Curb Ramps –
	Parallel Ramps w/Type A or B Curb
8-160	Piping of Ditchlines Under Driveways
8-165	Typical Roadway Section – Arterials
8-170	Typical Roadway Section – Major Collector
8-175	Typical Roadway Section – Minor Collector
8-180	Typical Roadway Section – Local Street
8-185	Typical Roadway Section – Alley
8-187	Road Closed Barricade
8-195	Bike Lane Markings on Street
8-200	Street Classifications with Variable Dimensions
8-205	Driveway & Intersection Sight Triangles
8-209	Standard PCC Sidewalk
8-210	PCC Driveway Across Sidewalk – Type 1
8-215	PCC Driveway Across Sidewalk – Type 2
8-216	PCC Driveway Across Sidewalk – Type C Curb
8-220	PCC Stairway Replacement within Public ROW
8-221	PCC Stairway Replacement within Public ROW
8-222	PCC Stairway Replacement within Public ROW
8-225	Rockery
8-230	Survey Control Monument Cases
8-235	Standard Method for Adjusting
	Underground Utility Access Structures
8-240	Standard Method for Matching Existing A/C Surface
8-245	Curb Replacement
8-245a	Curb Removal No – Cut Street
8-250	Typical Trench Patch (Cold Patch)

1000 SERIES – DRAFTING

10-100	Plan Set Sheet Sizes
10-105	Typical Sheet Arrangement 1
10-106	Typical Sheet Arrangement 2
10-110	Typical Title Blocks “A”
10-111	Typical Title Block “B” & “D”
10-115	Typical Line types
10-120	Standard Text Fonts
10-125	Example of Dimensions, Notes and Leaders
10-130	Standard Drawing Symbols
10-135	North Arrows
10-140	Typical Drafting Scales
10-145	Standard Section Cuts
10-150	Standard Callouts
10-155	Standard Hatch Patterns

SECTION 12 GUIDELINES FOR TRANSPORTATION IMPACT ANALYSES

12-1 PURPOSE

12-1.1 Transportation Planning and Transportation Impact Analyses

The City of Klamath Falls strives to accommodate growth in a responsible and sustainable manner. With regard to land use and transportation, this involves a need to balance property owners' rights to develop their land and the City's goal to plan for and provide a transportation system that serves its intended function in a safe, reliable, and predictable manner for the public.

The City adopted its Transportation System Plan (TSP) in 1997, outlining a plan to provide a multi-modal transportation system to accommodate expected growth through year 2020. *The Guidelines for Transportation Impact Analyses* are consistent with the TSP Goals:

1. Mobility – Develop a transportation system that serves the mobility needs of all Klamath Falls residents.
2. Safety – Develop a transportation system that provides adequate safety for the transportation system users.
3. Capacity – Develop a transportation system that provides adequate capacity to serve the system user's needs.
4. Travel Options – Develop a transportation system that incorporates, provides for, and encourages a variety of multi-modal travel options.
5. Environment – Develop a transportation system that preserves, protects, and supports the environmental integrity of the Klamath Falls community.
6. Economic Development – Develop a transportation system that facilitates the desired economic development and viability of the community.
7. Transportation Funding – Develop reasonable and effective funding and financing strategies for the recommendations and improvements contained within the Transportation System Plan.
8. Accessibility – Develop a transportation network that ensures adequate and efficient accessibility for all desired land uses, modes of travel, and system users.
9. Coordination – Develop a transportation system plan that is consistent with the goals, objectives, and vision of Klamath Falls residents, participating agencies, and the community in general.
10. Consistency – Provide Klamath Falls with a transportation system and transportation policies that allow the community to manage its transportation facilities in a manner consistent with the City's goals and philosophies.

12-1.2 The Need for Transportation Analyses for Individual Developments

The City's development review process is designed to help the City achieve its goal of managing growth in a responsible and sustainable manner. The applicant for development is required to submit full and accurate information upon which the City staff and elected officials can base

decisions. A developer-submitted transportation study prepared by a professional engineer qualified in the traffic engineering field is a critical tool used by the City to assess the expected transportation system impacts associated with a proposed development and the long-term viability of the transportation system. A study must highlight development-specific issues, present a mitigation plan to mitigate for traffic impacts, and alert the City to the potential need to program specific projects from the TSP into the Capital Improvement Program (CIP).

12-1.3 The Level of Analysis and Documentation

This document establishes analysis and submittal requirements for developments in accordance with their expected transportation impacts. Under certain conditions, the City can allow a lesser level of analysis and documentation for small developments. ***In addition, other developments meeting specific criteria are exempted from long-range analyses.***

12-2 OVERVIEW

12-2.1 Different Documentation for Different Development Proposals

This document describes the City's required content for a **Transportation Analysis Letter (TAL)** and for a **Transportation Impact Study (TIS)**. In general terms, the TAL is applicable to smaller developments that are presumed to have a lesser transportation impact. The TIS applies to larger developments that are presumed to have a greater transportation impact.

Whether the development requires a TAL or a TIS, a professional engineer must prepare it and must use appropriate data, methods, and standards. TAL and TIS documents share many common elements, but the scope of TALs is more limited. Furthermore, there will be more variability in the scope for TISs depending on the type, location, and size of the development being proposed.

Section 8-3.1 provides criteria use to determine whether a TAL or TIS is required.

12-2.2 Content of Transportation Impact Analyses Generally

Transportation analyses, whether conducted to support a TAL or a TIS, are required to provide an objective assessment of the potential modal transportation impacts associated with a specific land use action (e.g., the development of vacant land, the redevelopment of an existing land use, a comprehensive plan amendment or zoning change). The analysis and the documentation provided by the applicant must help answer several important transportation related questions including:

- Will the existing transportation system accommodate the proposed development from a capacity and safety standpoint?
- What on-site and off-site transportation system improvements will be necessary to accommodate the proposed development?
- How will access to the proposed development affect the traffic operations on the existing transportation system?
- How will transportation impacts of the proposed development impact the land uses, including commercial, institutional, industrial and residential uses within the development's influence area?
- How will the proposed development meet current city standards for roadway design?

- How will the proposed development ensure the safe and efficient circulation on and adjacent to the site?
- How will the proposed development provide needed connections to abutting parcels (developed or undeveloped) for motorized as well as non-motorized traffic?

12-2.3 Responsibilities of Those Preparing Transportation Analyses Generally

The responsibility for assessing the traffic impacts associated with a proposed land use action rests with the landowner or land use permit applicant. Transportation analyses submitted to the City must be prepared by or under the direct supervision of a Professional Engineer with competence in traffic engineering and registered in the State of Oregon. The report shall be signed and stamped by the professional engineer.

Under state law, engineers shall recognize at all times that their primary obligation is to protect the safety, health, property and welfare of the public in the performance of their professional duties.

These Guidelines in no way serve as a substitute for the application of sound professional engineering judgment expected to be used by practitioners in the preparation and submittal of transportation analyses.

12-2.4 Responsibilities and Authority for the City

Throughout this document the term “City Engineer” is used as the individual with authority for certain actions and for interpretation of aspects of these guidelines. For the purposes of this document, the term “City Engineer” should be taken to mean the “City Engineer or his/her designee.”

12-3 TRANSPORTATION IMPACT ANALYSIS DOCUMENTS

An analysis and appropriate documentation is generally required when a development application and/or application for a comprehensive plan/zone map amendment is filed with the City. A transportation impact analysis is required when application is made for land to be subdivided; when application is made for a conditional use; when new development or redevelopment is involved, and with a planning design review application.

A transportation analysis is not required for modification of a single-family dwelling or for construction of a replacement dwelling. In most other circumstances and for most other development applications, some level of transportation analysis is required.

Recognizing that not all developments will have a significant impact on the transportation system, the City of Klamath Falls has developed criteria to help determine the need for and level of transportation analysis required in relation to the proposed development.

12-3.1 Determining the Required Level of Transportation Analysis and Documentation

A Transportation Impact Study (TIS) is required for developments that are expected to have an impact on the transportation system. When specific criteria generally associated with small developments are met, a Transportation Analysis Letter (TAL) may be substituted for the required TIS.

At the discretion of the City Engineer, a TAL may satisfy the City's transportation analysis requirements, in lieu of a TIS, when a development meets all of the following criteria:

- A. The development generates fewer than 24 peak hour trips during either the weekday AM or PM peak hour and fewer than 250 daily trips.

Two examples of common developments generating fewer trips than these threshold levels are: a subdivision containing 24 or fewer single-family residences or a general office building less than 15,000 square feet.

- B. The development is not expected to impact intersections that currently fail to meet the City's level of service standards or intersections that are operating near the limits of the acceptable level of service thresholds during a peak operating hour. (LOS standards are defined in 8-7.9.1)
- C. The development is not expected to significantly impact adjacent roadways and intersections that are high accident locations, areas that contain an identified safety concern, or high concentration of pedestrians or bicyclists such as school zones

The specific requirements for and content of a TAL are contained in Section 8-5. The specific requirements for and content of a TIS are contained in Section 8-6.

12-4 PROCESS AND PROCEDURES

This section describes in general terms the process and procedures followed by the City in relation to the processing and review of transportation impact analyses. Nothing in this section is intended to replace or supersede the City's process, code requirements, or obligations under state law with regard to land use actions.

12-4.1 Pre-Application Meeting

A landowner or developer seeking to develop/redevelop property, request a zone change, subdivide or partition property, or develop/redevelop property shall contact the City Community Development Department and schedule a pre-application meeting. At the pre-application meeting, an applicant should be prepared to present the following in writing:

- type of uses within the development
- the size of the development
- the location of the development
- proposed new accesses or roads
- estimated trip generation and source of data
- proposed study area

12-4.2 Establishing the Scope of Work

During, or within a reasonable time following the pre-application meeting, the City will establish whether a TAL or TIS is required. (See Section 8-3.1). If a TIS is required, the City will provide a scoping summary detailing the study area and any special parameters or requirements beyond the requirements set forth in this document. An applicant is encouraged, but not required, to propose a scope of work and a study area using the guidance presented in Section 8-7.2.

12-4.2.1 Potential for Expansion of the Scope of Work

In the scoping summary the City as well as ODOT and Klamath County will establish expectations and a study area within which significant impacts of the development are expected. The City's final decision on the land use criteria cannot be bound by the specifications or limitations in the scoping summary because additional information or concerns may come to light over the course of the analysis that causes the City to require additional analysis or information. Ultimately, it is the applicant's responsibility to demonstrate compliance with the criteria in the Klamath Falls code.

The City Engineer reserves the right to require additional analysis, especially when the need for such analysis becomes evident from information gathered by or presented by the applicant. The applicant's engineer should be alert to this possibility and expand his/her scope of work to address issues, especially those of public safety, or at least advise the City of such issues if they arise.

The City Engineer may at his/her discretion expand the requirements and/or study area of a TIS or TAL if needed to address any issue that comes to light after the preparation of the scoping summary.

12-4.2.2 Time Limit on the Scoping Summary

The City's scoping summary and review requirements are to be considered valid for a reasonable period of time, but are not to be considered binding on the city. Applicants are advised that delays of more than a few months before submitting TAL or TIS documents significantly increases the likelihood that the City will need additional information to adequately evaluate the impacts of a proposed development.

12-4.3 Completeness Review

Upon completion of the TIS or TAL, the applicant will submit three (3) copies to the City Community Development Department for review. The TIS/TAL is due with the proposed application. At that time, City staff will perform an initial review of the project and the document to determine whether there are obvious omissions or concerns. The City will rely upon and make use of the completed and signed TIS checklist, described in more detail in Section 8-9.0, and which is to be incorporated as one of the first inside pages of the submittal to determine whether or not it is "complete."

Once the overall land use application, including the required TAL or TIS, as appropriate, is deemed "complete," the 120-day land use review process will begin.

12-4.4 Technical Review

Once the application is deemed complete, the City Engineer or their agent, will conduct a technical review of the TIS to determine the adequacy and quality of the work including, but not limited to the study data sources, methods, findings and recommendations. The City Engineer and/or his/her designee will provide findings for use by the City regarding expected transportation impacts from the proposed development.

If substantive errors or omissions are discovered during review, the applicant will be notified and asked to address the comments prior to a land use decision. The applicant should promptly rectify omissions and respond with any additional analysis or information; a delay or refusal to respond may result in the denial of an application if the information and analysis submitted is insufficient to show compliance with the applicable criteria.

The lack of specificity on the part of the City in the scoping summary or confusion in its interpretation does not alter the applicant's responsibility to perform a thorough and comprehensive transportation analysis nor does it preclude City decision maker from determining that a TAL or TIS that fully complies with the scoping requirement is insufficient to show compliance with all applicable criteria.

Issues or problems discovered during the Technical Review may, at the discretion of the City's decision maker, be resolved through the use of conditions of approval.

12-5 TRANSPORTATION ANALYSIS LETTER CONTENTS

If the City determines based on information provided by the applicant and in accordance with the criteria specified in Section 8-3.1 that a TAL is the appropriate document to submit, the following requirements shall apply.

The TAL shall be prepared by or prepared under the direct supervision of a Registered Professional Engineer who shall sign and stamp the TAL.

The TAL shall include the following:

1. The expected trip generation of the proposed development including the weekday AM and PM peak hour and daily traffic, and other germane periods as may be appropriate, together with appropriate documentation and references.
2. Site plan showing the location of all access driveways or private streets where they intersect with public streets, plus driveways of abutting properties and driveways on the opposite side of the street from the proposed development.
3. Documentation that all site access driveways meet Klamath Falls Private Access Driveway Width Standards and location.
4. Documentation that all proposed public streets meet Klamath Falls' Minimum City Street Intersection Spacing Standards.
5. Documentation that all new site accesses and/or public street intersections meet AASHTO intersection sight distance guidelines.
6. Documentation that there are no inherent safety issues associated with the design and location of the site access driveways.
7. Documentation that the applicant has reviewed the City's TSP and that proposed streets and frontage improvements do or will comply with any applicable standards regarding the functional classification, typical sections, access management, traffic calming and other attributes as appropriate.

12-6 TRANSPORTATION IMPACT STUDY CONTENTS

The following information shall be included in each TIS submitted to the City. Additional information specified by the City in the scoping summary or through the pre-application meeting or other project meetings shall also be included.

1. Completed TIS checklist signed by the Professional Engineer responsible for the preparation of the TIS.
2. Table of Contents – Listings of all sections, figures, and tables included in the report.

3. Executive Summary – A summary of key points, findings, conclusions, and recommendations including a mitigation plan.
4. Introduction:
 - Proposed land use action including site location, zoning, building size, and project scope.
 - Map showing the proposed site, building footprint, access driveways, and parking facilities.
 - Map of the study area that shows site location and surrounding roadway facilities.
5. Existing Conditions:
 - Existing site conditions and adjacent land uses.
 - Roadway characteristics of important transportation facilities and modal opportunities located within the study area, including roadway functional classifications, street cross-section, posted speeds, bicycle and pedestrian facilities, on-street parking, and transit facilities.
 - Existing lane configurations and traffic control devices at the study area intersections.
 - Existing traffic volumes and operational analysis of the study area roadways and intersections.
 - Roadway and intersection crash history analysis.
 - Intersection and stopping sight distance related to new and impacted driveways and intersections.
6. Background Conditions (without the proposed land use action)
 - Approved in-process developments and funded transportation improvements in the study area.
 - Traffic growth assumptions.
 - Addition of traffic from other planned developments.
 - Background traffic volumes and operational analysis.
7. Full Buildout Traffic Conditions (with the proposed land use action)
 - Description of the proposed development plans.
 - Trip generation characteristics of proposed project (including trip reduction documentation).
 - Trip distribution assumptions.
 - Full buildout traffic volumes and intersection operational analysis.
 - Site circulation and parking.

- Intersection and site-access driveway queuing analysis.
 - Recommended roadway and intersection mitigation measures (if necessary).
8. Conclusions and recommendations
 9. Appendix- With dividers or tabs
 - Traffic count summary sheets.
 - Crash analysis summary sheets.
 - Existing, Background, and Full Buildout traffic operational analysis worksheets with detail to review capacity calculations.
 - Signal, left-turn, and right-turn lane warrant evaluation calculations.
 - Signal timing sheets depicting the timing and phasing used in analysis.
 - Other analysis summary sheets such as queuing.

To present the information required to analyze the transportation impacts of development, the following figures shall be included in the TIS:

1. Vicinity Map
2. Existing Lane Configurations and Traffic Control Devices
3. Existing Traffic Volumes and Levels of Service for each required time period
4. Future Year Background Traffic Volumes and Levels of Service for each required time period
5. Proposed Site Plan, including access points for abutting parcels and for those across the street from the proposed development
6. Future Year Assumed Lane Configurations and Traffic Control Devices (if different from the Existing Conditions)
7. Estimated Trip Distribution/Assignment Pattern
8. Trip reductions (pass-by trips at site access(es))
9. Site-Generated Traffic Volumes for each required time period
10. Full Buildout Traffic Volumes and Levels of Service for each required time period

12-7 STANDARDS AND PROCEDURES

To help ensure consistency in the preparation and review of each TIS and TAL, the City of Klamath Falls has established a set of guidelines and procedures. These standards and procedures include the following:

- Preparer qualifications

- TIS study area
- Analysis years and time periods
- Data collection guidelines
- Trip generation guidelines
- Trip distribution and assignment guidelines
- Minimum intersection operational standards
- Minimum access spacing standards
- Other analysis guidelines

12-7.1 Preparer Qualifications

Each TIS and TAL shall be prepared by or under the direct supervision of a Professional Traffic Engineer registered in Oregon or a Professional Engineer registered in Oregon qualified to perform traffic engineering as defined by OAR 820-040-0030. The engineer must have background and experience in the methods and concepts associated with transportation impact studies. Each TIS and TAL shall be sealed and signed by the Professional Engineer prior to acceptance by the City for a technical review.

12-7.2 TIS Study Area

Each TIS shall include a vicinity map that shows the site, the study area, and the surrounding transportation system. A brief description of the site location and study area shall be provided. The study area shall be based on engineering judgment and an understanding of existing and future land use and traffic conditions in the vicinity of the site. The following considerations shall form the basis of establishing the study area.

The following facilities shall be included in the study area for all TIS's:

- All site-access points and intersections (signalized and un-signalized) adjacent to the proposed site. In particular, if the proposed site fronts an arterial or collector street, the analysis shall address all intersections and driveways along the site frontage, including those serving parcels on the opposite side of the street(s).
- Roads through and adjacent to site.
- Any intersection of two streets, each with a classification of collector or arterial, where site traffic will exceed 20 vehicles during a peak hour or, in the case of a rezone, if the trip differential resulting from the rezone will exceed 20 vehicles during a peak hour.
- All intersections needed for signal progression analysis.

As indicated in Section 8-4.1, the applicant is encouraged to propose a study area at the pre-application meeting or in response to the discussions between the applicant and the City's representatives.

In addition to these requirements, the City Engineer may determine any additional intersections or roadway links that may be adversely affected as a result of the proposed development. The

applicant reduces his risk of having an adverse staff report if the applicant reaches agreement with the City Engineer prior to the start of the transportation impact analysis.

12-7.3 Analysis Years to be Analyzed in the TIS

To adequately assess the impacts of a proposed land use action, several study periods should be addressed in the transportation impact analysis. These study periods or horizon years consist of the following:

- **Existing Year**
- **Background** – The conditions in the year in which the proposed land use action will be completed and occupied, but without the expected traffic from the proposed land use action. This analysis should include all in-process developments, or city approved developments that are expected to be fully built out in the proposed land use action horizon year. It should also account for all in-process/planned transportation system improvements.
- **Note:** Depending on funding or project development issues, it may not be appropriate to assume that certain planned transportation system improvements will be in place on opening day. Applicants should contact the City Engineer to confirm appropriate assumptions.
- **Full Buildout** – The background condition plus traffic from the proposed land use action assuming full build-out and occupancy.
- **Phased Years of Completion** – If the project involves construction or occupancy in phases or for master plans, the applicant is expected to assess the expected roadway, intersection, and land use conditions resulting from major development phases. Phased years of analysis will be determined in coordination with City staff.
- **20-Year or TSP Horizon Year** – For comprehensive plan amendments, zone changes, and conditional uses, the applicant shall assess the expected future roadway, intersection, and land use conditions resulting from deviations from approved comprehensive planning documents.

A twenty-year or TSP Horizon Year analysis will not be required for the following development proposals:

- For out-right permitted uses under the current zoning.

12-7.4 Analysis Periods to be Analyzed in the TIS

Within each analysis year, specific consideration should be directed to the time period(s) that experience the highest degree of network travel. These periods typically occur during the weekday morning (7:00AM to 9:00AM) and weekday evening (4:00 PM to 6:00 PM) peak commuting hours.

The TIS shall address the weekday AM and PM peak hours when the proposed land use action is expected to generate 25 trips or more during the peak time periods. If the applicant can demonstrate that the peak hour trip generation of the proposed land use action is fewer than 25 trips during one of the two peak study periods and the peak trip generation of the land use action corresponds to the roadway system peak, then only the worse of the two peak periods must be analyzed. This does not mean, however, that all aspects of the other peak period can be ignored.

The applicant should consider, for example, the possibility that inbound and outbound trips at the site driveway have specific operational issues that may need to be addressed for both peak hours.

Depending upon the proposed land use action and the expected trip generating characteristics of that development, other time periods may be specified, either as a substitute for, or in addition to the weekday AM and PM peak hours. Examples of land uses that have non-typical trip generating characteristics include schools, restaurants, movie theatres, nightclubs, and churches. Applicants should assume that the City will require additional analysis periods for certain uses as summarized below:

- Schools – End of the school day (early afternoon) peak hour
- Churches and worship facilities – Peak period prior to and after worship services.
- Restaurants – Mid-day weekday peak hour
- Shopping centers, home improvement centers, superstores, and retail facilities of more than 60,000 square feet – Saturday peak hour.

When the additional hours for analysis are specified, the applicant need not necessarily carry the analysis through all steps if the data and the engineer's analysis show that some time periods clearly represent the worst case. If, for example, the mid-day peak period traffic volumes at a restaurant are lower than the other peak periods, except at the site driveway, the mid-day peak need only be analyzed for the driveway location. The engineer preparing the TIS is advised to provide thorough documentation of the reasons for reducing the scope of the extra time periods. The applicant may choose to bring such issues to the attention of the City Engineer for discussion prior to submittal of the TIS.

The above list is not necessarily an all-inclusive list of uses for which additional analysis periods is required. The City Engineer and applicant should discuss the potential for additional study periods prior to the start of the transportation impact analysis.

12-7.5 Applications Involving Zone Changes

In the case of a land use proposal involving a zone change, the TIS must analyze a 20-year horizon period as required by the Oregon Transportation Planning Rule (TPR) and may require interim years in the case of a master plan that also requires a zone change. Applicants seeking a rezoning are advised that in addition to any requirements specified by the City, it is their obligation to address requirements in OAR 660-12-0060. The City's exemption from the requirement for 20-year analysis for certain rezoning actions as specified in Section 7.3 may not exempt the applicant from addressing TPR requirements.

For proposals involving rezoning, the applicant shall compare the traffic generated by his/her development proposal, a reasonable worst-case development under the proposed zoning and a reasonable worst-case development under current zoning.

12-7.6 Traffic Count Requirements

Once the TIS study area and analysis periods have been determined, turning movement counts shall be collected at all study area intersections to determine the base traffic conditions. These turning movement counts should typically be conducted during the weekday (Tuesday through Thursday) between 7:00 a.m. – 9:00 a.m. and 4:00 p.m. – 6:00 p.m. and for other periods depending upon the proposed and/or surrounding land uses. Historical turning movement counts may be used if the data is not more than 12 months old at the time the TIS is deemed complete

for review. Historical counts shall be factored accordingly to meet the existing traffic conditions. In high traffic locations where congestion is present or traffic peaks early or late, extended or altered count periods may be required.

12-7.7 Trip Generation for the Proposed Development

To determine the impacts of a proposed development on the surrounding transportation network, the trip generation characteristics of that development must be estimated. Trip generation characteristics should be obtained from one of the following acceptable sources:

- Institute of Transportation Engineers (ITE) *Trip Generation* (latest edition).
- Specific trip generation studies that have been conducted for the particular land use for the purposes of estimating peak hour trip generating characteristics, subject to approval by the City Engineer prior to their inclusion in the transportation impact analysis.

In addition to new site generated trips, several land uses typically generate additional trips that are not added to the adjacent traffic network. These trips include pass-by trips and internal trips and are considered to be separate from the total number of new trips generated by the proposed development. The procedures listed in the (ITE) *Trip Generation Handbook* should be used *where appropriate* (emphasis added) to account for pass-by trips and internal trips. The applicant's engineer shall not use any pass-by or internal trip reductions with prior approval of the method or data sources by the City Engineer.

Special Attention Items

The ITE *Trip Generation Handbook* maintains limited data regarding pass-by, diverted-linked, and internal shared trip-making characteristics. Professional judgment needs to be used in applying this data. For example, it is not appropriate to apply PM peak hour pass-by percentages to AM or daily periods where AM and daily percentages do not exist. Also, ITE's internal shared trip characteristics are based on a limited number of studies from the early 1990's in Florida. These sites included a mix of commercial, residential, retail, and other uses. For developments that contain only one or two of these uses, a maximum shared trip reduction of five (5) percent will be allowed without appropriate justification and supporting data from the applicant.

The ITE *Trip Generation Handbook* outlines specific guidelines for use of weighted average trip rates versus regression equations. These guidelines shall be followed unless the applicant provides valid justification for deviation.

12-7.8 Trip Distribution and Assignment

Estimated site generated traffic for the proposed development should be distributed and assigned to the existing or proposed arterial and collector street network. Trip distribution methods should be based on a reasonable assumption of local travel patterns and the locations of off-site origin/destination points within the site vicinity. Acceptable trip distribution methods should be based on one or more of the following procedures:

- An analysis of local traffic patterns and intersection turning movement counts can be used as long as the data has been gathered within the previous twelve months.
- A detailed market study specific to the proposed development and surrounding land uses may be used to determine the specific influence area. Site generated traffic within the identified influence area should be distributed based on principles and concepts associated with the gravity model theory. Note that if a market study is to be used as a

basis for trip distribution, the entire market study must be made available to the City and it shall become part of the public record and, as such, any client confidentiality is lost.

Special Attention Items

In the case of retail developments, the applicant shall clearly distinguish between pass-by and non-pass-by trips to allow the reviewer to understand how the pass-by trips were accounted for and applied throughout the study area. The treatment of pass-by trips at the site entrance may be most easily addressed through separate figures depicting the total site trips and the individual pass-by and non-pass-by components.

12-7.9 Intersection Operational Standards

To assess the impacts of the proposed land use action on the transportation system, the TIS shall compare the existing, background, and full buildout intersection traffic volumes to the minimum intersection operational standards.

The City of Klamath Falls evaluates intersection operational performance based on the Level of Service (LOS) as defined in the *Highway Capacity Manual (HCM)* published by the Transportation Research Board.

LOS calculations for signalized intersections are based on the average control delay per vehicle, while LOS calculations for unsignalized intersections are based on the average control delay and volume-to-capacity (v/c) ratio for the worst or critical movement. All LOS definitions should be consistent with the most recent version of the *HCM*.

12-7.9.1 Intersection Level of Service Standards

The City of Klamath Falls requires all intersections within the study area to maintain an acceptable level of service (LOS) upon full buildout of the proposed land use action.

Klamath Falls' minimum acceptable Level of Service (LOS) is defined as follows for signalized intersections throughout the city:

LOS "D" or better for the intersection as a whole and no approach operating at worse than LOS "E" and a v/c ratio not higher than 1.0 for the sum of critical movements.

Klamath Falls' minimum acceptable LOS is defined as follows for unsignalized intersections throughout the city:

LOS "E" or better for the poorest operating approach and with no movement serving more than 20 peak hour vehicles operating at worse than LOS "E." In other words, LOS "F" will be tolerated for minor movements during a peak hour.

12-7.9.2 Intersection Design Features and Queuing Calculations

The TIS shall contain sufficient data and information derived from the traffic analysis to provide the roadway/intersection designer and City staff with information on which to assess intersection design features such as the length of storage required for lanes on each approach.

Queue lengths shall be calculated for each lane of all approaches to signalized intersections for the 95th percentile queue. Queue lengths shall also be calculated for unsignalized locations, such as site driveways, where standing queues can interfere with other movements, especially if such interference can contribute to safety problems. Appropriate

analysis methods should be used that account for the actual arrivals of vehicles at an intersection.

Special Attention Items

The applicant's engineer shall use professional judgment in selecting the appropriate analysis tools and methods for evaluation of intersection operations. The HCM, for example, states "The [HCM] methodology does not take into account the potential impact of downstream congestion on intersection operation. Nor does the methodology detect and adjust for the impacts of turn-pocket overflows on through traffic and intersection operation." If these conditions are present or can reasonably be expected to exist as a result of the proposed development, the applicant's engineer shall supplement his/her initial analysis with other analysis tools and methods that account for such conditions.

The applicant's engineer also must use reasonable signal timing and consider corridor timing plans where appropriate.

When calculating queues, Poisson distribution may be used for locations subject to random arrivals. Other analysis methods shall be used where signal systems cause different arrival patterns and when congestion causes accumulation from one cycle to the next. Queue lengths shall be based on average vehicle length of twenty-five (25) feet, or longer where appropriate.

12-7.10 Access Spacing Standards

Access locations on roadway sections must be located to ensure safe and efficient travel along a transportation facility to limit potential conflicting turning movements, weaving maneuvers over short distances, and congestion along facilities. Access management standards vary depending upon the functional classification and purpose on a given roadway. Roadways in the upper echelon of the functional classification system (i.e. arterials) tend to have stringent spacing standards, while facilities ranked lower in the functional classification system allow more closely spaced accesses.

The applicant shall use the *Proposed Access Management Strategy* as outlined in the *Klamath Falls Urban Area Transportation Systems Plan* and discuss whether the following standards are met through their proposed development:

- Minimum city street intersection spacing (the distance between adjacent intersections),
- Minimum private access spacing (the distance between adjacent driveways and between driveways and street intersections),
- Minimum traffic signal spacing (the distance between adjacent signalized intersections),
- Minimum private access driveway widths (the measurement of the individual driveway surface)

Exception Process:

In cases where physical constraints or unique site characteristics limit the ability for the above access spacing standards to be met, the City decision maker may grant an access spacing exception. Typically, access exceptions are available only for a parcel whose roadway frontage, topography, or location would otherwise preclude issuance of a conforming permit and the parcel would either have no reasonable access or cannot otherwise obtain reasonable alternate access to the public road system. However, if the limitation or condition is one that the applicant or owner

has contributed to by any previous subdivision of property, sale, building activity, or site development, the limitation or condition shall not constitute a basis for an access exception. Note also that the City may choose to prohibit some movements (e.g. left turns) at the site access location, especially if such access is in a location where an access exception is needed.

When an exception is required, the transportation impact analysis must show that the new access will not adversely impact the existing transportation system. A high burden is placed on the applicant and his/her engineer to prove that the system will not be adversely impacted and that public safety will not be compromised.

12-7.11 Sight Distance

For all new proposed site driveways and public street intersections, an evaluation of stopping sight distance (SSD) and intersection sight distance (ISD) shall be conducted consistent with procedures outlined in the current version of the AASHTO *Policy on Geometric Design of Highways and Streets*. At the discretion of the City Engineer, the applicant may be exempted from a need to assess sight distance.

The City standard for new driveways and intersections requires that ISD meet the minimum distance specified in AASHTO. The applicant may apply for a design exception allowing a driveway or intersection that meets SSD rather than ISD. A high burden is placed on the applicant and his/her engineer to prove that the system will not be adversely impacted and that public safety will not be compromised. The City Engineer may grant a design exception if the following conditions are met: 1) the intersection or driveway is proposed to intersect with a local or neighborhood collector street (not a major collector or arterial street), and 2) the approach is forecast to serve fewer than forty (40) vehicles per day, and 3) the intersection will not adversely impact the existing transportation system. The City Engineer may also grant a design exception if the intersection is forecast to serve less than 100 vehicles per day for a period of not more than twenty-four (24) months. Should the City Engineer choose to grant a design exception, he/she may place additional conditions on the applicant, such as, but not limited to placement of warning signs or the use of flaggers for manual traffic control as prescribed by the *Manual on Uniform Traffic Control Devices* (MUTCD).

Special Attention Items

Under AASHTO procedures, intersection sight distance is evaluated based on the roadway design speed – not the roadway posted speed. Where design speed is not known, it shall be estimated using procedures outlined in the AASHTO *Policy on Geometric Design of Highways and Streets*. This generally results in a design speed anywhere from 5 to 10 mph above prevailing posted speed.

12-7.12 Crash History

Within the study area for each TIS, a crash history evaluation shall be conducted for the most recent three-year period. The intent of the evaluation is to identify any apparent trends in the data that reflect a safety issue that may be exacerbated by the proposed development and to identify mitigation to resolve the issue(s). At a minimum, the analysis shall summarize the number of crashes per year by type and severity. Intersection crash rates shall be calculated and evaluated. The engineer shall assess the overall results of the safety analysis.

12-7.13 Safe Routes to School

For proposed residential developments, the TIS shall include a brief discussion of routes to the nearest schools. The applicant shall identify the primary walking/biking route between the proposed development and the nearest elementary, middle, and high school. Specifically, the

applicant shall describe the general bicycle and pedestrian environment between the proposed development and each school, including the presence and condition of pedestrian and bicycle facilities and the roadway environment (speed, lanes, etc.) along the routes. This section requires applicants to address the special need to link residential areas to area schools.

12-7.14 Warrants (Turn Lane, Traffic Control)

The following section provides guidance on evaluating turn lane and traffic signal warrants.

12-7.14.1 Traffic Control Warrants

An evaluation of traffic signal warrants shall be conducted for all un-signalized study area intersections where any approach is shown to operate at LOS E or worse under existing, background, or total traffic conditions. Signal warrant analysis shall be conducted in accordance with the current version of the *Manual on Uniform Traffic Control Devices for Streets and Highways* (MUTCD).

Warrants to evaluate conversions between yield control, two-way STOP control, and multi-way-STOP control shall, as deemed necessary by the applicant's traffic engineer, comply with the MUTCD.

Special Attention Items

The reduction of minor street right turns is an important factor in evaluating traffic signal warrants and care must be taken to ensure the practice is not overlooked or improperly applied as it can affect warrant determinations. Both the MUTCD and the National Cooperative Highway Research Program (NCHRP) Report 457- *Evaluating Intersection Improvements: An Engineering Study Guide, 2001* offer detailed discussions of the proper methods to address right turn reductions.

For state highways, ODOT's Transportation Planning Analysis Unit maintains specific guidelines regarding right turn reductions that shall be applied to highway intersections. Other methods such as delay-based reduction methods may be considered if reasonably explained and justified by the applicant.

The construction of a lane to accommodate right turns shall be considered as a mitigation measure before or in addition to the analysis of traffic signal warrants for the installation of a traffic signal.

Note that Warrant 3, Peak Hour according to the MUTCD "shall be applied only in unusual cases." The burden of proof is on the applicant that the case is truly unusual. The applicant must evaluate the conditions using other warrants before attempting to justify the use of the Peak Hour warrant.

12-7.14.2 Turn Lane Warrants

The provision of dedicated left- and right-turn lanes on the major approach to an un-signalized intersection can significantly improve operations and safety at an intersection. The provision of a second lane on minor street approaches at un-signalized intersections can significantly reduce side street delay for right-turning motorists.

The applicant's engineer shall exercise professional judgment in evaluating the need for, and benefits of, providing dedicated left-turn and right-turn lanes. Documentation of the engineer's analysis of turn lanes shall be provided in the TIS.

The following is a non-exclusive list of conditions where an evaluation of turn lanes is appropriate:

- When no lane is currently provided for left turns and when left turn movements from the major street are predicted to increase because of the proposed development. This is especially appropriate when a turn lane is included as part of the standard cross-section for a street of this classification in the Transportation System Plan.
- When an intersection has a crash rate above 1.0 crashes per million entering vehicles and includes crash types subject to improvement from a turn lane.
- When the speed and volume of through traffic and increases predicted in right turn volumes raise concerns in the engineer's professional judgment about safety or about impeding through traffic.
- When only a single lane is provided for minor street approaches and the approach LOS is calculated to be "E" or worse.

The following are some of the references that should be considered by the applicant's engineer.

- **State Highways** – The Oregon Department of Transportation (ODOT) maintains criteria that shall be used for evaluating development of left- and right-turn lanes along state highways at Unsignalized Grade Intersections.
- **Local Streets**- Much of the published information regarding warrant criteria are centered on highway facilities and practitioners have therefore applied these criteria to local streets. The applicant shall refer to pages 686-89 of the 2001 AASHTO *Policy on Geometric Design of Highways and Streets* when evaluating turn lane warrants. Specifically, the applicant shall draw from other sources [see sources 2, 11, 12, and 13] cited by AASHTO. This criteria shall be updated coinciding with future revisions to the AASHTO Policy. An additional resource not cited by AASHTO is the National Cooperative Highway Research Program (NCHRP) Report 457- *Evaluating Intersection Improvements: An Engineering Study Guide, 2001*.

12-8 COMMON ERRORS AND OMISSIONS

The following are some common errors and omissions. Special care should be taken to address these items that are part of the TIS requirements identified herein.

- Failure to include a crash analysis.
- Failure to conduct a warrant analysis or incorrect methods, particularly a failure to account for right turns from minor streets.
- Failure to address access spacing.
- Lack of discussion of observed traffic flow.
- Failure to address intersection and/or stopping sight distance.
- Failure to discuss bicycle, pedestrian and transit facilities.
- Failure to present justification for some assumptions.

- Failure to account for downstream congestion, turn-pocket overflow, or signal timing of adjacent traffic signals (particularly with regard to the selection of software analysis tools)
- Use of unrealistic signal timing
- Use of inappropriate tools and assumptions for calculation of queues.

12-9 TIS CHECKLIST

All TISs submitted to the City of Klamath Falls must include the City's *Transportation Impact Study Checklist*. This checklist, presented on the following page, is designed to help the applicant address the City's requirements and to help the City staff determine whether it is complete as specified in Section 8-4.3.

The completed and signed checklist shall be incorporated into the bound TIS following the inside cover page and preceding the Table of Contents.

TRANSPORTATION IMPACT STUDY CHECKLIST

Project Name: _____
City Reference Code: _____

Provided? Page No.

☐ Yes ☐ No _____ Study Required Comment: _____ Date: _____

☐ Yes ☐ No _____ **BACKGROUND INFORMATION** ☐
Oregon PE Stamp and Signature

☐ Yes ☐ No _____ **INTRODUCTION AND SUMMARY** ☐

☐ Yes ☐ No _____ **EXISTING CONDITIONS**
Roadway Network - summary of roadway classifications, lanes, speeds, transit service and facilities, alternative mode service and facilities (e.g., sidewalks, bike lanes, crosswalks) and description of study area
☐ Yes ☐ No _____ Analysis Periods Correct (☐ AM, ☐ Mid-day, ☐ PM ☐ Afternoon _____, ☐ Saturday _____, ☐ Other _____)
☐ Yes ☐ No _____ Existing Traffic Operations (Existing LOS, traffic volumes (new counts ☐), speeds ☐, crash data ☐)

☐ Yes ☐ No _____ **IMPACTS**
☐ Yes ☐ No _____ Trip Generation - Daily, peak hour trips generated by site development
☐ Yes ☐ No _____ Level of Service Analysis -projected LOS with site build out, existing, and background traffic growth
☐ Yes ☐ No _____ Future year 20-year analysis required for zone change or conditional use
☐ Yes ☐ No _____ Signal Warrant Analysis
☐ Yes ☐ No _____ Turn Lane Warrant Analysis
☐ Yes ☐ No _____ Access Spacing Standards
☐ Yes ☐ No _____ Analysis of intersection and stopping sight distance at frontage road access point(s)
☐ Yes ☐ No _____ Identify safe route to school or school bus stop (Contact with school district)
☐ Yes ☐ No _____ Analysis of safe pedestrian/bicycle access to nearest transit stop (if within 1/2 mile of project site)
☐ Yes ☐ No _____ Identify accessibility to public transit
☐ Yes ☐ No _____ Account for planned roadway improvements at future build year ☐ and 20-year horizon

☐ Yes ☐ No _____ **MITIGATION**
☐ Yes ☐ No _____ Identify need for right/left turn lanes, storage capacity and length
☐ Yes ☐ No _____ Identify possible corrections of any LOS deficiencies
☐ Yes ☐ No _____ Identify any access deficiencies (including transit/pedestrian/bicycle connections)
☐ Yes ☐ No _____ Identify any TDM measures

☐ Yes ☐ No _____ **FIGURES**
☐ Yes ☐ No _____ Vicinity Map
☐ Yes ☐ No _____ Site Plan
☐ Yes ☐ No _____ Existing peak hour turn movement volumes (counts conducted within previous 12 months)
☐ Yes ☐ No _____ Trip Distribution (%) including Added Project Peak Hour Traffic Volumes (see sample)
☐ Yes ☐ No _____ Approved Projects Peak Hour Traffic Volumes (see sample)
☐ Yes ☐ No _____ Programmed transportation improvements and transportation mitigation outlined in study

☐ Yes ☐ No _____ **TABLES**
☐ Yes ☐ No _____ Intersection Performance Existing Conditions
☐ Yes ☐ No _____ Project Trip Generation
☐ Yes ☐ No _____ Intersection Level of Service

☐ Yes ☐ No _____ **OTHER**
Technical appendix - sufficient material to convey complete understanding of traffic issues (e.g. HCM or similar analyses, trip generation calculations, signal warrant analyses, turn lane warrant analyses, queuing calculations, signal timing sheets, traffic counts, etc.)

Completed By: _____ [SEAL]
Date: _____