

Appendix D



Irrigation Standards

I. Irrigation Design Standards

(a) *Purpose.* To conserve water resources and promote the efficient use of water resources by establishing requirements for design, installation and maintenance of automatic irrigation systems.

(b) *Applicability.* These standards shall apply to:

(1) New development. All new development where automatic underground irrigation of landscape areas is required per Chapter 146, Article 14 (Landscaping), including all common area landscape tracts, curbside landscape, private common open space and private parks.

a. Individual residential lots. The individual lots of single-family detached homes, two-family homes, and single-family attached duplex homes are exempt from plan submittal requirements but shall meet the following standards:

1. Materials must comply with standards of this section
2. Sprinkler head layout. Head spacing shall not exceed fifty percent (50%) of the diameter of each head's effective coverage. Part circle heads must be used around the entire turf/bed perimeter to avoid overthrow onto buildings, asphalt, concrete, etc., and walks. Radius reduction at the head shall not exceed twenty-five percent (25%) of the designed maximum arc as indicated in manufacturers' catalog. If there are coverage problems in unique areas, use part circle "backup/kicker heads".
3. Head spacing adjacent to impermeable surfaces may not be greater than the width of the irrigated area
4. Installing heads in a manner that create overspray on to impermeable surfaces is not permitted
5. Nozzles must be installed prior to inspection
6. Automatic drain valves are not permitted.

(2) Replacement of existing irrigation systems. Existing irrigation systems being replaced, modified, upgraded or expanded pursuant to Chapter 146. Existing irrigation systems that are operating in an efficient manner and are not found to be wasting water as found in Section 138-190 of the City of Aurora Code are exempt from these standards when performing routine maintenance, and repairs.

(c) *Irrigation design plan.* Prior to the installation of the irrigation system the Aurora Water Department shall approve a design plan prepared by a designer that complies with the system requirements specified in this section. An electronic AutoCAD file with .dwg file extension or .pdf is preferable.

The irrigation design plan shall accurately and clearly identify:

- Property boundaries.
- Locations, model and size of all components of the irrigation system.
- Detailed drawings of all major components of the irrigation system.
- Static water pressure at the point of connection.
- Flow rate, zone number, application rate (inches per hour), and design operating pressure for each zone or station on the controller.
- Backflow preventer.
- The square footage of turf and planting beds on the plans.
- Pressure loss worksheet.
- Calculation of water usage in gallons for the year.
- Irrigation schedule.
- Clearly displayed registered Landscape Architect or Certified Irrigation Designer (CID) Stamp.
- Note stating **“An Irrigation and Soil Permit is required. Please call Water Conservation at 720-859-4364 to obtain your permit”**.

(d) *System requirements.*

(1) Flow requirement. The system shall be designed so it is capable of providing sufficient water for adequate plant growth during periods of peak demand when evapotranspiration (ET) is highest. Peak demand shall be based on 1.8 inches per week for turf and 1.0 inch per week for planting beds. Water requirements for each site must be determined prior to designing the system in order to size the system for adequate capacity.

(2) Pressure control. In order to control pressure and protect the system from damage, pressure-reducing valves shall be located immediately downstream of the backflow preventer if static pressure is fifteen (15) Pounds per Square Inch (PSI) above the system design pressure. System design pressure is the required operating pressure at the head plus total system pressure losses, including tap, service and meter. Pressure at all heads shall be within ten percent (10%) of the system design operating pressure. (Example: a head designed for 30.0 PSI shall operate within the 27.0 to 33.0 PSI range.) A combination pressure-reducing and control valve can be used to control the pressure within a zone.

(3) Master valves shall be installed on all non-residential irrigation systems.

(4) Sprinkler head layout. Head spacing shall not exceed fifty percent (50%) of the diameter of each head's effective coverage. Part circle heads must be used around the entire turf/bed perimeter to avoid overthrow onto buildings, asphalt, concrete, etc., and walks. Radius reduction at the head shall not exceed twenty-five percent (25%) of the designed maximum arc as indicated in manufacturers' catalog and on the plans. If there are coverage problems in unique areas, use part circle "backup heads" where there is not enough space for another row of full circle heads.

a. Slopes in excess of a three-to-one (3:1) ratio. Heads placed at the bottom of a slope need to be valved separately. Mid-point on the slope shall

need a moderate amount of water and therefore these heads shall also have their own zone. Heads placed on the top of the slope must be valved separately, as they shall water for the longest period of time because this section will have no run-off from above and is exposed to more sun and wind.

Lateral lines and heads on slopes shall be installed along the contour rather than up and down the slopes.

b. Narrow strips, parking lot islands, curbside landscape, and medians. Subsurface drip irrigation is encouraged in all narrow areas. **If the area is less than eight feet (8') wide, use of subsurface drip irrigation is required.**

c. Zone control. Irrigated areas shall be divided into zones that have the same water requirements.

The designer shall identify all depressions, drainage ways, and stormwater detention, retention, and water quality ponds, and zone them separately from adjacent higher areas. Heads and valves shall be installed adjacent to and outside of these low areas.

All heads within a zone must have matched application rates. Heads that have different application rates shall be zoned separately. Parking lot medians and islands that are surrounded by pavement shall be located in separate zones from other landscape areas.

(5) Hydraulics.

a. Pressure loss table. A pressure loss table shall be included on the irrigation plan. The table shall include information for zones with the highest flow rate that are located the greatest distance from the source. Use seventy percent (70%) of the maximum safe water flow when calculating pressure losses for all irrigation systems. The table shall include the following information:

- Valve number and flow rate.
- Available static water pressure.
- Loss or gain due to elevation.
- Detailed list of various component pressure losses and velocities.
- The operating pressure requirements.
- Project location and date.
- Water service and meter.

Example: Pressure Loss Hydraulic Chart

Property Name:	EXAMPLE						
Project Location:	AURORA						
Irrigation System Hydraulic Worksheet							
Prepared By:	example						
	Date	12.2.05					
Static Water Pressure:	75.00	From:	of:City of Aurora				
Hydraulic Grade:							
(Measured from backflow to valve X10)						Flow-GPM	Loss/Gain
Svc Line:	20	LF 3" K Copper	6.10	/100FT	80.00	1.22	
Water Meter:		3"			80.00	6.51	
Svc Line:	30	LF 3" K Copper	6.10	/100FT	80.00	1.83	
Backflow:		3" Febco 825YA Series			80.00	12.50	
Master Valve:					0.00	0.00	
Pressure Required at Head:		Rainbird Series				30.00	
Lateral Allowance:						3.50	
Control Valve Allowance:						3.40	
Mainline Allowance:							
@80GPM	25	LF 3" CL200BE	0.52	/100FT		0.13	
@40GPM	1285	LF2.5"CL200BE	0.38	/100FT		4.88	
				/100FT		0.00	
Elevation							
Tap Elevation	5106	High/Low	5116			4.33	
Total System requirements (PSI)						68.30	
Available Pressure (PSI)						75.00	

The following table shall be used when determining meter size requirements, maximum flows and for calculating pressure losses for meters and copper pipe. The seventy percent (70%) max flow is recommended for all designs and required for all designs utilizing a meter providing both indoor and outdoor water.

Average Flow and Pressure Losses for Displacement Type Meters and "K" Copper Pipe

Size in.	Maximum Capacity Flow Criteria		70% of Max		K Copper (C=130) Service Line Loss @ 70% Max Flow	
	GPM	PSI loss	GPM	PSI LOSS	PSI/100'	PSI/50'
3/4"	14	3.1	9.8	1.6	15.83	7.92
1"	25	3.7	17.5	1.7	11.37	5.69
1-1/2"	55	6.0	38.5	3.1	7.04	3.52
2"	100	7.8	70	3.7	5.46	2.73
3"	220	11.0	154	5.4	4.81	2.41

b. Backflow preventer and specialty valves. Maximum velocity for water flow through backflow preventers shall not exceed 7.5 Feet Per Second (FPS).

A starting pressure no greater than 90% of the verified static pressure is recommended. When using pressure-reducing valves, the sizing of the backflow preventer and specialty valve shall be based on the devices flow capacity at the reduced pressure level.

(6) Sizing. Mainline velocities shall not exceed five (5) FPS. Lateral line velocities shall not exceed six (6) FPS.

(7) Pressure difference. Pressure difference between any two (2) heads in the zone shall not exceed ten percent (10%) of the highest pressure within the zone.

(8) Equipment selection.

a. Spray heads. Pop-up spray heads for turf areas shall have a minimum pop-up height of six (6) inches. Four (4) inch pop-up height heads may be used on single-family detached lots. The twelve inch (12") pop-up height shall be used in ground cover and flowerbeds. Heads shall seal in the operating position at ten PSI or less, and the water used in the flush mode shall not exceed .05 Gallons Per Minute (GPM). Heads shall have a ratcheting feature for adjusting the direction of spray.

Pop-upheads with spray nozzles shall have built in check valves and a pressure-regulating device (set at thirty (30) PSI) installed in the base of the stem, a check valve installed in the base of the body, and under slotted plastic nozzles, with matched precipitation rate nozzles. Pop-up heads with rotary style nozzles shall have built in check valves and a pressure regulating device limiting the operating pressure at or below the manufacturer recommended operating pressure. All heads within a zone must be of the same manufacturer.

b. Rotary heads. Rotary heads shall be internally driven, have a closed-case rotor with wiper seals that is spring retracted. The pop-up stem surface diameter shall be less than two inches (2”), and have a minimum pop-up height of four inches (4”). All heads shall have check valves built into the bottom of the body. Small radius rotor heads shall be used for areas that range from twenty feet (20') to thirty feet (30') wide. All heads within a zone must be of the same manufacturer.

c. Automatic rain shut-off devices. All systems shall be equipped with an automatic rain shut-off device except where an Aurora Water approved weather-based irrigation controller is utilized.

d. Automatic controllers. The following features shall be incorporated into the controller:

- Multiple programs/start times
- Water budgeting and/or spray and soak features
- Memory retention
- Battery backup
- Flexible day programming for any intervals

e. Drip irrigation. Drip irrigation is defined as subsurface low volume systems that apply water in gallons per hour (gph) through either calibrated pressure compensating emitters, bubblers, micro-sprays, and/or micro-spray pop-ups directly to a plant's root system or to a planted area.

Self-flushing, pressure-compensating subsurface drip irrigation is recommended in all planting beds that are mulched or in narrow turf strips where spray heads are not practical. All subsurface drip shall be installed in the soil, not on the surface.

Point-source drip emitters must have a visible point of emission. A minimum of two emitters must be used for plants with an installation size of five (5) gallons or larger to ensure even wetting of the soil. All point-source and sub-surface drip emitters must be pressure-compensating and utilize check valves. Flush valves and operational indicators at the termination point of each zone are required.

As with sprinkler irrigation, drip irrigation shall be zoned for varying plant needs, slopes, and exposures.

f. Backflow prevention devices. All irrigation systems shall be equipped with an appropriate backflow prevention device.

g. Single-family detached and duplex development does not require irrigation plans review, but does require adherence to other applicable sections of this

standards document and inspection after irrigation installation for all irrigation installations. The following sections from the ordinance describe what is required in terms of irrigation materials

(9) Total gallons budgeted per 1,000 square feet of turf for one growing season may be calculated as: $1,000 \times 28" \times 0.623 \text{ gal/inch} = 17,444$ gallons per growing season.

Total gallons budgeted per 1,000 square feet of plant bed per growing season may be calculated as: $1,000 \times 15" \times 0.623 \text{ gal/inch} = 9,345$ gallons per growing season.

Total gallons budgeted per 1,000 square feet of native per growing season may be calculated as: $1,000 \times 15" \times 0.623 \text{ gal/inch} = 9,345$ gallons per growing season. If native will be designated as Z-zone this must be noted on the plan set.

Table C shows the annual budgeted water in gallons for all turf areas and plant beds. The completed table shall be shown on the irrigation plan.

Example: Calculated annual irrigation water use

Calculated Annual Irrigation Water Use					
AREA IN TURF (SF)	AREA IN TURF X 28 IN.	AREA IN PLANT BEDS (SF)	AREA IN BEDS X 15 IN.	AREA IN NATIVE (SF)	AREA IN BEDS X 15 IN.
	X 0.623 = GALLONS APPLIED		X 0.623 = GALLONS APPLIED		X 0.623 = GALLONS APPLIED
0 s.f	0 Gallons	0 s.f	0 Gallons	0 s.f	0 Gallons
TOTAL ANNUAL GALLONS APPLIED	0		TOTAL ANNUAL GALLONS		
TURF + PLANT BEDS + NATIVE					

(10) Irrigation schedule. An annual irrigation program with monthly irrigation schedules shall be shown on the irrigation plans. The irrigation schedule shall show the following information:

- Runtime.
- Number of cycles per day.
- Frequency of irrigation for each zone.

EXAMPLE CONTROLLER CHART 'A'								
Zo Plant	Zone	Prec rate	Zon flow	Peak inche per	<i>Weekl zone run</i>	<i>Daily zone run</i>	<i>Water usage gallons</i>	Design operatin pressur

No.	Type	Description	in/hr	GP	week	hours	minute	per	psi
A1	Shru Drip		0.50	4	1.00	2.00	40.00	480	30.00
A2	Shru Drip		0.50	4	1.00	2.00	40.00	480	30.00
A3	NativRotors		0.57	17	1.00	1.75	35.09	1,768	50.00
A4	Turf Pop-Up (15')		1.83	18	1.80	0.98	19.67	1,091	30.00
A5	Turf Pop-Up (8')		1.83	7	1.80	0.98	19.67	436	30.00
A6	Turf Pop-Up (15')		1.83	26	1.80	0.98	19.67	1,527	30.00
A7	Turf Pop-Up (10')		1.75	20	1.80	1.03	20.57	1,255	30.00
A8	Turf Pop-Up (12')		2.01	31	1.80	0.90	17.91	1,689	30.00
A9	Turf Pop-Up (8')		1.83	11	1.80	0.98	19.67	654	30.00
A1	NativRotors I-20		0.57	11	1.00	1.75	35.09	1,179	50.00
A1	NativRotors I-20		0.78	36	1.00	0.93	18.69	1,996	50.00
A1	Shru Drip		0.50	4	1.00	2.00	40.00	480	30.00
Total projected peak season water use per week								13,036	
Total peak season hours per week -						16.65			
Number of days/week						3			
Two (2) starts per day									

The irrigation system operator shall monitor and adjust automatic sprinklers based on the current month and available moisture. Information on efficient watering shall be available from the Aurora Water office of Water Conservation.

(11) Final construction observation. All fees for irrigation meters must be paid in full at time of system construction.

Prior to issuance of a permanent certificate of occupancy the irrigation system must be inspected by the Aurora Water Department.

Prior to inspection, the site must be free of construction debris so that components of the system can be observed. Contact information for the irrigation system installer must also be provided. Operating manuals and a recommended watering schedule must be available.

(12) Maintenance and operation requirements. A seasonal maintenance schedule beginning on April 1 through October 1 shall be shown on the irrigation plan to establish procedures for optimum irrigation efficiency and preventive maintenance practices that will conserve water resources. The maintenance schedule should include the following items:

- Check heads for coverage and leakage.
- Reprogram controllers monthly or more often if necessary, according to the seasonal needs.
- Verify that the water supply and pressure are as stated in the design.
- Inspect the backflow prevention device to determine if it is working correctly.
- Periodically verify that sensors in the irrigation system are working properly.

(e) *Requirements for reclaimed domestic wastewater.* All irrigation systems installed on a site must connect to the reclaimed water system where reclaimed domestic wastewater is available meeting the requirements of the Colorado Department of Health and Environment (CDPHE), "Reclaimed Domestic Wastewater Control Regulations" and the following guidelines.

(1) Design requirements. Design requirements for irrigation systems that will connect to reclaimed domestic wastewater shall meet the following criteria:

a. Site water containment. Reclaimed domestic wastewater shall be confined to the authorized use area, strictly minimizing runoff and/or ponding of the water. Zone slopes and microclimates to strictly minimize runoff and/or ponding of reclaimed domestic wastewater. Direct and windblown irrigation water spray shall be confined to the site. Precautions shall be taken to ensure that reclaimed domestic wastewater will not be sprayed on any facility or area not designated for application.

b. Pipe marking. Identification shall be one of the following:

- The warning "CAUTION: RECLAIMED WATER - DO NOT DRINK" embossed or stenciled on the pipe at five foot (5') intervals.
- Purple plastic marking tape the width of the pipe with the warning "CAUTION: RECLAIMED WATER - DO NOT DRINK" and taped to the pipe every ten feet (10').
- Install purple-colored pipe.

c. Outlets. All sprinkler heads, quick coupler valves, and other outlets shall have purple-colored tops or rubber covers. Permanent hose outlets are not allowed.

d. Valve boxes. All valve boxes used in the irrigation system shall have purple-colored valve box lids.

e. Irrigation controllers. Irrigation controllers shall be labeled inside and out with "CAUTION: RECLAIMED WATER - DO NOT DRINK". A laminated reduced drawing of the irrigation system shall be kept in the controller cabinet.

f. Backflow prevention. An approved reduced-pressure principle backflow prevention device or an air gap shall be provided at all potable water service connections to reclaimed domestic wastewater use areas.

g. Warning signs. Notification by clearly visible signs shall be provided to inform the public that reclaimed domestic wastewater is being used for irrigation and is not safe for drinking. The notification shall include posting of

signs of sufficient size to be clearly read in all application areas and around impoundments with the following wording: ATTENTION: RECLAIMED DOMESTIC WASTEWATER - DO NOT DRINK

Signs should be in the predominant language(s) spoken in the area at the site.

These requirements are based on Colorado Department of Public Health and Environment Regulation 84, Reclaimed Domestic Wastewater Control Regulation and American Water Works Association Manual M24, Dual Water Systems.

(h) *Enforcement and penalty.* Any violation of this section shall be considered a waste of water as defined in Section 138-190 and the enforcement provisions of Section 138-190 shall apply.

Upon the issuance of any violation the system shall be adjusted within three (3) days of notification for commercial properties and within seven (7) days of notification for residential properties whenever irrigation water falls or runs onto hard surfaces such as sidewalks, streets or driveways. Breakdowns or failures of the irrigation system shall be repaired within three (3) days of notification for commercial properties and within seven (7) days of notification for residential properties to avoid unnecessary wasting of water. Any observed or reported wasting of water may result in penalties as described by Section 138-190 of the City of Aurora Code.

(e) *Requirements for soil preparation.* Composted amendment must be added to the soil at a rate not less than four (4) cubic yards per 1,000 square feet and tilled to a minimum depth of six (6) inches.

II. Plan Review and Inspection Procedures

The City of Aurora Ordinance requires irrigation plan submittal for all multi-family, commercial and common open space development. Irrigation plan review is not required for single family detached homes, however single-family detached homes will be required to comply with the approved irrigation materials outlined in the ordinance and be subject to permitting and inspection.

Step 1. Design the irrigation plan(s) based on the approved stamped landscaping plans. Follow the Irrigation Plans Checklist (See Section III).

Step 2. Schedule a pre-submittal meeting with Water Conservation 303-326-8819. The pre-submittal meeting is recommended but not mandatory prior to plan submission.

Step 3. Plans will be submitted using the online submittal portal. The Irrigation Plans Examiner will notify the project representatives when the plans can be uploaded. Be sure to include at least one (1) copy of the approved landscaping plans with the irrigation plans. *All irrigation plans must be reviewed before issuance of the building permit.* An electronic .DWG file in AutoCAD or PDF is preferred.

There is a per sheet fee for the irrigation plans review (corresponding landscaping plans and a cover page will not be assessed this fee, just the irrigation sheets.) Detail sheets (required) are assessed a fee of one (1) sheet regardless of the quantity of detail sheets.

- a. Example: 10 plan sheets and 4 details sheets. Per sheet fee for this example is \$300.00:

$$(10 \times \$300.00) + (4 \times \$300.00) = \$3,300.00$$

See schedule below for plan review timelines.

Step 4. Upon final approval of irrigation plans, submit final approved irrigation plans in electronic .PDF format to the Irrigation Plans Examiner. The approved irrigation plans will be digitally stamped approved by the Irrigation Plans Examiner and returned to the responsible party who submitted the plans.

Step 5. Submit the Irrigation Permit Application to the Water Conservation Office [by](mailto:conservationinspections@auroragov.org) email to conservationinspections@auroragov.org.

Step 6. After installation of the irrigation system, call 720-859-4364 to schedule an inspection. A City of Aurora inspector will perform the inspection prior to issuance of the Certificate of Occupancy. *All irrigation systems must be inspected and approved before issuance of the Certificate of Occupancy.*

Please direct any questions to: Water Conservation Division
Phone: 303-739-7195

Irrigation Construction Plan Review Schedules

Irrigation Construction Plans	Up to 5 Sheets	Up to 10 Sheets	11+ Sheets
1st Aurora review	10 days	15 days	20 days
Consultant revisions on 1st round	5 days	5 days	5 days
2nd Aurora review*	10 days	10 days	10 days
Consultant revisions on 2nd round	5 days	5 days	5 days
3rd Aurora review	5 days	5 days	5 days
TOTAL weeks	7 weeks	8 weeks	9 weeks

III. Irrigation Plan Checklist

Include all of the following information in the irrigation design plans:

1. The City approved landscape plans must be included with the submitted irrigation design plan.
2. Plans must be 24"x36" and at a scale of 1"=40' or greater. The drawing must be the same scale as the corresponding approved landscape plans. Exceptions will only be made when the civil plan set was accepted by Aurora Water in an alternative size.
3. Irrigation systems must be designed to deliver a minimum budget of twenty-eight inches (28") (17.46 gallons) of water per square foot of turf and fifteen inches (15") (9.35 gallons) of water per square foot of plant bed per growing season. Systems must be designed to deliver this budget within three watering days per week and sixteen (16) hours per watering day window.
4. The Irrigation Design Plan shall accurately and clearly identify:
 - Property boundaries, existing and future right of way lines.
 - North arrow, title block with name of project, sheet name, company identification including address, phone number and name of person preparing plan and date.
 - Graphical and written scale - sheet size and scale to match the approved landscape plan(s).
 - Existing and proposed structures and paving.
 - Proposed grades or spot elevations in sloped or bermed areas.
 - Location, model and size of all components of the irrigation system along with typical detail sheet.
 - Static water pressure at the point of connection.
 - Each zone or station shall list the:
 - Zone number.
 - Design operating pressure.
 - Flow rate.
 - Application rate (inches per hour).
 - Location, number and size of water tap(s), meter(s) and backflow preventer(s).
 - Location and size of each hydrozone (low, moderate, high) showing:
 - Square footage of turf areas.
 - Square footage of planting bed areas.
 - Site water requirements.
 - Method of irrigation used for each hydrozone (sub-surface, drip, micro-spray, pop up, rotor).
 - Calculated Annual Irrigation Water Use table(See example below)
 - Any zone(s) using non-potable water.
 - Seasonal maintenance schedule.
 - Pressure loss worksheet.
 - Irrigation schedule showing total run times, zone run times, number of cycles, frequency of irrigation for each zone.
 - Note stating **"An Irrigation and Soil Permit is required. Please call Water Conservation at 720-859-4364 to obtain your permit"**.

- **Clearly displayed registered Landscape Architect or Certified Irrigation Designer (CID) stamp**

The City of Aurora requires the irrigation system to be inspected prior to the issuance of the Certificate of Occupancy. The City will be inspecting the following:

- Installation of irrigation system per approved irrigation plans.
- Equipment types (controllers, rain shut-offs, heads, etc.).
- Proper installation of equipment. (Including proper head usage, spacing, types, alignment, depth, etc.).
- Spray coverage.
- Controller program watering schedule.