

CITY OF GOLDEN, COLORADO GRAYWATER SYSTEM DESIGN CRITERIA



City of
Golden



September 10, 2020

City of Golden, Colorado

Graywater System Design Criteria

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List of Exhibits

GW-1	Graywater Pumped System Schematic (Typical)
GW-2	Gray Water Laundry-To-Landscape Direct System Concept

Abbreviations and Acronyms

ANSI	American Nation Standards Institute
C.R.S.	Colorado Revised Statutes
FEMA	Federal Emergency Management Agency
Gpd	Gallons per Day
GR	Granular
IPC	International Plumbing Code
Mg/L	Milligrams per Liter
MPI	Minutes per Inch
NFIP	National Flood Insurance Program
NSF	NSF International, formally known as National Sanitation Foundation
OWTS	On-Site Wastewater Treatment System(s)
PR	Prismatic
UIC	Underground Injection Control

1.0 Introduction

This Design Criteria document contains the minimum requirements for all Graywater Systems installed within the City of Golden, Colorado as established by Ordinance 2143 allowing for laundry-to-landscape graywater systems. This design criteria is a direct reflection of the Ordinance noted (and cited Regulation 86) and does not intend to add further restriction or requirement to the ordinance, but merely consolidate and present the information to guide applicants through the design and permitting process.

All Applicable laws and regulations incorporated by reference cited herein include only those versions that were in effect as of September 10, 2020 and not later amendments to the incorporated material.

All materials referenced in this Design Criteria document may be examined online, where available, or at City of Golden Public Works 1445 10th Street, Golden, CO 80401.

A glossary of terms is included in Section 5.

2.0 Design Criteria

All graywater systems must be designed to meet the requirements of this Design Criteria Document, City adopted International Plumbing Codes, the backflow prevention requirements identified in Section 7 – Part 7 (Backflow Prevention Devices) of Golden’s Water and Sanitary Sewer Specifications. The following minimum design criteria is required for all Graywater Systems within the City of Golden:

2.1 Graywater Use Categories

Graywater systems shall be categorized as follows:

- A. Category A: Properties upon which a single-family household building or structure is located, whereby:
 - 1. Graywater is collected from laundry machines only.
 - 2. Outdoor, subsurface irrigation discharging to a mulch basin within the confines of the legal property boundary only.
 - 3. Design flow is limited to a maximum of 400 gallons per day for all combined flow.
- B. Category B: Properties upon which a Non-Single-Family structure is located, whereby:
 - 1. Graywater is collected from laundry machines only.
 - 2. Outdoor, subsurface irrigation discharging to a mulch basin within the confines of the legal property boundary only.
 - 3. Design flow is limited to a maximum of 2000 gallons per day for all combined flow.

2.2 Flow Projections

Flow to the graywater system must be calculated based on anticipated flows/discharge from the laundry washing machine(s).

The design flow of each system component or combination of multiple components must be greater than the calculated peak graywater production if upstream of the storage tank, or if no storage tank is proposed with the system.

Graywater Systems may not be used as a factor to reduce the design or capacity of any domestic wastewater system.

2.3 Graywater System Components

Refer to Exhibit GW-1 for a schematic of a typical graywater system.

- A. Diversion Valve: The graywater system must have a diversion valve that directs graywater from laundry discharge to either the graywater system or a closed sewerage system. The diversion valve must be:
 - 1. Easily operable
 - 2. Clearly labeled

3. Constructed of material that is durable, corrosion resistant, watertight as allowed per section 702 of the International Plumbing Code as adopted.
 4. Designed to accommodate the inlet and outlet of pipes in a secure and watertight manner.
 5. Indirectly connect the bypass line to the closed sewerage system:
 6. Installed as described in Section 1302.8 of the International Plumbing Code as adopted.
- B. The graywater system may not have any piping that allows the storage tank to be bypassed prior to graywater use.
- C. Graywater Storage Tank
1. Constructed of durable, non-absorbent, water-tight, and corrosion resistant materials:
 2. Be closed and have access openings for inspection and cleaning.
 3. Be vented: For outdoor tanks the storage tank must have a downturned screen vent. For indoor tanks, the tank must be vented to the atmosphere outside of the house.
 4. Piping: Tank shall have an overflow line with the same or larger diameter as the influent line, with no shut-off valve, that is trapped to prevent the escape of gas vapors from the tank, and that is indirectly connected to the closed sewerage system. Additionally, tank piping shall include a valved drain line with the same or larger diameter line as the influent line that is indirectly connected to the closed sewerage system.
 5. Be a minimum of 50 gallons.
 6. Be placed on a stable foundation.
 7. If placed outdoors, tank shall not be exposed to direct sunlight.
 8. Labeling: Tank shall have a permanent label stating: "Caution! Non-Potable Water. Do Not Drink.", and shall include the use of a pictograph in accordance with Figure 1301.3 of the IPC, as shown below:



- D. Backup Potable Water: Greywater systems providing subsurface irrigation are not required to have a backup potable water system to provide potable irrigation water when graywater is not being produced or is produced in insufficient quantities. However, if selected, the backup potable water system connections must be designed to prevent uncontrolled cross connections between the graywater system and the potable water system. To meet this requirement, all connections to public or private potable water supply systems must be protected in accordance with Section 7 – Part 7 (Backflow Prevention Devices) of Golden’s Water and Sanitary Sewer Specifications.
 - 1. Inflow Control: backup system shall have means to control inflow into the system such as a float control valve or other means.
- E. Piping: All greywater piping (inlet and outlet etc.) shall be purple in color or the piping shall be installed with a purple identification tape (banded) or wrap. Piping shall be labeled with a flow arrow and the words: “CAUTION: NONPOTABLE WATER – DO NOT DRINK”. Piping above grade shall also include a pictograph warning in accordance with Figure 1301.3 of the IPC as previously noted.
- F. Pump: Shall have adequate capacity (volumetric pumping rate, and discharge pressure) to meet desired irrigation rates and elevations within the receiving mulch bed(s).
- G. Controls: Controls must be present to ensure the distribution of graywater through the irrigation zone. This may include valves, switches, timers, or other controllers as needed/appropriate.

2.4 Graywater System Site Considerations

- A. Floodways/Floodplains: Graywater systems and graywater use is prohibited within designated 100-year floodway or 100-year floodplain.
- B. Collection and distribution piping and appurtenances for all graywater systems must be located within the confines of the legal property boundary on which they are located and not within a City right-of-way or easement, or an adjacent property.

2.5 Graywater Design Criteria for Mulch Basin Irrigation Systems

The following minimum Design Criteria are required for mulch basin irrigation systems for subsurface irrigation. See Exhibit GW-2 for direct laundry to landscape mulch system with a mulch bed for further information.

- A. Mulch basins must be sized using a site evaluation method as follows:
1. Develop a site map showing the location of proposed graywater system irrigation components and the irrigation area in relation to physical features of the property requiring setbacks as noted in Table-1.

Table 1 – System Setback Requirements

Minimum Horizontal Distance Required From	Graywater Storage Tank	Mulch Basin
Buildings	5 feet	10 feet
Property Line Adjoining Private Property	10 feet	10 feet
Property Line Adjoining Private Property with Supporting Property Line Survey	1.5 feet	1.5 feet
Streams/Rivers	Outside Floodway	Outside Floodway & 100 Year Floodplain
Domestic Potable Service Line	10 feet	10 feet
Public Water Main	10 feet	10 feet
Public Sewer Main	10 feet	10 feet

2. Conduct a soil investigation to determine long-term acceptance rates of soils in the mulch basin area. Results will be used as basis of design. The soil investigation must consist of either:
 - a) A visual or tactile evaluation of soil profile test pit, or
 - b) A percolation test.
- B. Mulch basins shall meet the following soil requirements for siting and sizing:
1. Table-2 describes soil types and maximum hydraulic loading rates for typical soils in the Denver area.
 2. Subsurface Irrigation Components of the Graywater System must be installed in suitable soil as defined in Table-2.
 3. A minimum of twenty-four inches (24”) of suitable soil must be present between the subsurface irrigation components and any restrictive soil layer, bedrock, concrete, or the highest water table. Restrictive layers are soil types 4, 4A, and 5 in Table-2.

Table 2 – Soil Requirements

Soil Type	USDA Soil Texture	USDA Structure-Shape	USDA Soil Structure-Grade	Percolation Rate (MPI)	Loading Rate for Graywater (gal/sq-ft/day)
0	Soil Type 1 with more than 35% Rock (>2mm) Soil Types 2-5 with more than 50% Rock (>2mm)	--	0 (Single Grain)	Less than 5	Not suitable without augmentation 1.0 with augmentation
1	Sand, Loamy Sand	--	0	5-15	Not suitable without augmentation 1.0 with augmentation
2	Sandy Loam, Loam, Silt Loam	PR BK GR	2 (Moderate) 3 (Strong)	16-25	0.8
2A	Sandy Loam, Loam, Silt Loam	PR BK GR 0 (none)	1 (Weak) Massive	26-40	0.6
3	Sandy Clay Loam, Clay Loam, Silty Clay Loam	PR BK GR	2, 3	41-60	0.4
3A	Sandy Clay Loam, Clay Loam, Silty Clay Loam	PR BK GR 0	1 Massive	61-75	0.2
4	Sandy Clay, Clay, Silty Clay	PR BK GR	2, 3	76-90	Not suitable
4A	Sandy Clay, Clay, Silty Clay	PR BK GR 0	1 Massive	91-120	Not suitable
5	Soil types 2-4A	Platy	1, 2, 3	121+	Not Suitable

4. Soil Suitability
 - a) Type 2, 2A, 3, or 3A undisturbed, native is suitable for mulch basins with subsurface graywater irrigation systems.
 - b) Type 0 or 1 soils must be amended as described in Section 2.5.B.5 to improve drainage characteristics to be suitable for mulch basins.
 - c) Type 4, 4A, and 5 are not suitable and must be removed and replaced with soil with suitable drainage characteristics as noted above.
5. Amended Soils must meet the following criteria to ensure suitable drainage characteristics for mulch beds.
 - a) The amendment must have an organic content that is at least five percent (5%) and no greater than ten percent (10%).
 - b) The amendment must be a well-blended mix of mineral aggregate (soil) and compost where the soil ratio depends on the requirements for the plant species.

- c) The mineral aggregate must meet gradation requirements as set forth in Table-3.

Table 3 – Amendment Soil Gradation

Sieve	Percent Passing
3/8 Inch	100
No. 4	95-100
No. 10	75-90
No. 40	25-40
No. 100	4-10
No. 200	2.5

- d) Soil amendments must be tilled into the native soil a minimum of six inches (6”) below the irrigation application zone.
6. Mulch in beds shall be permeable enough to allow rapid infiltration of graywater.
- C. Irrigation Rates: Irrigation rates must not exceed the allowable soil loading rates as reflected in Table 2, based on the finest textured soil in the twenty-four inches (24”) of suitable soil beneath the subsurface irrigation components.
- D. Mulch Basin Geometry
1. Multiple mulch basins may be utilized to meet required volumes/areas.
 2. Mulch basin must have a minimum depth of twelve inches (12”) below grade and not more than twenty-four inches (24”) below grade.
 3. Mulch basins must only be located on slopes of less than thirty percent (30%) from horizontal.
 4. Mulch Basin Minimum Void Space
 - a) If the graywater system does not have a storage tank, the basin shall have a minimum void space of three (3) times the average daily flow for graywater system. This provides sufficient volume for graywater surges and prevention of surfacing or runoff.
 - b) If the graywater system has a storage tank as identified, the minimum void space is one and a half (1.5) times the anticipated average daily flow.
- E. Mulch Basin Supply Lines:
1. All mulch basin supply lines shall be polyethylene tubing or PVC Class 200 pipe or better and Schedule 40 fittings. All joints shall be pressure tested at 40 psi and shown to be drip tight for five minutes before burial.
 2. Mulch basin supply lines must discharge a minimum of four inches (4”) below grade into a container for dispersal of graywater into the mulch basin. The container must be designed to have four (4”) of

freefall between the invert of the discharge pipe and the mulch. The container must have an access lid for observation of flow to check Mulch levels.

2.6 Signage Requirements

A. General Requirements:

1. Words on signs shall be legibly and indelibly printed on a tag or sign constructed of a corrosion-resistant waterproof material or shall be indelibly printed on the fixture. The letters of the words shall be not less than 0.5 inch in height and in colors in contrast to the background on which they are applied.

B. Signage Requirements

1. Use Category A – Single Family Application: No signage requirements
2. Use Category B – Non-Single-Family Application: Must comply with the following requirements.
 - a) A permanent warning sign must be visible at all fixtures from which graywater is collected. The signs must state that, “WATER FROM THIS FIXTURE IS REUSED. CHEMICALS, EXCRETA, PETROLEUM OILS, AND HAZARDOOUS MATERIALS MUST NOT BE DISPOSED DOWN THE DRAIN”
 - b) Any room contain graywater system components must have a sign noting:” CAUTION GRAYWATER SYSTEM, DO NOT DRINK, DO NOT CONNECT TO THE POTABLE DRINKING WATER SYSTEM. NOTICE: CONTACT BUILDING MANAGEMENT PRIOR TO PEFORMING ANY WORK ON THIS WATER SYSTEM”
 - c) Each area being irrigated with Graywater must have a sign that says: “CAUTION GRAYWATER BEING USED FOR IRRIGATION. DO NOT DRINK, DO NOT CONNECT TO THE POTABLE DRINKING WATER SYSTEM”

3.0 Operation and Maintenance Manual

All graywater systems must have an Operations and Maintenance (O&M) Manual.

3.1 O&M Manual Requirements

- A. Graywater System Description: A description of the system including an equipment list, the design basis data including but not limited to design flow rates of each component and service area, a system as-built drawing, and an overall process description.
- B. Maintenance Information: A maintenance plan including but not limited to: Component maintenance schedule, instructions for component repair, replacement, or cleaning, replacement component source list, testing and

frequency for potable backflow prevention device (as applicable), and instructions for periodic removal of residuals.

- C. Operational ranges for parameters including but not limited to operating pressure ranges, tank level set points, valve status, pump operation parameters etc.
- D. Step-by-step instructions for starting and shutting down the graywater system including valve operation, any electrical connections, cleaning procedures, visual inspection, etc.
- E. A guide for visually evaluating the system and any problem scope based on alarm activations, effluent characteristics, system operation, etc.
- F. A guide for graywater control measures in which the graywater treatment works must be operated.

3.2 Operations

- A. The graywater system must be operated and maintained in accordance with the O&M Manual, including all manufacturer recommended maintenance activities.
- B. The O&M manual must remain with the graywater system throughout the system's life and be updated based on any upgrades or modifications that may be made to the system.
- C. The O&M manual must be transferred, upon change of ownership or occupancy, to the new owner or tenant.

4.0 Permitting, Inspection, and Approval

4.1 Permitting

Prior to construction for use, all graywater systems must be permitted by the City of Golden. Refer to Attachment A for the Preconstruction Design Submittal Checklist & Form, which shall be submitted, along with required supporting documentation, to the City of Golden Public Works at 1445 10th Street.

4.2 Fees

- A. Fees for review and inspection of graywater systems shall be based on the valuation of materials and labor in accordance with the established building permit fee schedule.

4.3 Inspection

- A. Prior to approval for use, all graywater systems must be inspected verified, and accepted by the City of Golden.

5.0 References & Glossary of Terms

5.1 References

All references are available for viewing at City of Golden Public Works, 1445 10th Street.

- A. City of Golden Municipal Code
- B. City of Golden Engineering Standards
- C. Colorado Department of Regulatory Agencies, State Plumbing Board (2018), Plumbing Rules and Regulations (3 CCR 720-1).
- D. Colorado Water Quality Control Act (2015), CRS 25-8-101 et. Seq.
- E. Colorado Water Quality Control Commission (2015) Regulation 86, Graywater Control Regulation (5 CCR 1002-86). Effective December 2015.
- F. International Code Council (2018). 2018 International Plumbing Code.

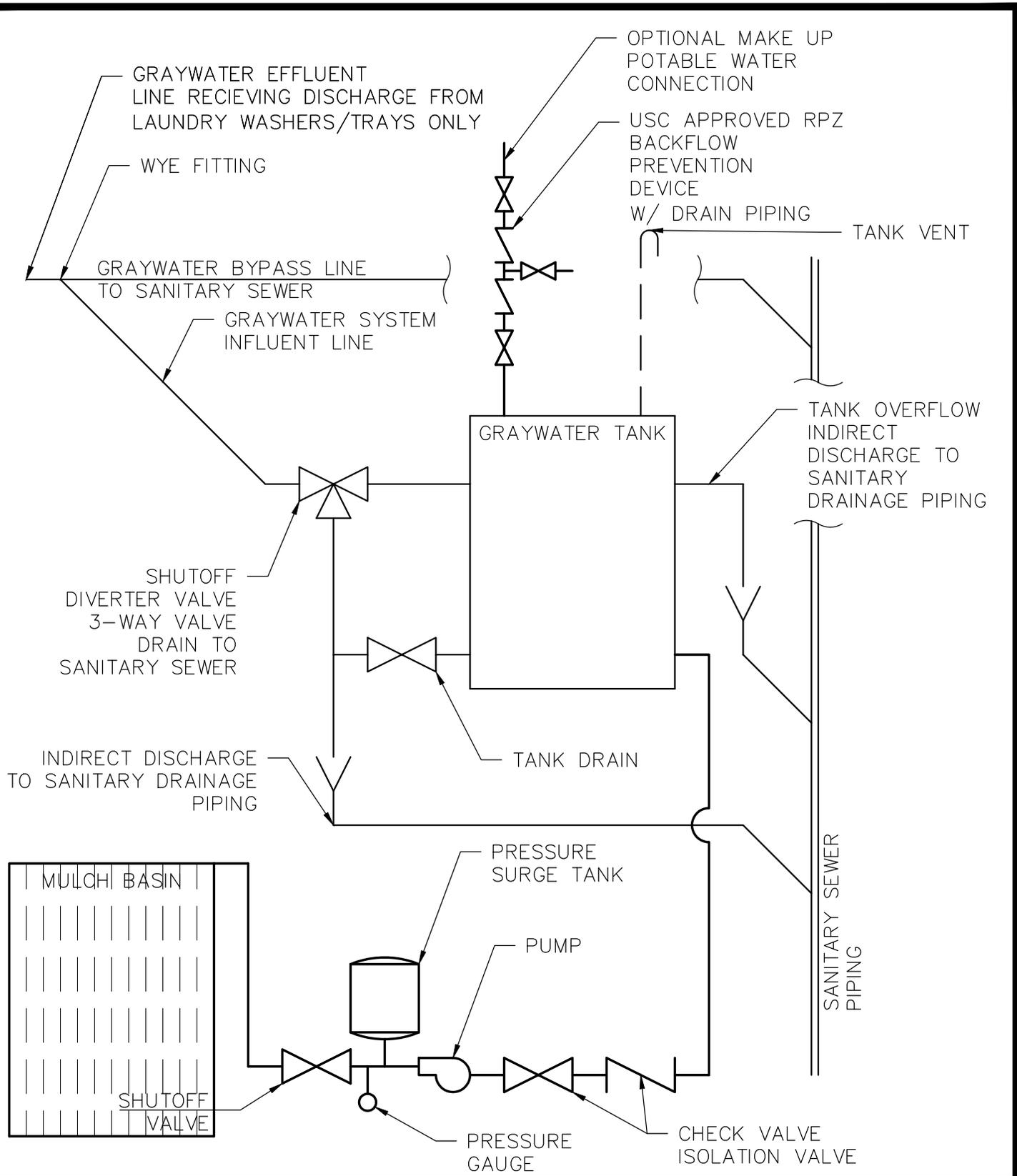
5.2 Glossary of Terms

- A. Agronomic Rate: The rate of application of nutrients to plants that is necessary to satisfy the nutritional requirements of the plants.
- B. Closed Sewerage System: Means either a permitted sanitary sewer service, or a permitted and properly functioning OWTS.
- C. Component: Means a subpart of the graywater system, which may include multiple devices such as pumps, tanks, valves, piping, etc.
- D. Cross-Connection: Means any connection that could allow any water, fluid, or gas such that the water quality could present an unacceptable health and/or safety risk to the public, to flow from any pipe, plumbing fixture, or a customer's water system into the public water system's distribution system or any other part of the public water system through backflow.
- E. Design: Means the process of selecting and documenting in writing the size, calculations, site specific data, location, equipment specification and configuration of system components that match site characteristics and facility use.
- F. Design Flow: Means the estimated volume of graywater per unit of time for which a component or graywater system is designed.
- G. Dispersed Subsurface Irrigation: Means a subsurface irrigation system that includes piping, emitters, etc. installed throughout the mulch bed area.
- H. Facility: Means any building, structure, or installation, or any combination thereof that uses graywater subject to the Graywater Use Program, is located on one or more contiguous or adjacent properties, that are owned and operated by the same person or legal entity.
- I. Floodplain (100-year): Means an area adjacent to a river (clear creek) or other watercourse which is subject to flooding as the result of the occurrence of a one hundred (100) year flood, and is so adverse to past, current, or foreseeable construction or land use as to constitute a

significant hazard to public or environmental health and safety or to property, or is designated by the Federal Emergency Management Agency (FEMA) or National Flood Insurance Program (NFIP). In absence of FEMA/NFIP maps, a Professional Engineer shall certify the floodplain elevations.

- J. Floodway: Means the channel of the river or other watercourse and adjacent land areas that must be reserved in order to discharge the base flood without cumulatively increasing the water surface elevation more than one foot or as designate by FEMA/NFIP.
- K. Graywater: means that portion of wastewater that, before being combined or treated with other wastewater, is diverted from laundry fixtures for the purpose of being put to beneficial uses. Graywater does not include the wastewater from toilets, urinals, kitchen sinks, dishwashers, or non-laundry utility sinks.
- L. Graywater System: Means an arrangement of devices and structures used to (a) collect graywater from the building or facility laundry and to disperse this water into irrigation.
- M. Graywater Use Program: Means the administrative program implemented by the Department of Environmental Health and administered by the City of Golden's Public Works Department to facilitate and regulate graywater use within the City of Golden.
- N. Mulch: Means organic material including but not limited to leaves, prunings, straw, and wood chips.
- O. Mulch Basin: Means a type of irrigation or treatment field filled with mulch or other approved permeable material of a sufficient depth, length, and width to prevent ponding or runoff. A mulch basin may include a basin around a tree, a trough along a row of plants, or other shapes necessary for irrigation.
- P. Non-Single-Family: Means any structure that is not a single-family residential structure.
- Q. Potable Water System: Means the system for the provision of water to the public for human consumption through pipes and other constructed conveyances.
- R. Professional Engineer: Means an engineer licensed in accordance with section 12-25-1, C.R.S.
- S. Public Water System: Means a system for the provision of water to the public for human consumption through pipes or other constructed conveyances.
- T. Single Family: Means a detached or attached structure , arranged and designed as a single family residential unit intended to be occupied by not more than one family, and that has separate water and sewer service connections from other dwelling units.

- U. Site Evaluation: Means a comprehensive analysis of soil and site conditions for a graywater irrigation area.
- V. Soil Horizon: Means layers in the soil column differentiated by changes in texture, color, redoximorphic features, bedrock, structure, consistence, and any other characteristic that affects water movement.
- W. Soil Profile Test Pit: Means a trench or other excavation used for access to evaluate the soil horizons for properties influencing effluent movement, bedrock, evidence of seasonal high ground water, and other information to be used in locating and designing a graywater irrigation area.
- X. Subsurface Irrigation: Means discharge of graywater into a soil/mulch area.
- Y. Suitable Soil: Means unsaturated soil in which the movement of water, air, and growth of roots is sustained to support healthy plant life and conserve moisture.



APPROVED
Dan Hunt
 DIRECTOR OF PUBLIC WORKS

APPROVED
[Signature]
 CITY ENGINEER

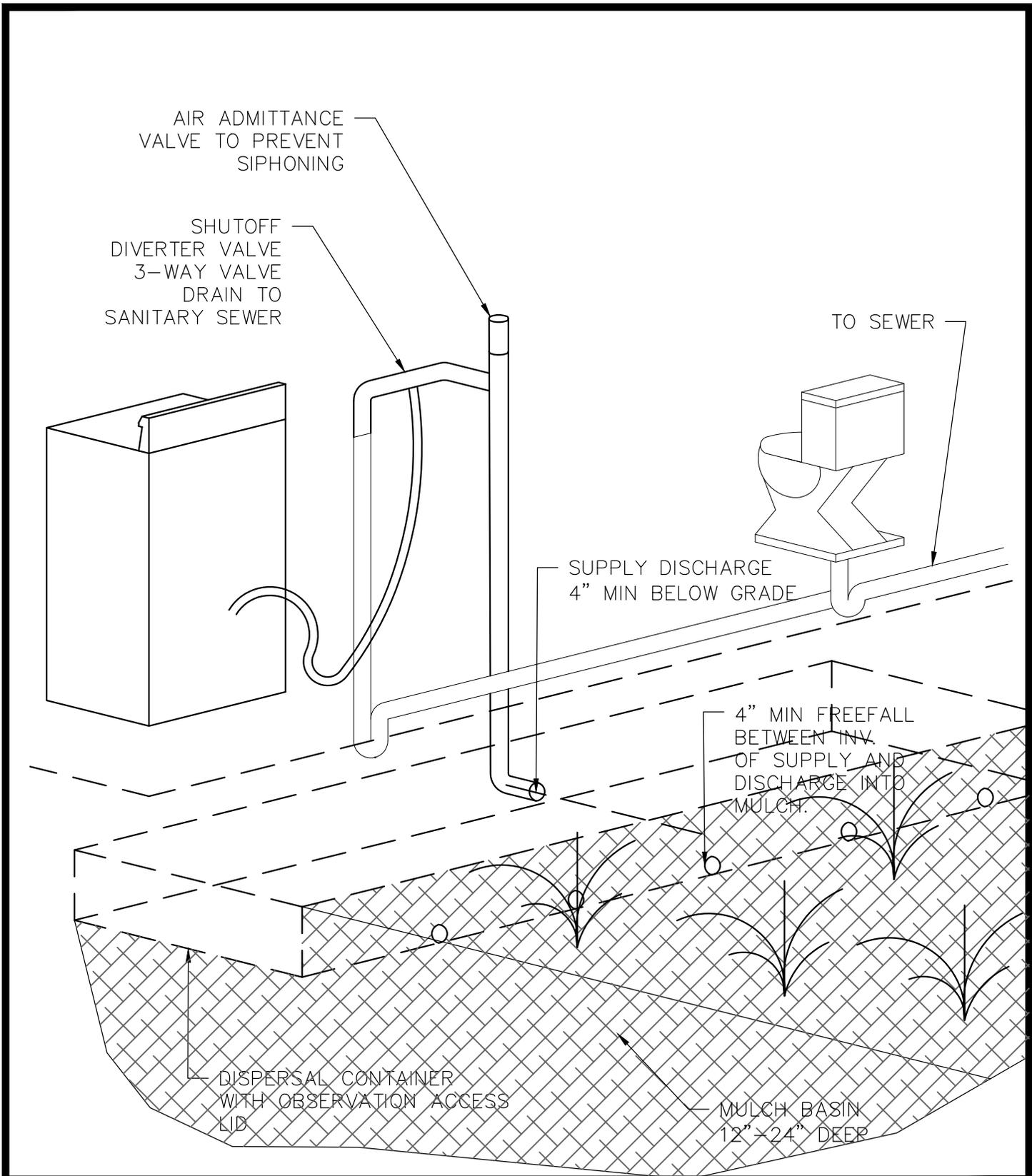
CITY OF GOLDEN



DEPARTMENT OF PUBLIC WORKS

GRAYWATER PUMPED SYSTEM SCHEMATIC (TYPICAL)

SCALE: NTS	DETAIL NO.
DATE: JULY 2020	GW-1



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DEPARTMENT OF PUBLIC WORKS

GRAY WATER
 LAUNDRY-TO-LANDSCAPE
 DIRECT SYSTEM CONCEPT

SCALE: NTS
 DATE: JULY 2020

DETAIL NO.
GW-2