ENVIRONMENTAL MANAGEMENT SYSTEMS, INC.

# Recycling and Reuse: Not a Prescriptive Formula

## National Onsite Wastewater Recycling Association

MEGA Conference October 2023

## Onsite Wastewater Recycling Professionals

Presenter: Robert Sweeney, MS,

OR REHS / WA Professional Onsite Wastewater Treatment System Designer

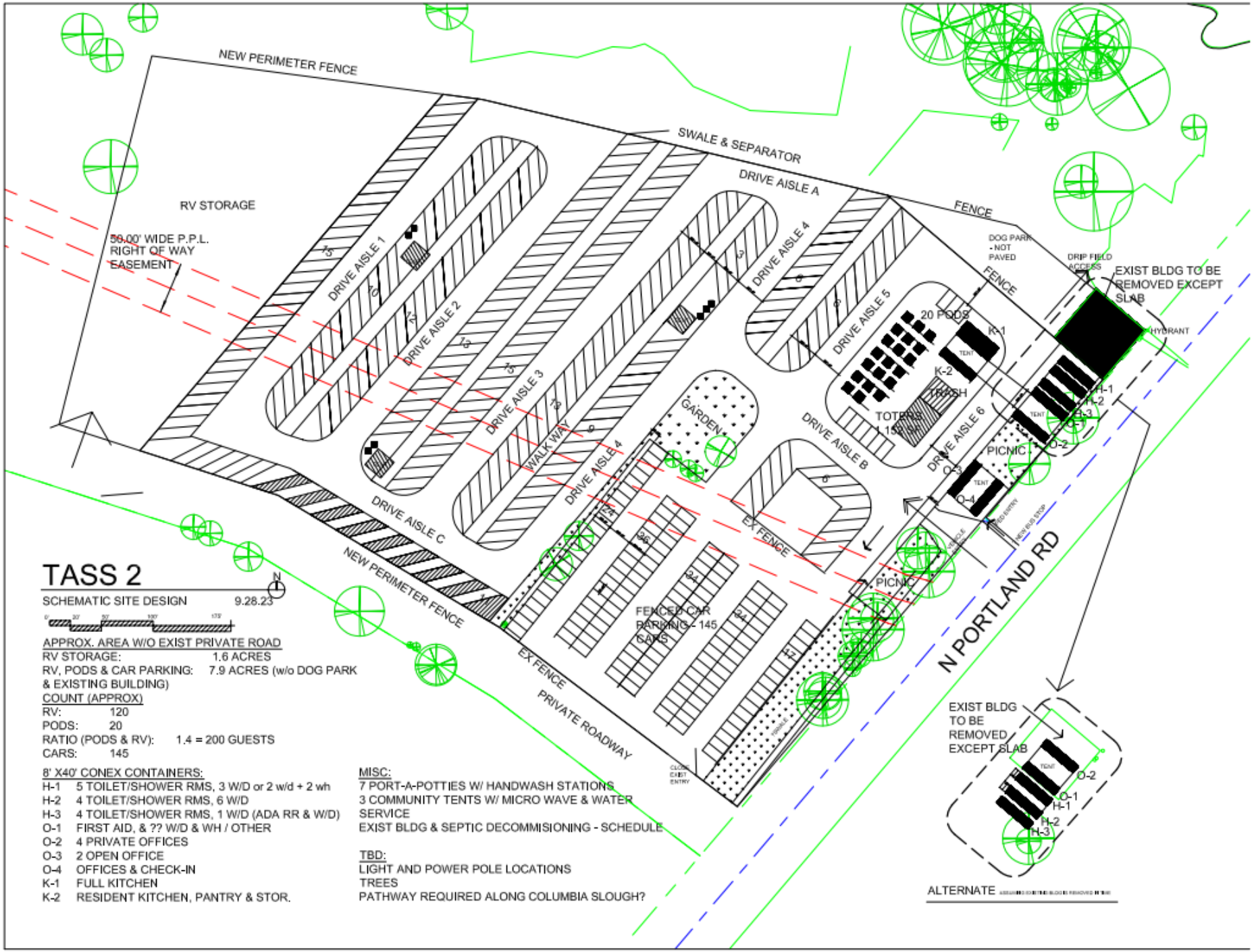
**This Presentation Represents the Opinion of the Author and Does Not Reflect the Opinion of NOWRA, its Members or Sponsors of the 2023 Mega-Conference.**

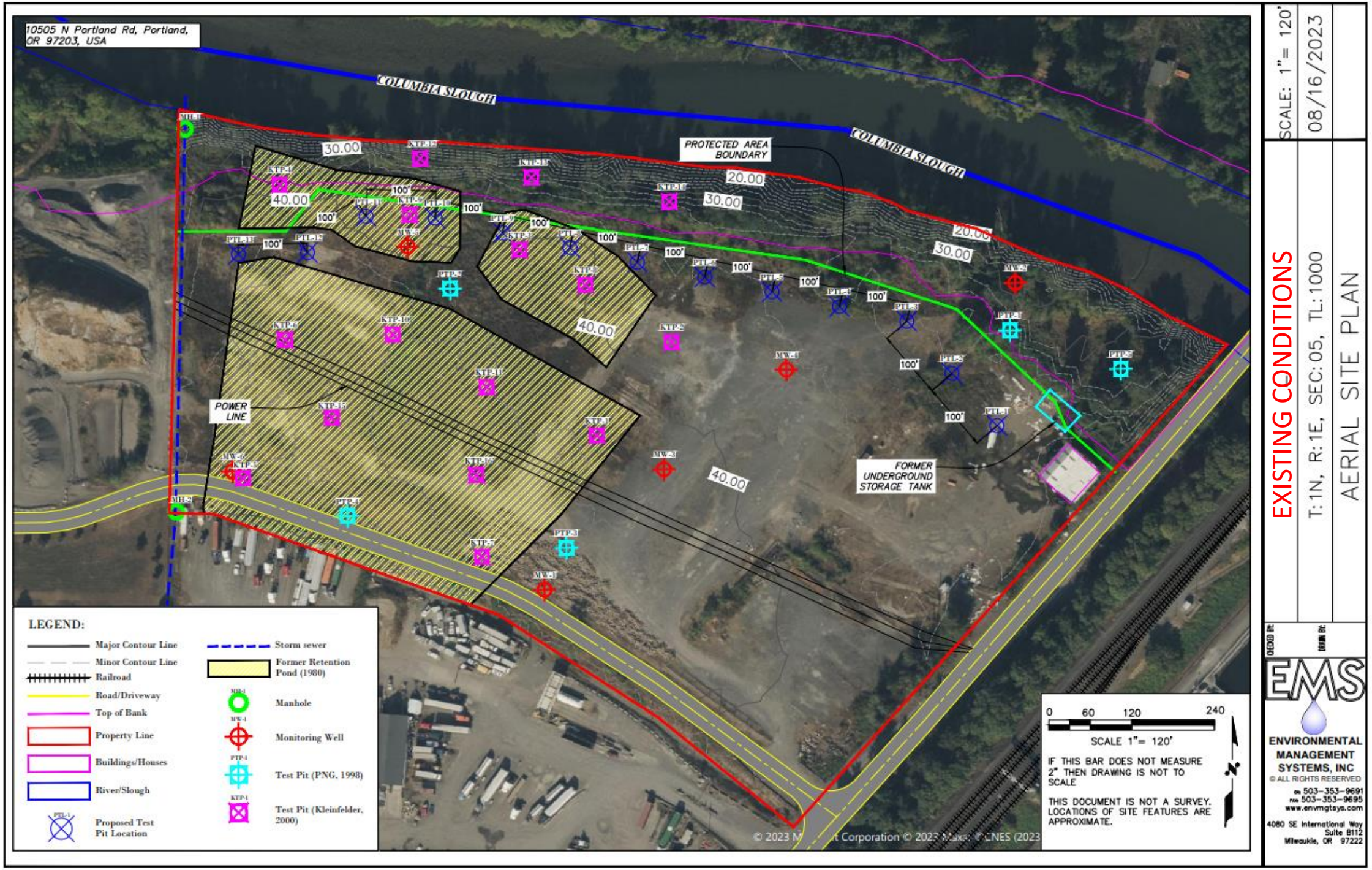
Latest Version of Site Development Plan from Architect 6 Oct 23.

Image does not include whole parcel extent

**Project Preliminary Layout by SOSYAL Architecture.**

503-922-9099 |
E:
syesilada@sosyalarchitecture.com






SCALE: 1"= 120'

08/16/2023

EXISTING CONDITIONS

T: 1N, R: 1E, SEC: 05, TL: 1000

AERIAL SITE PLAN

DESIGNED BY:

DRAWN BY:


EMS

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ph 503-353-9691
fax 503-353-9695
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Suite B112
Milwaukie, OR 97222

# Test Pits 5 Oct 23

Lab Results were Not Available as of 13Oct23

12 Soil Pits were evaluated:  All were found to have: disturbed structure,  visible debris &/or petroleum odors.

# Site Constraints

**2011 Sampling w/ Exceedance Contaminants**

Volatile Organic Compounds(VOCs)
- Benzene
- Vinyl chloride
- Dichloroethane
- Dichloroethene
- Trichloroethene
- Dichloropropane
- Tetrachloroethene
- Chlorobenzene

Heavy Metals
- Cadmium
- Copper
- Zinc

**Planning Restrictions**

Environmental Conservation Zone Mapped w/ Green Line 75 to 200+ feet from River Bank = Only area that is relatively un-disturbed.

**Department of Environmental Quality Standards for Onsite Wastewater Treatment System Siting: Oregon Administrative Rule 340-071-0150 Site Evaluation Procedures**

50 Ft setback from top of river bank with treatment standard 2:
Biochemical Oxygen Demand (BOD5) <= 20 mg/L
Total Suspended Solids (TSS) <= 20 mg/L
Total Nitrogen (TN) <= 30 mg/L
Fecal Coliform Units (FC) <= 400 Fecal Coliform / 100 mL

**Red Flags for Evaluator Approval:**

Disturbed Soil, Compaction, Cuts & Unknown Fills,
Soil Pits Revealed Contaminated Fill & Compressed Soil,
Best Area for Initial & Replacement Disposal Fields is Zoned as Environmental Conservation & Deemed Unavailable by Planning.
Underground Storage Tank. (Has been removed per City BES)
Sewer Available within 5 years (Not Planned or Funded)

We Love Challenging Sites !

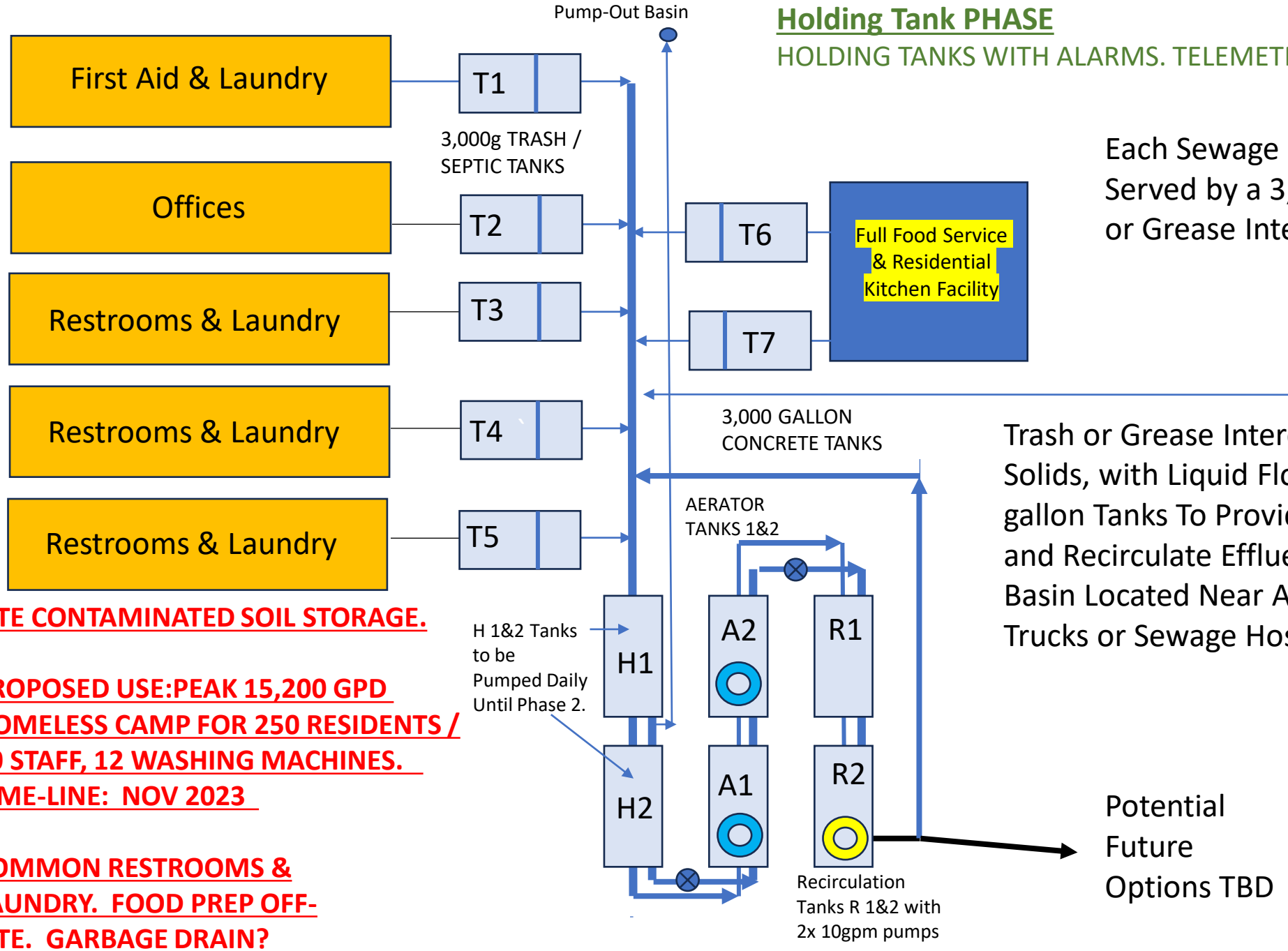
# PROPOSED OCCUPANCY / FLOW:

- Occupants: 250 Homeless Persons x 35 g/d/c = 8,750 gpd
- Staff: 30 x 15 g/d = 450 gpd
- Washing Machines : 12 x 500 g/d each = 6,000 gpd
- TOTAL PEAK FLOW: 15,200 gpd
- AVERAGE FLOW: (1/2 Peak Flow) 7,600 gpd

# OPTIONS:

- Traditional Sewer: Not Available

- Phase 1. Holding Tanks
  - Hauling Off-Site at >= $0.50 x 7,600 gallons / day = $3,800/day.
    - $3,800 x 365.35 days / year = $1,387,950 / year just for pumping & hauling.
  - Monitor Actual Quantity & Quality for Future Options




## Holding Tank PHASE

HOLDING TANKS WITH ALARMS. TELEMETRY & RECIRCULATION

Each Sewage Source to be Served by a 3,000 gallon Trash or Grease Interceptor Tank

Trash or Grease Interceptor Tanks Screen Solids, with Liquid Flowing to 6x 3,000 gallon Tanks To Provide Primary Treatment and Recirculate Effluent to a Pump-Out Basin Located Near Access to avoid Pumper Trucks or Sewage Hoses in the Camp Itself.

**SITE CONTAMINATED SOIL STORAGE.**

**PROPOSED USE:PEAK 15,200 GPD HOMELESS CAMP FOR 250 RESIDENTS / 30 STAFF, 12 WASHING MACHINES.**
**TIME-LINE: NOV 2023**

**COMMON RESTROOMS & LAUNDRY. FOOD PREP OFF-SITE. GARBAGE DRAIN?**

- Phase 2.  Convert to Septic Tank Effluent Pump (STEP)
  - Pump to Sewer.  Not Available
    - Requires Pumping Under the Railroad / No Easement.
  - Pump to Onsite Treatment System
    - Treatment and Disinfection Prior to:
      - Traditional Drainfield / Seepage System:  Not Suitable
      - Saturated Flow By-passes Soil Treatment Capacity

- Treatment and Bio Remediation Via Subsurface Dripfield,
  - Augmented in Modified Soils, incorporating Symbiotic Effects of:
    - Phyto-Remediation with Native Trees and Shrubs, &
    - Myco-Remediation via Mushroom Compost (various species)
    - Bio-Remediation via Soil Microbial & Effluent Bacterial & Action
  - Requires Application & Design in Accordance with Oregon *Administrative Rule (OAR 340-052-0050) for Sewage Systems Utilizing New or Unproven Technology.*
  - *This May be considered after Holding Tanks Are in Place.*

Oregon Administrative Rules in Support of Innovation in Wastewater Treatment & Reuse.

## 340-055-0007

**Policy**

It is the policy of the Environmental Quality Commission to encourage the use of recycled water for domestic, agricultural, industrial, recreational, and other beneficial purposes in a manner which protects public health and the environment of the state. The use of recycled water for beneficial purposes will improve water quality by reducing discharge of treated effluent to surface waters, reduce the demand on drinking water sources for uses not requiring potable water, and may conserve stream flows by reducing withdrawal for out-of-stream use.

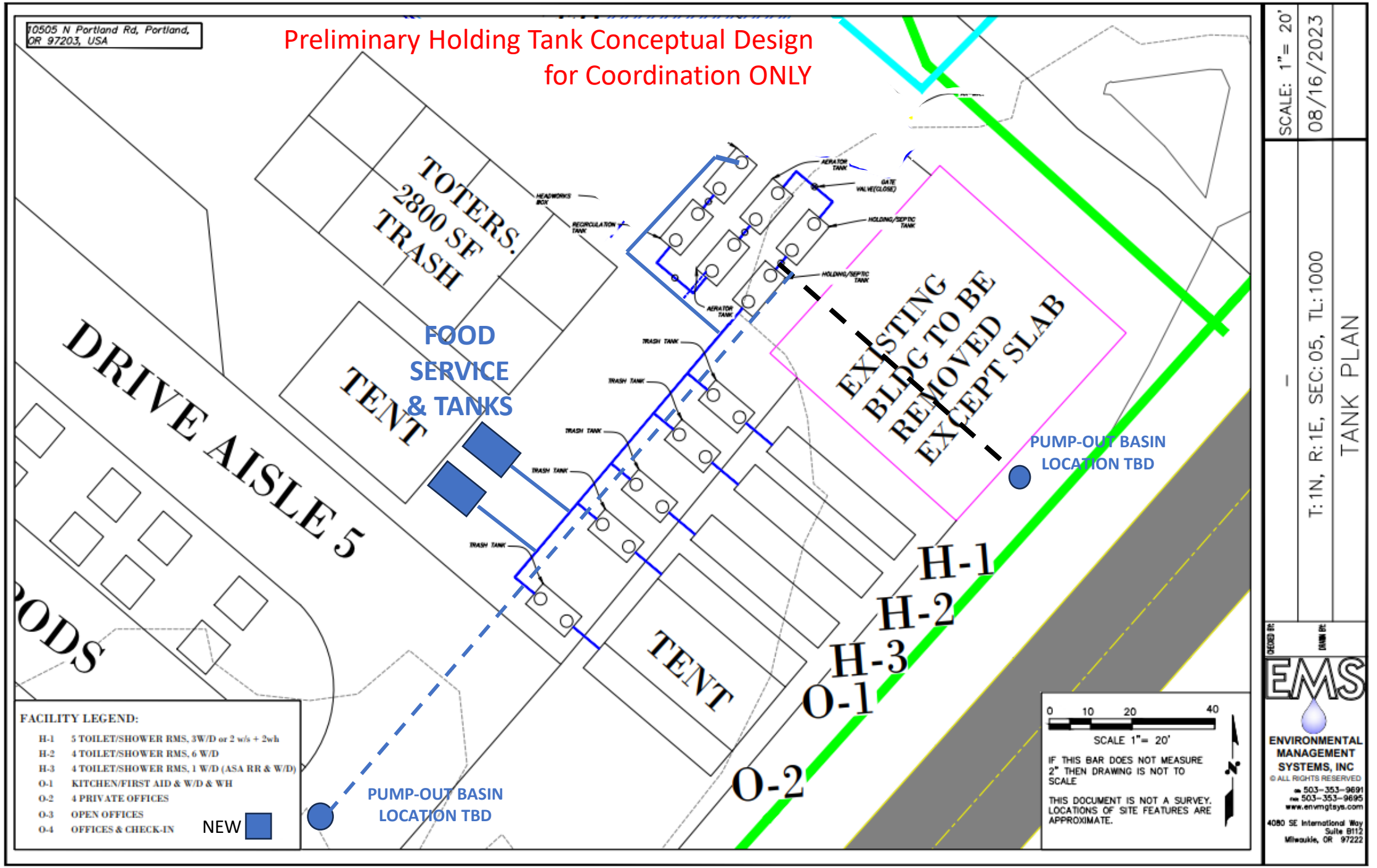
## REVIEW OF PLANS AND SPECIFICATIONS

**340-052-0050**

**Treatment Works and Sewerage Systems Utilizing New or Unproven Technology**

The Department encourages the development of new technology and will approve plans of such provided adequate documentation is submitted. The burden of proof for demonstrating new processes, treatment systems, and technologies lies with the design engineer. Documented case histories where any such new application has been successfully and similarly demonstrated or operated on a full scale basis shall be submitted. Demonstrations shall be at other than bench scale and shall be at field conditions such that the prototype information can be validly scaled up to a working facility. Experimental data need not be acquired solely from actual permanent operating facilities. For all such proposals, contingency plans shall be presented which will assure that in event of failure, public health and water quality would be protected.

**Statutory/Other Authority:** ORS 468


10505 N Portland Rd, Portland, OR 97203, USA
Preliminary Holding Tank Conceptual Design
for Coordination ONLY
TOTERS.
2800 SF
TRASH
FOOD
SERVICE
& TANKS
TENT
DRIVE AISLE 5
EXISTING
BLDG TO BE
REMOVED
EXCEPT SLAB
PUMP-OUT BASIN
LOCATION TBD
H-1
H-2
H-3
O-1
O-2
TENT
PUMP-OUT BASIN
LOCATION TBD
FACILITY LEGEND:
H-1 5 TOILET/SHOWER RMS, 3W/D or 2 w/s + 2wh
H-2 4 TOILET/SHOWER RMS, 6 W/D
H-3 4 TOILET/SHOWER RMS, 1 W/D (ASA RR & W/D)
O-1 KITCHEN/FIRST AID & W/D & WH
O-2 4 PRIVATE OFFICES
O-3 OPEN OFFICES
O-4 OFFICES & CHECK-IN
NEW
0 10 20 40
SCALE 1"= 20'
IF THIS BAR DOES NOT MEASURE 2" THEN DRAWING IS NOT TO SCALE
THIS DOCUMENT IS NOT A SURVEY. LOCATIONS OF SITE FEATURES ARE APPROXIMATE.
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08/16/2023
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TANK PLAN
EMS
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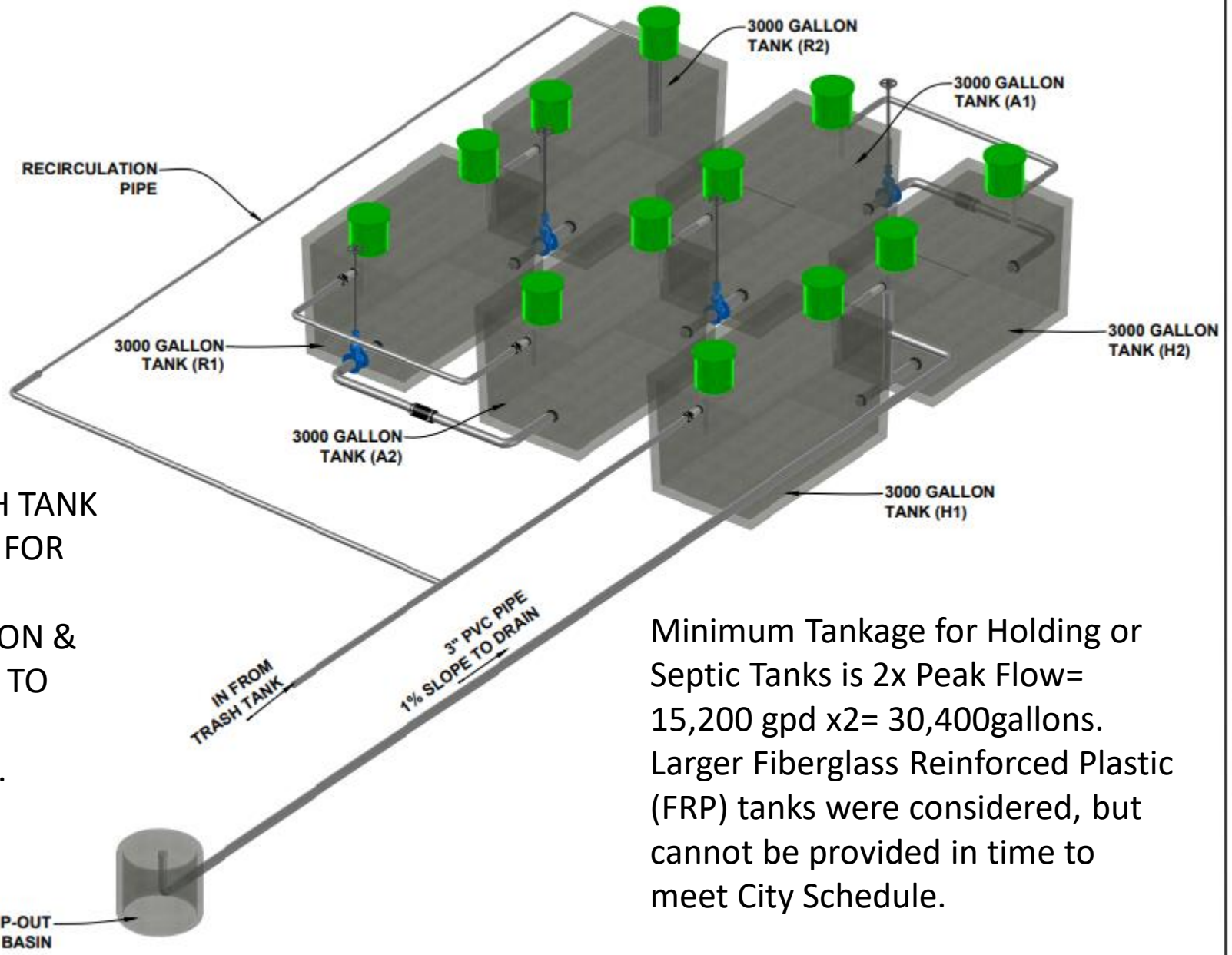


POST - TRASH TANK PROCESSING FOR AERATION, RECIRCULATION & EASY ACCESS TO PUMP-OUT OPERATIONS.

Minimum Tankage for Holding or Septic Tanks is 2x Peak Flow= 15,200 gpd x2= 30,400gallons. Larger Fiberglass Reinforced Plastic (FRP) tanks were considered, but cannot be provided in time to meet City Schedule.

08/16/2023

INTERTIED TANK ISOMETRIC VIEW

T:1N, R:1E, SEC:05, TL:1000

-

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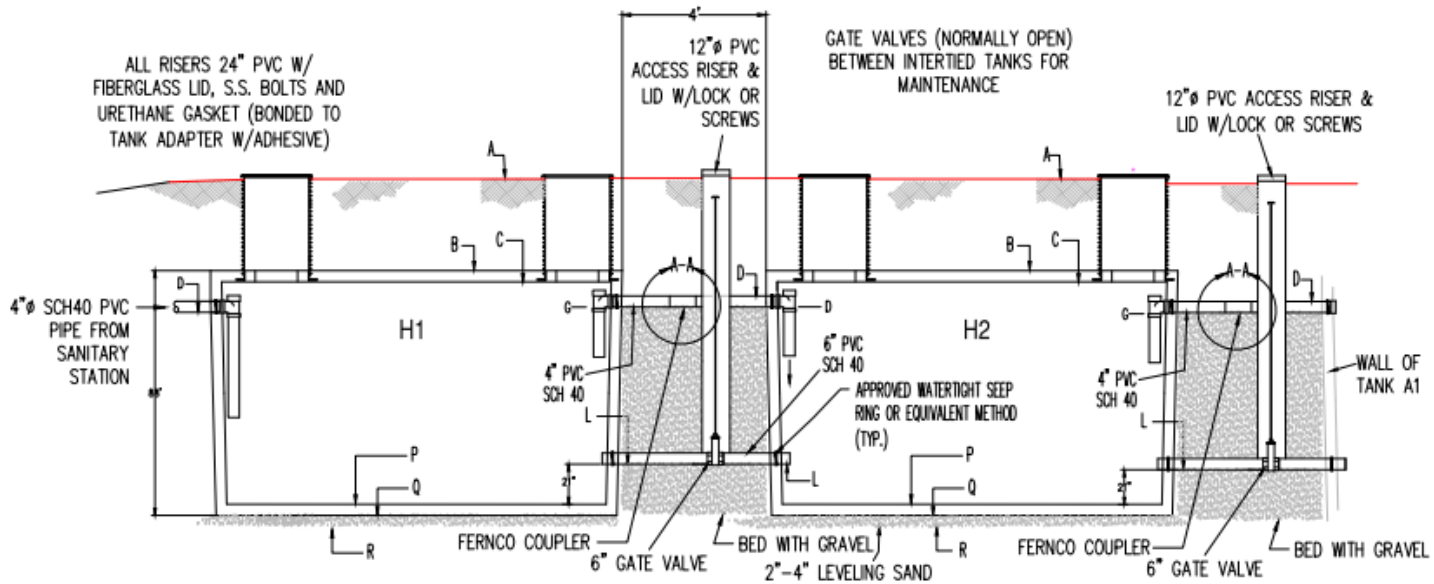
## Holding Tank (H1)

| Letter | Component | Elevation from Tank Floor (Inches) | Elevation from Tank Top (Inches) | Estimated Elevation from TBM (feet) |
|---|---|---|---|---|
| A | Ground Surface | 116.00 | 32.00 | 0.00 |
| B | Top of Tank | 84.00 | 0.00 | -2.67 |
| C | Ceiling of Tank | 80.00 | -4.00 | -3.00 |
| D | Inlet Invert | 74.00 | -10.00 | -3.50 |
| E | RSV Manifold | na | na | na |
| F | RSV Stinger Seat | na | na | na |
| G | Outlet Invert | 72.00 | -12.00 | -3.67 |
| H | Outlet Opening | na | na | na |
| I | Alarm (HWA) | 68.00 | -16.00 | -4.00 |
| J | Pump On | na | na | na |
| K | Pump Off | na | na | na |
| L | na | na | na | na |
| M | Redundant Off | na | na | na |
| N | Vault Inlet Holes | na | na | na |
| O | Pump Intake | na | na | na |
| P | Floor of Tank | 0.00 | -84.00 | -9.67 |
| Q | Bottom of Tank | -4.00 | -88.00 | -10.00 |
| R | Excavation | -8.00 | -92.00 | -10.33 |

## Holding Tank (H2)

| Letter | Component | Elevation from Tank Floor (Inches) | Elevation from Tank Top (Inches) | Estimated Elevation from TBM (feet) |
|---|---|---|---|---|
| A | Ground Surface | 120.00 | 36.00 | 0.00 |
| B | Top of Tank | 84.00 | 0.00 | -3.00 |
| C | Ceiling of Tank | 80.00 | -4.00 | -3.33 |
| D | Inlet Invert | 74.00 | -10.00 | -3.83 |
| E | RSV Manifold | na | na | na |
| F | RSV Stinger Seat | na | na | na |
| G | Outlet Invert | na | na | na |
| H | Outlet Opening | na | na | na |
| I | Alarm (HWA) | 41.72 | -42.28 | -6.52 |
| J | Pump On | na | na | na |
| K | Pump Off | na | na | na |
| L | na | na | na | na |
| M | Redundant Off | na | na | na |
| N | Vault Inlet Holes | na | na | na |
| O | Pump Intake | na | na | na |
| P | Floor of Tank | 0.00 | -84.00 | -10.00 |
| Q | Bottom of Tank | -4.00 | -88.00 | -10.33 |
| R | Excavation | -8.00 | -92.00 | -10.67 |




WAITE 3000-GAL HOLDING TANKS H1-H2 (TANKS 1 & 2 OF 6)

TYPICAL DRAWING – NOT FOR CONSTRUCTION

NOTE: CHECK WITHERTIGHTNESS OF FERNCO COUPLERS

SECTION A–A COUPLER

4"ø COUPLER FOR UPPER PIPE

08/16/2023

T: 1N, R: 1E, SEC: 05, TL: 1000

TANK DETAILS (H1 & H2)

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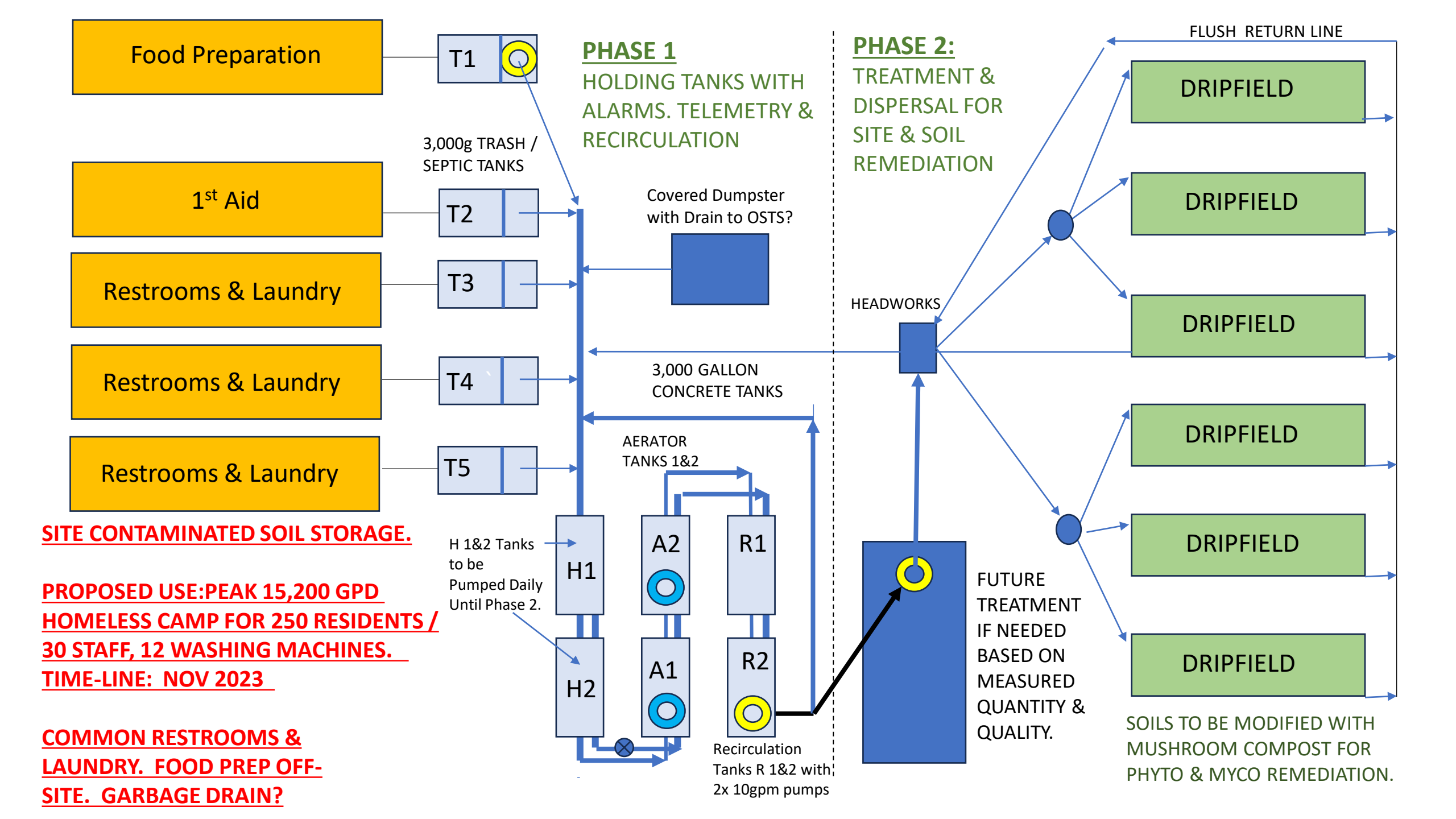
# Types of Water Reuse

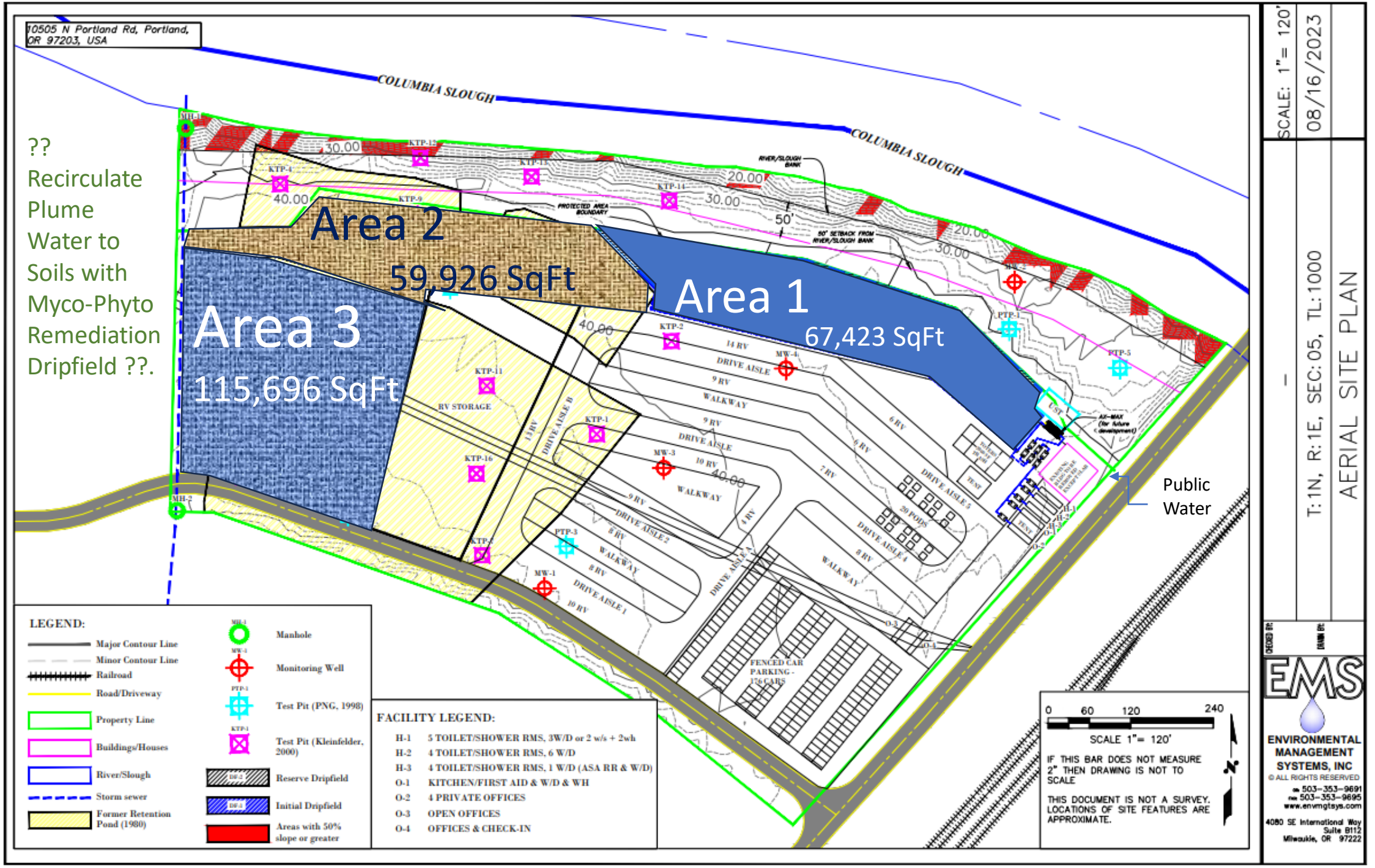
- Sources of water include municipal wastewater, industry process and cooling water, stormwater, agriculture runoff and return flows, and produced water from natural resource extraction activities.

- These sources of water are adequately treated to meet “fit-for-purpose specifications” for a particular next use.

  - For example, reclaimed water for crop irrigation would need to be of sufficient quality to prevent harm to plants and soils, maintain food safety, and protect the health of farm workers.

  - In uses where there is a greater human exposure water may require more treatment.


Food Preparation
T1
1st Aid
T2
Restrooms & Laundry
T3
Restrooms & Laundry
T4
Restrooms & Laundry
T5
3,000g TRASH / SEPTIC TANKS
PHASE 1
HOLDING TANKS WITH ALARMS. TELEMETRY & RECIRCULATION
Covered Dumpster with Drain to OSTS?
3,000 GALLON CONCRETE TANKS
AERATOR TANKS 1&2
H1
H2
A2
A1
R1
R2
H 1&2 Tanks to be Pumped Daily Until Phase 2.
Recirculation Tanks R 1&2 with 2x 10gpm pumps
PHASE 2:
TREATMENT & DISPERSAL FOR SITE & SOIL REMEDIATION
HEADWORKS
FLUSH RETURN LINE
DRIPFIELD
DRIPFIELD
DRIPFIELD
DRIPFIELD
DRIPFIELD
DRIPFIELD
FUTURE TREATMENT IF NEEDED BASED ON MEASURED QUANTITY & QUALITY.
SOILS TO BE MODIFIED WITH MUSHROOM COMPOST FOR PHYTO & MYCO REMEDIATION.
SITE CONTAMINATED SOIL STORAGE.
PROPOSED USE:PEAK 15,200 GPD HOMELESS CAMP FOR 250 RESIDENTS / 30 STAFF, 12 WASHING MACHINES.
TIME-LINE: NOV 2023
COMMON RESTROOMS & LAUNDRY. FOOD PREP OFF-SITE. GARBAGE DRAIN?


10505 N Portland Rd, Portland, OR 97203, USA
COLUMBIA SLOUGH
COLUMBIA SLOUGH
??
Recirculate
Plume
Water to
Soils with
Myco-Phyto
Remediation
Dripfield ??.
Area 2
59,926 SqFt
Area 1
67,423 SqFt
Area 3
115,696 SqFt
Public
Water
LEGEND:
Major Contour Line
Minor Contour Line
Railroad
Road/Driveway
Property Line
Buildings/Houses
River/Slough
Storm sewer
Former Retention Pond (1980)
Manhole
Monitoring Well
Test Pit (PNG, 1998)
Test Pit (Kleinfelder, 2000)
Reserve Dripfield
Initial Dripfield
Areas with 50% slope or greater
FACILITY LEGEND:
H-1 5 TOILET/SHOWER RMS, 3W/D or 2 w/s + 2wh
H-2 4 TOILET/SHOWER RMS, 6 W/D
H-3 4 TOILET/SHOWER RMS, 1 W/D (ASA RR & W/D)
O-1 KITCHEN/FIRST AID & W/D & WH
O-2 4 PRIVATE OFFICES
O-3 OPEN OFFICES
O-4 OFFICES & CHECK-IN
0 60 120 240
SCALE 1"= 120'
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| AREA NUMBER & SqFt of Area | PEAK FLOW @ 15,200 gpd = gpd/SqFt | AVERAGE FLOW @ 7,600 gpd = gpd/SqFt |
|---|---|---|
| 1. 67,423 | 0.23 gpd/SqFt | 0.11 gpd/SqFt |
| 2. 59,926 | 0.25 gpd/SqFt | 0.13 gpd/SqFt |
| 3. 115,696 | 0.13 gpd/SqFt | 0.07 gpd/SqFt |
| TOTAL. 243,045 | 0.06 gpd/SqFt | 0.03 gpd/SqFt |

1 Inch of Rainfall = 0.623 gpd / SqFt (at the high range for Rainfall for this location)

**Lawn Irrigation Typically Calls for 1 inch of water per week in the summer months.**

DEQ Staff expressed Concerns about the Option of Considering Soil Remediation because of the potential for contamination to be carried deeper into the water table and river.

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## Holding Tank (H1)

| Letter | Component | Elevation from Tank Floor (Inches) | Elevation from Tank Top (Inches) | Estimated Elevation from TBM (feet) |
|---|---|---|---|---|
| A | Ground Surface | 116.00 | 32.00 | 0.00 |
| B | Top of Tank | 84.00 | 0.00 | -2.67 |
| C | Ceiling of Tank | 80.00 | -4.00 | -3.00 |
| D | Inlet Invert | 74.00 | -10.00 | -3.50 |
| E | RSV Manifold | na | na | na |
| F | RSV Stinger Seat | na | na | na |
| G | Outlet Invert | 72.00 | -12.00 | -3.67 |
| H | Outlet Opening | na | na | na |
| I | Alarm (HWA) | 68.00 | -16.00 | -4.00 |
| J | Pump On | na | na | na |
| K | Pump Off | na | na | na |
| L | na | na | na | na |
| M | Redundant Off | na | na | na |
| N | Vault Inlet Holes | na | na | na |
| O | Pump Intake | na | na | na |
| P | Floor of Tank | 0.00 | -84.00 | -9.67 |
| Q | Bottom of Tank | -4.00 | -88.00 | -10.00 |
| R | Excavation | -8.00 | -92.00 | -10.33 |

## Holding Tank (H2)

| Letter | Component | Elevation from Tank Floor (Inches) | Elevation from Tank Top (Inches) | Estimated Elevation from TBM (feet) |
|---|---|---|---|---|
| A | Ground Surface | 120.00 | 36.00 | 0.00 |
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| C | Ceiling of Tank | 80.00 | -4.00 | -3.33 |
| D | Inlet Invert | 74.00 | -10.00 | -3.83 |
| E | RSV Manifold | na | na | na |
| F | RSV Stinger Seat | na | na | na |
| G | Outlet Invert | na | na | na |
| H | Outlet Opening | na | na | na |
| I | Alarm (HWA) | 41.72 | -42.28 | -6.52 |
| J | Pump On | na | na | na |
| K | Pump Off | na | na | na |
| L | na | na | na | na |
| M | Redundant Off | na | na | na |
| N | Vault Inlet Holes | na | na | na |
| O | Pump Intake | na | na | na |
| P | Floor of Tank | 0.00 | -84.00 | -10.00 |
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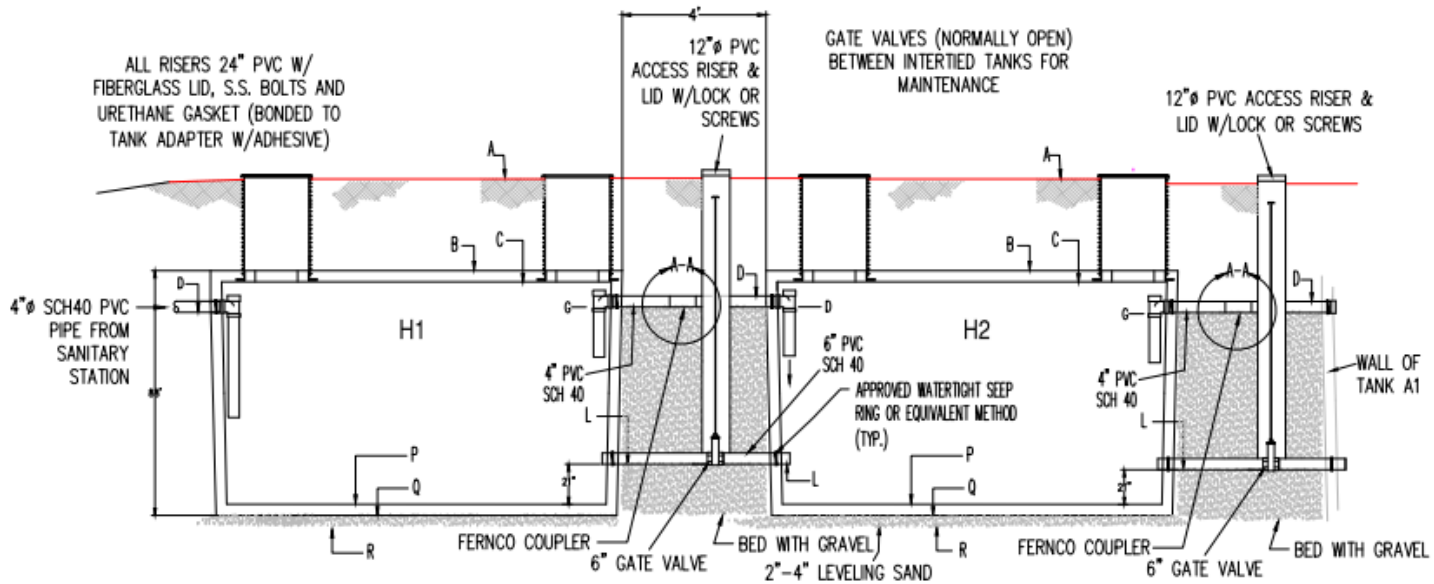


WAITE 3000-GAL HOLDING TANKS H1-H2 (TANKS 1 & 2 OF 6)

TYPICAL DRAWING – NOT FOR CONSTRUCTION

NOTE: CHECK WITHERTIGHTNESS OF FERNCO COUPLERS

SECTION A–A COUPLER

4"ø COUPLER FOR UPPER PIPE

08/16/2023

T: 1N, R: 1E, SEC: 05, TL: 1000

TANK DETAILS (H1 & H2)

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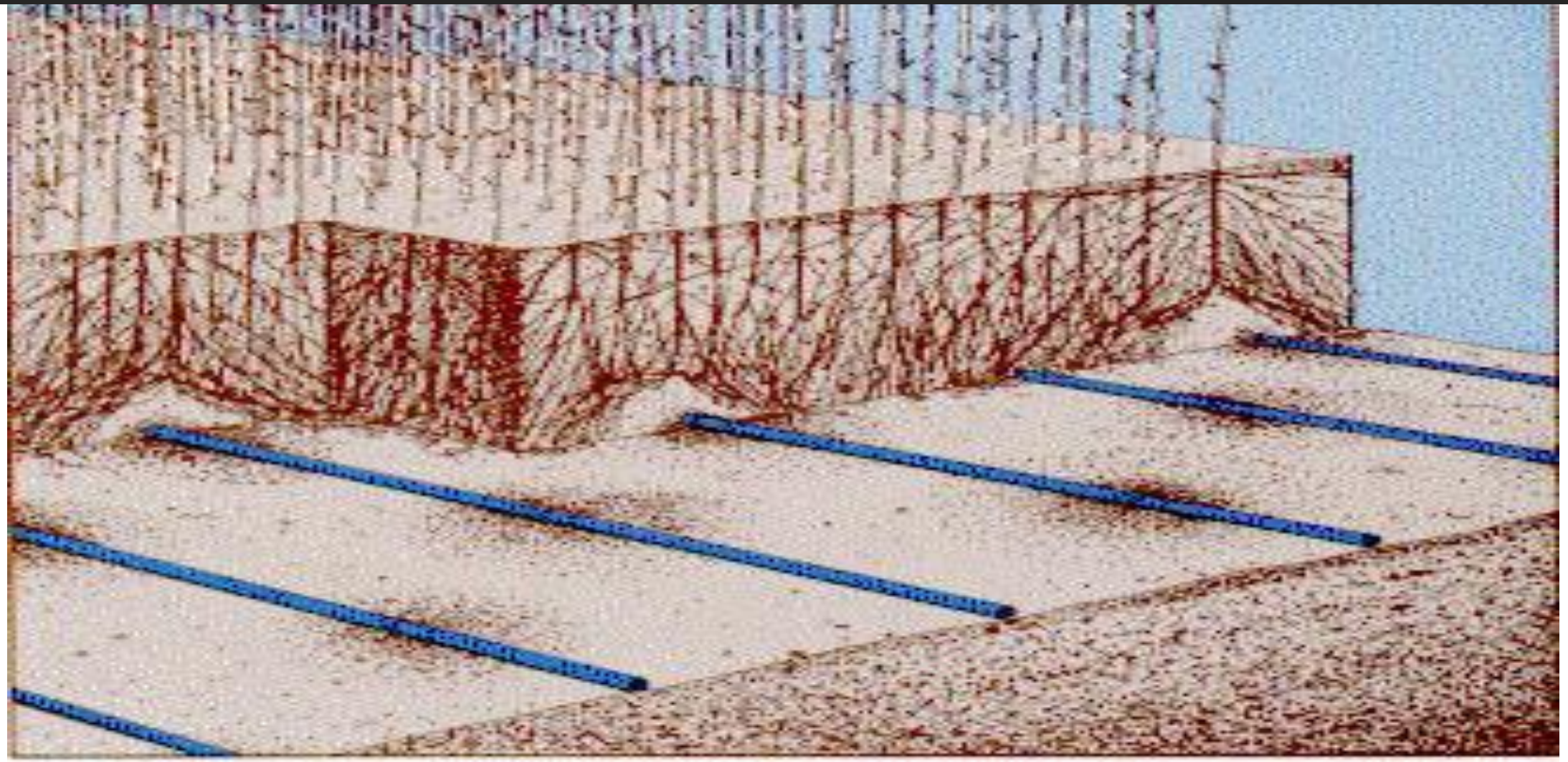
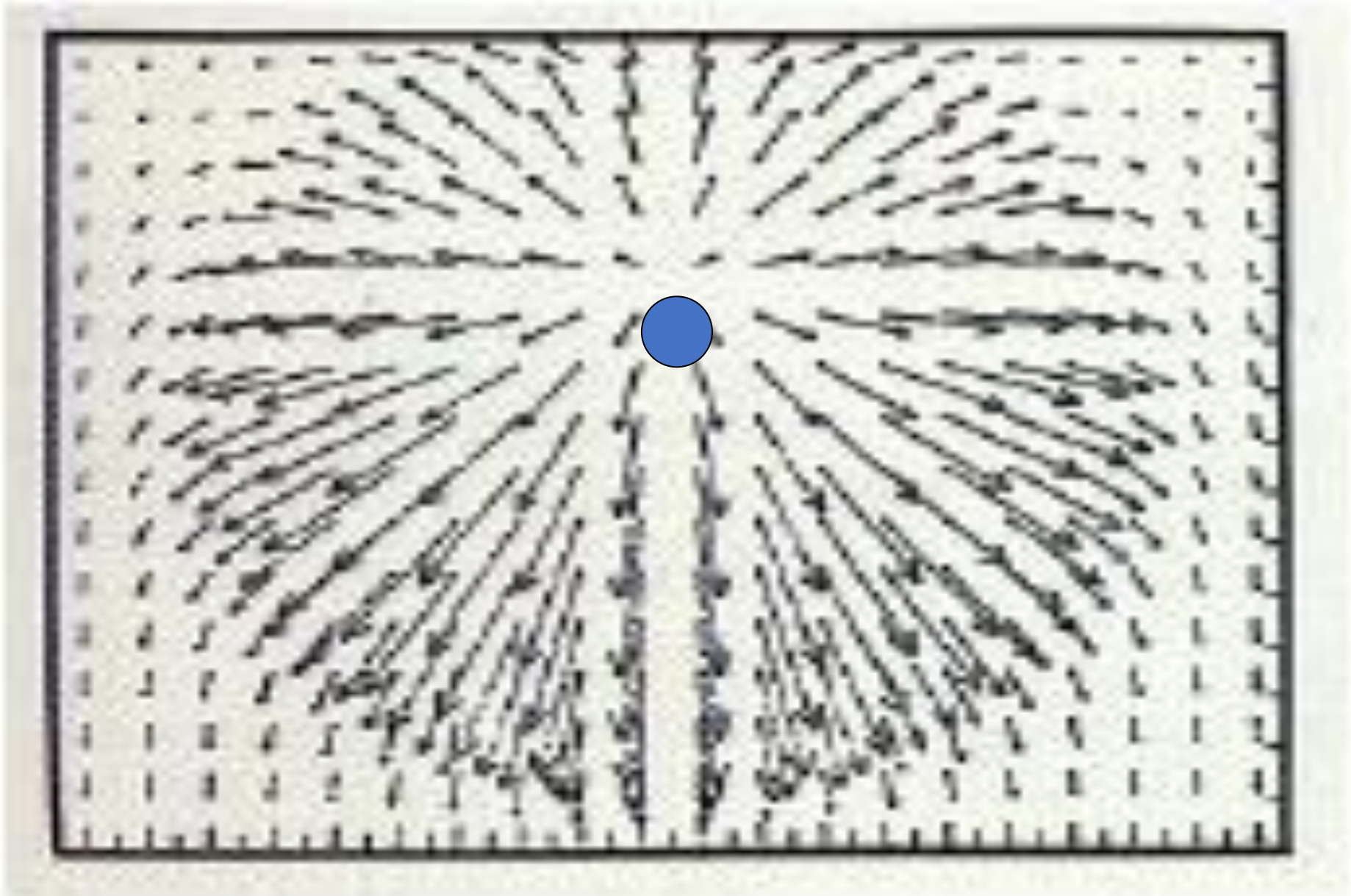
# Dripfield Emitter Pattern

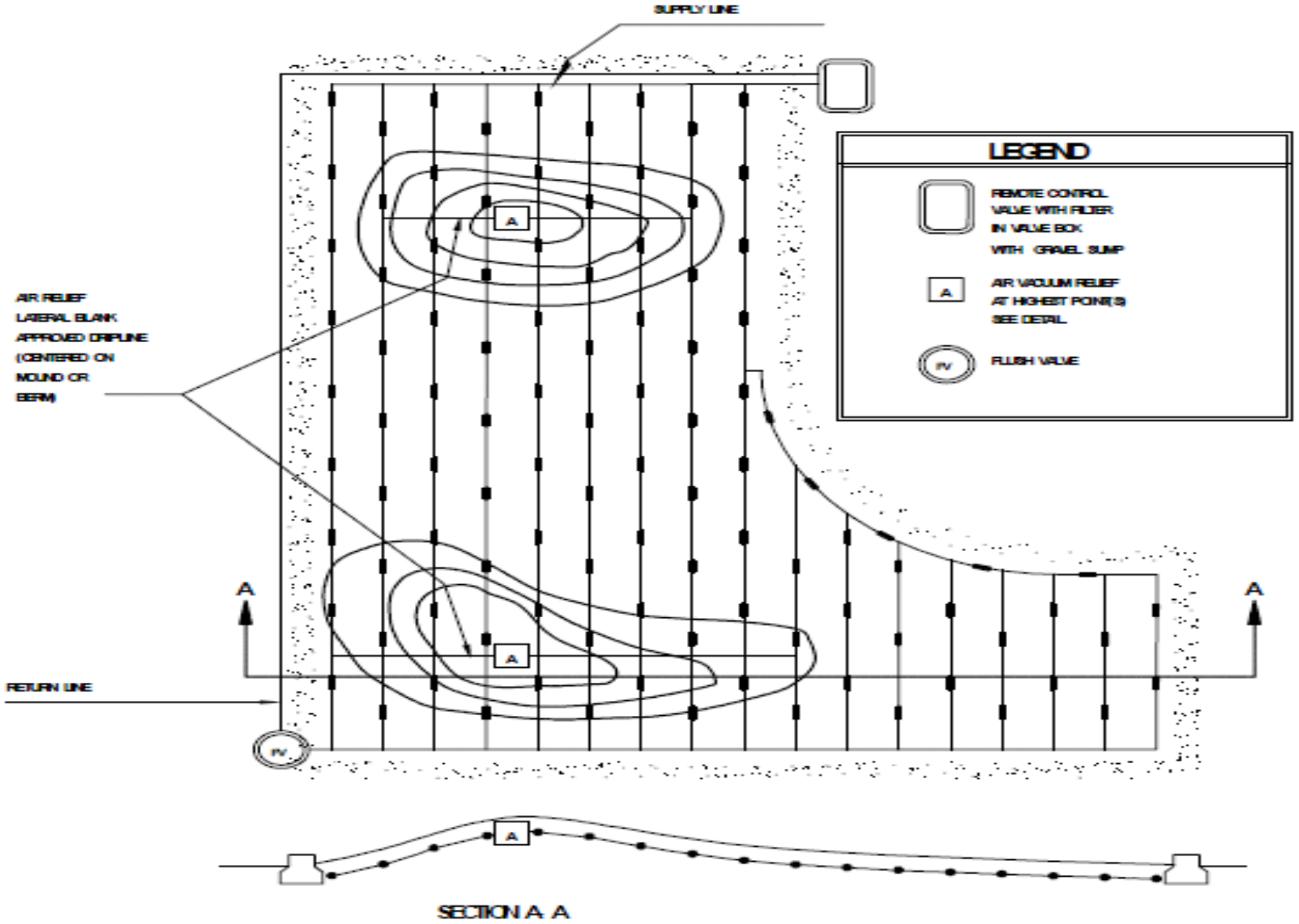


Battelle-Northwest's biobarrier technology excludes plant roots from drip emitters for upto 20 years.

# Soil Wetting Pattern at Emitters



# Topographic considerations



# What are Bio-, Phyto- and Myco-Remediation?

Working with plants to clean up contaminated soil or water is called ‘phytoremediation’ and working with fungi to clean soil or water is called ‘mycoremediation.’ There are decomposer fungi who break down organic materials for food and can also break down some contaminants, and mycorrhizal fungi (aka “plant friend” fungi) which connect to plants through the roots and help plants grow, who can enhance or inhibit hazardous metal uptake into plants. Phyto and myco – remediation are part of a larger approach known as biological remediation or bioremediation for short.

# Testing Locally-Adapted and Sustainable Solutions for Brownfields Cleanup

Taylor Yard, one of the study pilot locations, a former railyard on the LA river.

Researchers at the University of California, Riverside have teamed up with the City of Los Angeles and several community land trusts to test a soil clean up method involving native plants and fungi in a 1-year research field study launching this winter. UCR researchers in the Environmental Sciences and Toxicology department found that some plants and fungi growing naturally on contaminated sites around Los Angeles take up metals such as lead and cadmium from the soil

# University of California, Riverside Study

The field study will test these biological remediation combinations:

- Native plants (pictured below)
- Native soil fungi
- Commercial Mycorrhizal Fungal Inoculum
- Decomposer Fungal Inoculum
  - with and without irrigation

(Telegraphweed

California Buckwheat


Bob Sweeney, MS, REHS
President, EMS,

- bob@envmgtsys.com O: 503-353-9691

# Will cover the following slides, if Time Allows:

# Supporting Information
# REGARDING
# Bio-Phyto-Myco-Remediation of Contaminated Soils

# Oregon TREATMENT & DISINFECTION IN ONSITE WASTEWATER TREATMENT DISPOSAL SYSTEMS

Biological Treatment Typically Achieves Better than Treatment Standards for Non-Reuse / Disposal Systems of the following:

| Oregon TS2 | | Typical Results |
|---|---|---|
| BOD5 | <20mg/L | <10mg/L |
| TSS | <20mg/L | <10mg/L |
| TN | <30mg/L | <10mg/L |

Disinfection to 99% effectiveness via

- Ultra Violet Rays
- Ozone

Onsite Systems Rarely: use ANY Chlorine or Iodine

**EPA Class D Recycled Water:**

•**Description:** Class D recycled water receives basic treatment to reduce suspended solids and some contaminants. It's typically used for non-potable applications where there's minimal potential for human exposure.

•**Beneficial Uses:**

- Landscape Irrigation: Typically for less sensitive areas.
- Industrial Uses: Non-potable industrial processes, dust control, and construction.

OREGON. The following requirements apply to **Class D recycled water**.
Any beneficial purpose authorized in writing by the department.

Treatment.

Must not exceed a 30-day log mean of 126 E. coli organisms per 100 mL & 406 E. coli CFU per 100 mL in any single sample.

Monitoring for E. coli organisms must occur once per week at a minimum.

**EPA Class C Recycled Water:**

•**Description:** Class C recycled water receives basic treatment to reduce suspended solids and some contaminants. It's typically used for non-potable applications where there's minimal potential for human exposure.
•**Beneficial Uses:**
- Landscape Irrigation: Typically for less sensitive areas.
- Industrial Uses: Non-potable industrial processes, dust control, and construction.

OREGON. The following requirements apply to **Class C recycled water**.
Any beneficial purpose authorized in writing by the department.

Treatment. Must be **Oxidized** and **Disinfected**

Must not exceed a 30-day log mean of **23 Total Coliform organisms per 100 mL** &
240 TC per 100 mL in any two consecutive samples.

**Monitoring** for E. coli organisms must occur **once per week at a minimum**.

**EPA Class B Recycled Water:**

•**Description:** Class B recycled water undergoes treatment to reduce pathogens and contaminants, though not to the same extent as Class A water. It's suitable for uses that don't involve direct human contact or consumption.
•**Beneficial Uses:**

- Landscape Irrigation: Similar to Class A, but not in areas with public access.
- Agricultural Irrigation: Irrigating crops and non-food plants.
- Industrial Uses: Non-potable industrial processes and cooling.

OREGON. The following requirements apply to **Class B recycled water**.
Any beneficial purpose authorized in writing by the department.

Treatment.

Must not exceed a 30-day log mean of 2.2 E. Total Coliform organisms per 100 mL &
23 CFU per 100 mL in any single sample.

Monitoring for Total Coliform organisms must occur Three Times per week at a minimum.

**EPA Class A Recycled Water:**

**Description:** Class A recycled water undergoes advanced treatment processes that effectively remove pathogens, suspended solids, organic matter, and other contaminants.

**Beneficial Uses:** Landscape Irrigation: Watering lawns, gardens, parks, and other green spaces. Agricultural Irrigation: Irrigating crops and farmlands. Industrial Uses: Cooling water, process water, and non-potable industrial purposes. Toilet Flushing: Using recycled water for flushing toilets in commercial and residential buildings.

OREGON. The following requirements apply to **Class A recycled water**.
Treatment. **oxidized**, **filtered** and **disinfected**

Turbidity must not exceed avg of 2 nephelometric turbidity units (NTU) within a 24-hour period, 5 NTU more than five percent of the time within a 24-hour period, and 10 NTU at any time,

Must not exceed a 30-day log mean of 2.2 Total Coliform organisms per 100 mL &
23 CFU per 100 mL in any single sample.

**Monitoring for Total Coliform organisms must occur Once per Day at a minimum.**
**Turbidity must be sampled at least hourly.**

**EPA Unrestricted Recycled Water:**

- **Description:** This is the highest quality recycled water that meets stringent treatment requirements. It's treated to a level where it can be safely used for essentially any non-potable application, including those with human exposure.
- **Beneficial Uses:**
  - All the above uses, including more sensitive applications like spray irrigation in urban areas, decorative fountains, and even indoor uses like flushing toilets and urinals.

OREGON. **Not Found in Oregon Rules**

Several technologies are commonly used in wastewater treatment and reuse to achieve effective treatment and ensure water quality for various reuse applications. Here are some of the technologies frequently employed:

It's important to note that the selection of technologies depends on the specific characteristics of the wastewater, desired water quality, regulatory requirements, and the intended reuse application. Often, a combination of several treatment processes is employed to achieve the desired treatment goals and ensure water safety and quality for reuse.

**Biological Treatment:**

- Activated Sludge Process:
  - microorganisms break down wastewater in an aerated tank.

- Sequencing Batch Reactor (SBR):
  - process treats wastewater in batches in a single tank.

- Trickling Filter:
  - spread over a media bed that contains a biofilm of microorganisms that degrade organic matter.

**Chemical Treatment:**

•Coagulation and Flocculation: coagulants to destabilize and aggregate suspended solids, allowing them to settle and be removed more easily.

•Chemical Precipitation: chemicals to wastewater to induce the formation of insoluble particles (precipitates) that can be separated from the water.

•Disinfection: The use of chemicals (e.g., chlorine, ozone, ultraviolet light) to destroy or inactivate pathogens in the wastewater.

**Advanced Treatment:**

•Membrane Filtration: fine pores separate suspended solids, bacteria, and other contaminants from wastewater.

•Advanced Oxidation Processes (AOPs): Employing chemical reactions (such as ozonation or UV/hydrogen peroxide) to break down persistent organic compounds and eliminate microorganisms.

•Adsorption: activated carbon or other materials to adsorb and remove organic compounds and contaminants from wastewater.

1. Wastewater Reuse Specific Technologies:
    1. Reverse Osmosis (RO): A high-pressure membrane filtration
    2. UV Disinfection: ultraviolet (UV) light to disinfect and inactivate pathogens, making it safe for specific reuse purposes.
    3. Advanced Electrochemical Processes: use electrical current to treat wastewater and remove contaminants.

# Recycling and Reuse:
# Not a Prescriptive Formula

**1ST DRAFT (graphics to be added & slides will be shortened)**

for

## Onsite Wastewater Recycling Professionals

Presenter: Robert Sweeney, MS,
OR REHS / WA Professional Onsite Wastewater Treatment System Designer

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**This Presentation Represents the Opinion of the Author and Does Not Reflect the Opinion of NOWRA, its Members or Sponsors of the 2023 Mega-Conference.**


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