Treatment Methods and Disposal Options for Radionuclides

TREATMENT METHODS

Ion Exchange
Radionuclide Removal Process

Raw Water

Resin

Loaded Resin

Salt Brine

Sewer Pipe

Waste Water Treatment Plant

Compliant Softened Water

Exhausted Resin

Appropriate Landfill

Radionuclide + Sludge

OR

Land Application

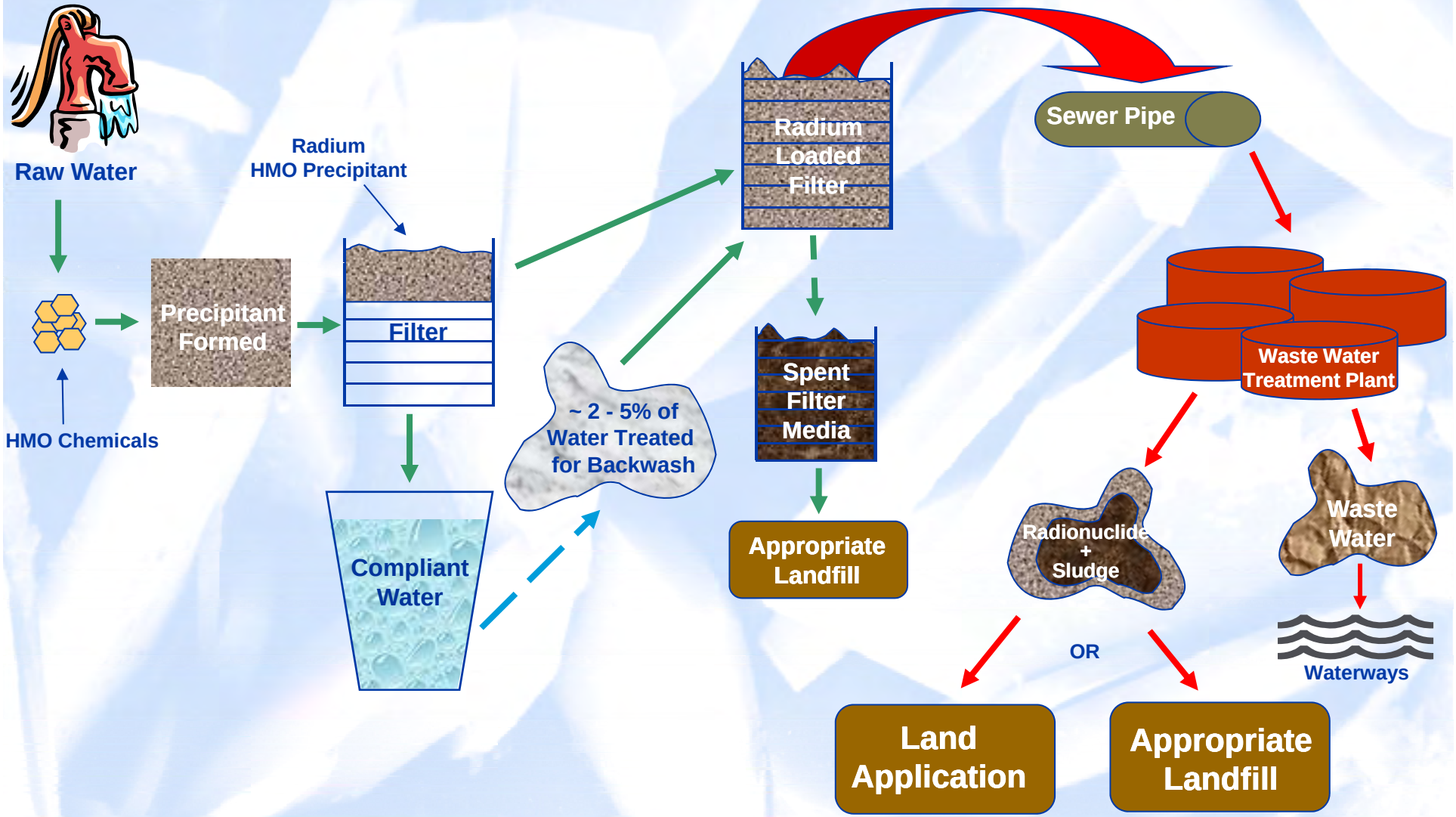
Appropriate Landfill

Waste Water

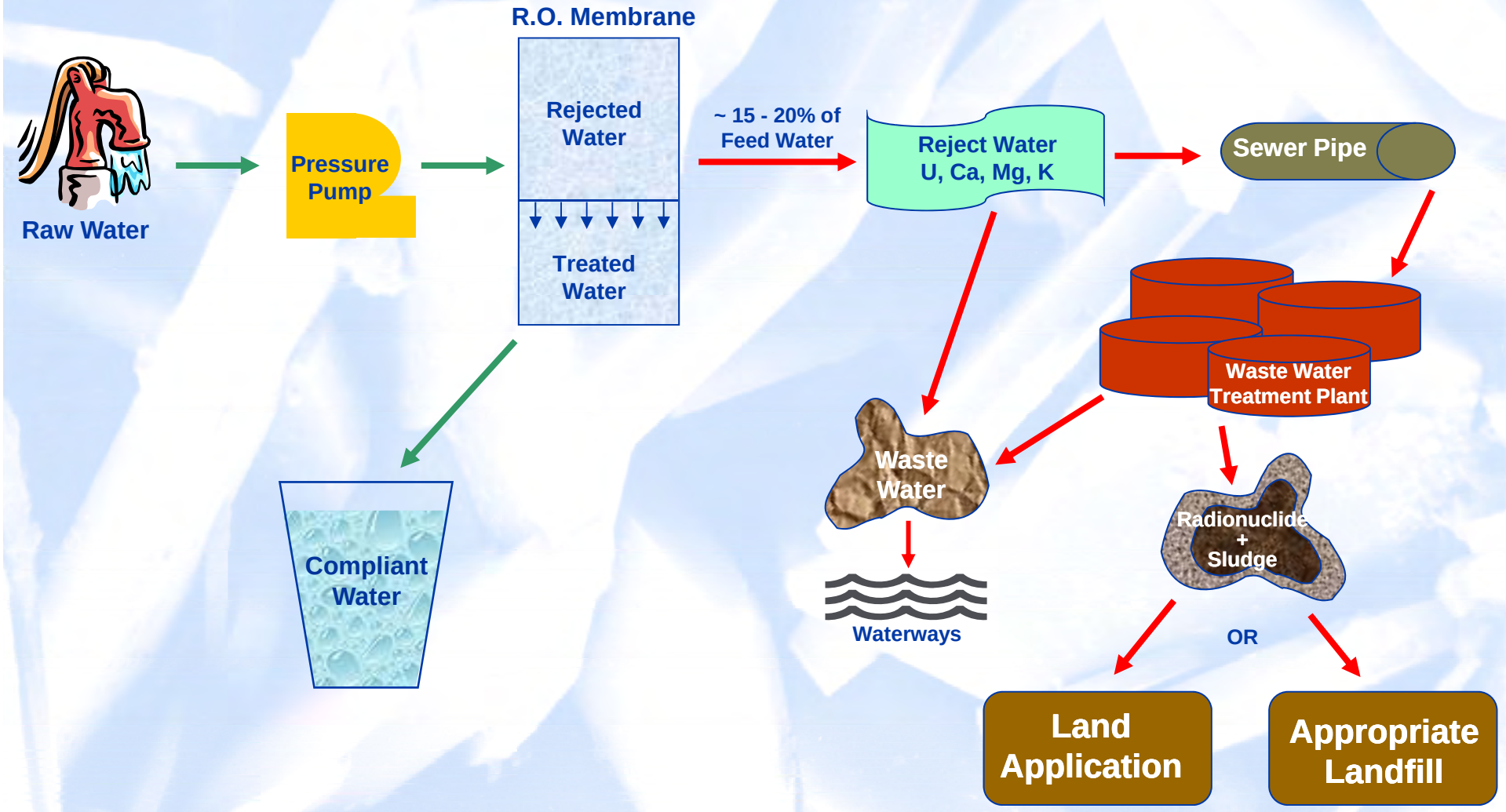
Waterways

Issues:
Corrosion of piping & values
Sodium in drinking water

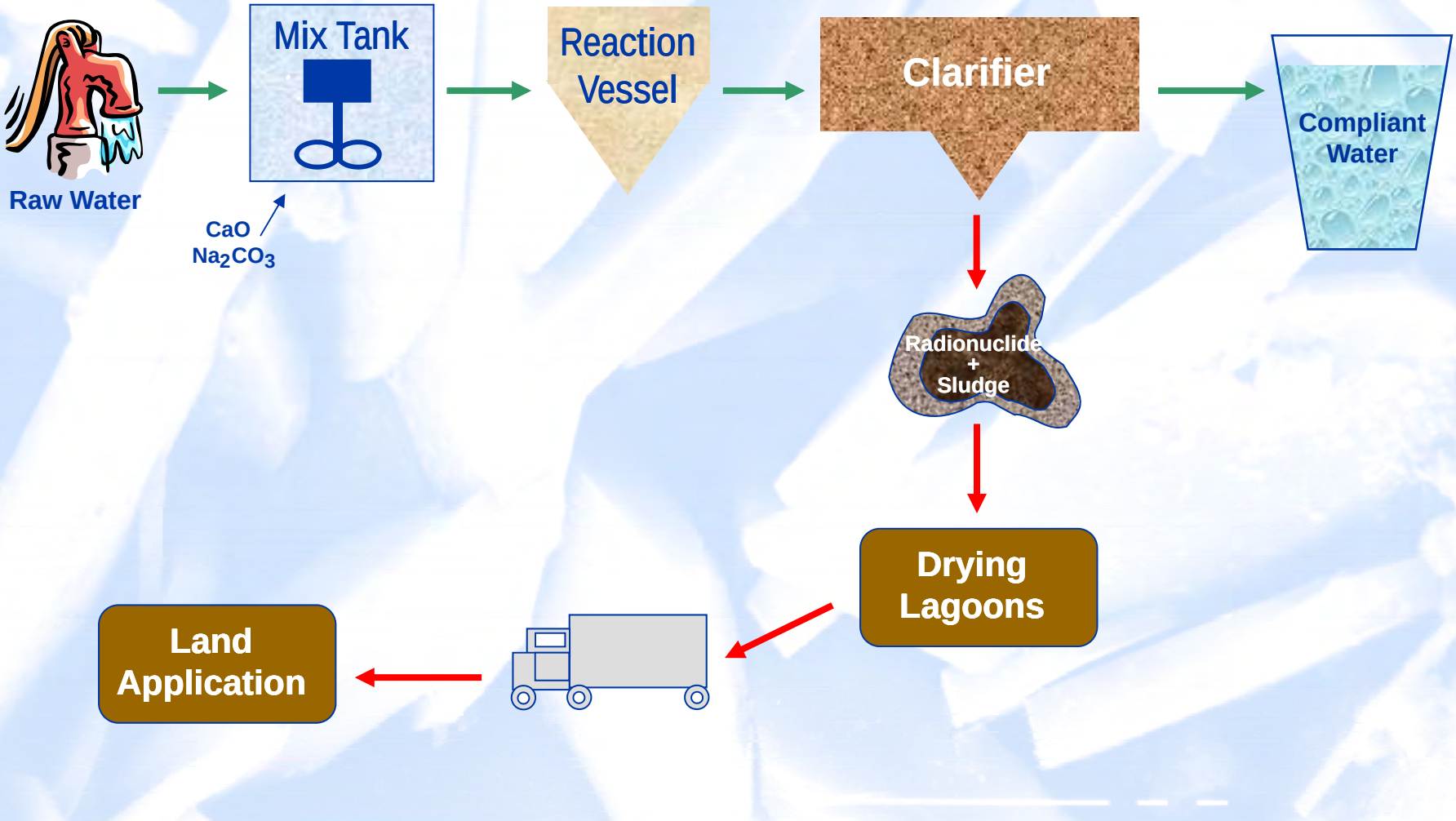
Hydrous Manganese Oxide (HMO) Radionuclide Removal Process



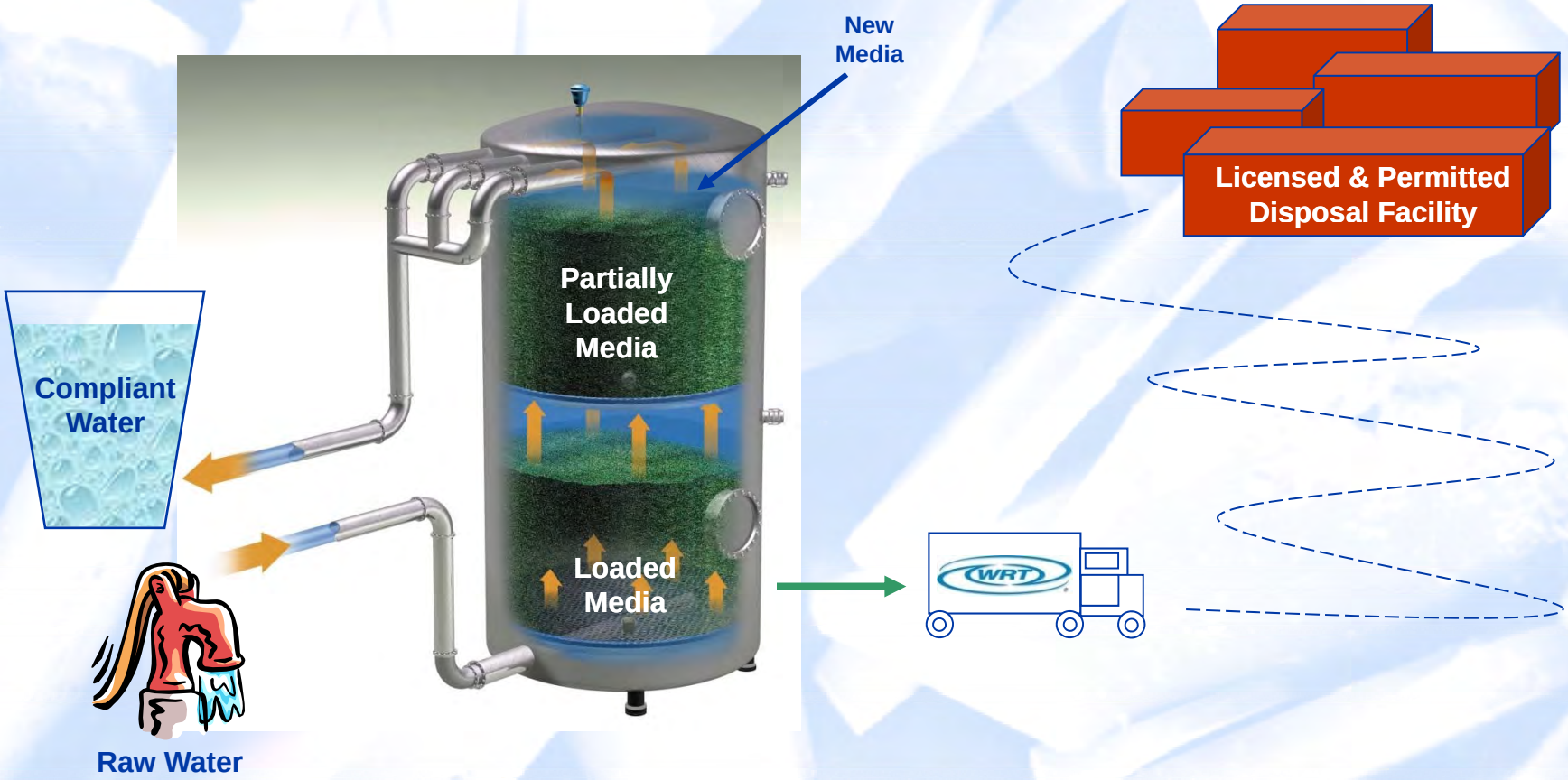
Reverse Osmosis Radionuclide Removal Process



Lime Softening
Radionuclide Removal Process



Absorbent Media Radionuclide Removal Process



Comparison of Radium Treatment Technologies

	WRT Z-88®	Conventional Ion Exchange	HMO	Reverse Osmosis	Lime Softening
NSF Std.61 Certified for use in potable water	Yes	Yes	Yes	Yes	Yes
Chemical Addition	No	Yes	Yes	Yes	Yes
Liquid Waste Generated	No	Yes	Yes	Yes	Yes
Changes in Other Water Quality Parameters	No	Yes	Yes	Yes	Yes
Type of Operation	Passive	Active	Active	Active	Active
Disposal of Radium	Licensed Disposal Facility	Sewer	Sewer	Sewer	Land / Landfill
Combined Radium in Residuals (13 pCi/L in source water)	500 - 2,000 pCi/g	100 - 2,000 pCi/L	5,000 - 15,000 pCi/g	25 - 150 pCi/L	10 - 20 pCi/g of sludge
Media Ownership	WRT	Utility	Utility	Utility	Utility
Radioactive Material License	WRT	?	?	?	?
Guaranteed Performance	Yes	No	No	No	No

DISPOSAL OPTIONS

Disposal Options for Water Treatment Plants

Raw Water

Treatment Process

Compliant Water

Treatment Residuals

Sewer

Waterways

Landfill

USEPA Recommendations – Disposal of Water Treatment Residuals

< 5 pCi/g	Unrestricted disposal
5 to 100 pCi/g	Possible burial in local landfill with restrictions
50 to 2,000 pCi/L	Burial in NORM facility
> 2,000 pCi/L	Burial in LLRW disposal site

Radionuclide Source to Discharge
No Treatment

Raw Water
Ra = 11 pCi/L
Ra = 20 pCi/L

Customers

Ra = 11 pCi/L
Ra = 20 pCi/L

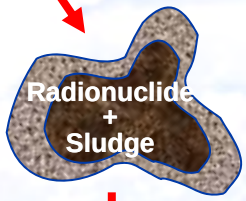
Non-Radionuclide Influent

40%

60%

Ra = 2.8 pCi/L
Ra = 8.0 pCi/L

Waterways



Ra = 48 pCi/g
Ra = 138 pCi/g

Land Application

Note: Assumes a 50% dilution of waste water with non-radium bearing water.

Radionuclide Source to Discharge
HMO Treatment

Raw Water
Ra = 11 pCi/L

Ra = <5 pCi/L

Customers

High Ra Solid
Ra = 15,600 pCi/g

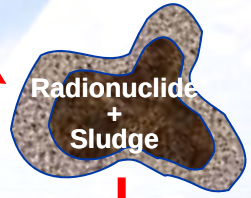
Non-Radionuclide Influent

10%

Ra = 0.7 pCi/L

Waterways

90%



Particles: Ra = 15,600 pCi/g
Average Sludge: Ra = 73 pCi/g

Land Application

Note: Assumes a 50% dilution of waste water with non-radium bearing water.

Radionuclide Source to Discharge
Radionuclide-Selective Media Treatment

Raw Water
Ra = 11 pCi/L
Ra = 20 pCi/L

Ra = <5 pCi/L
Unchanged

Customers

Non-Radionuclide Influent

40%

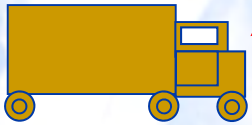
Ra = 1.29 pCi/L
Unchanged

Waterways

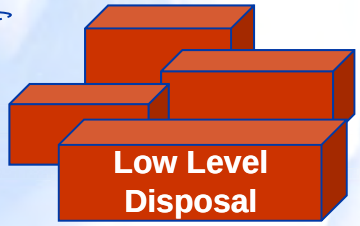
60%

Ra = 22 pCi/g
Unchanged

Land Application



Ra = ~2,000 pCi/g



Note: Assumes a 50% dilution of waste water with non-radium bearing water.

Why not send radioactive treatment residuals to the sewer?

- **Solids settle out in sewer pipes creating radioactive dead zones**
- **Contamination of surrounding land due to leakage**
- **Contaminated pipes**
  - Worker exposure risk during maintenance and repairs
  - Future pipe replacement will present worker exposure and disposal of contaminated pipes issues
- **Extends exposure and contamination risks to the wastewater treatment plant**
- **Potential cleanup costs are expensive**
  - 12 Sewer/POTW contamination incidents since 1984
  - Ohio cleanup cost was in excess of $2,000,000
- **Land application**
  - May restrict land use for agriculture
  - May impact future land development
  - Extends exposure and contamination risks to the application sites

Disposal of Treatment Residuals

- Removal of radionuclides in any process generates a radioactive by-product
- Most treatment methods dispose of radionuclide waste to the sanitary sewer
- WRT's Radionuclide Removal Process generates a solid, granular, low level TENORM* waste
- All handling, exchange, transportation and disposal of media is facilitated by WRT
- Disposal by WRT to a licensed facility

* Technically Enhanced Naturally Occurring Radioactive Material