



IEMA-OHS

ILLINOIS EMERGENCY MANAGEMENT AGENCY
AND OFFICE OF HOMELAND SECURITY

32 IAC 622 Guidance Document for the Handling and Disposal of Radium Residuals from the Treatment of Groundwater



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I. Purpose and Scope

To assist registrants in the implementation of 32 Illinois Administrative Code 622, hereafter referred to as “Part 622”. Part 622 exempts entities possessing, generating, storing, or transporting groundwater treatment residuals with elevated levels of radium-226 and radium-228 from the licensing and reporting requirements set forth in 32 Illinois Administrative Code 330. While those entities producing these residuals as a result of the treatment of drinking water or wastewater are exempted from licensing, there is specific sampling, documenting, and disposal conditions, and safety concerns that exist. This guidance is designed to assist municipal drinking water and wastewater plants, land applicators, Illinois Environmental Protection Agency (IEPA) permitted facilities, haulers of treatment residuals, and other entities in determining if they qualify for exempt status and what minimum requirements are necessary to demonstrate compliance with Part 622.

II. Disclaimer

Please note that the regulations described in this document contain legally binding requirements. The recommendations contained in this document are not substitutes for those regulations, nor is this document a regulation. This guide is strictly voluntary and does not impose legally binding requirements on U.S. Environmental Protection Agency (US EPA), the State of Illinois, Illinois Emergency Management Agency and Office of Homeland Security (IEMA-OHS), Illinois Environmental Protection Agency (IEPA), local or tribal governments, or members of the public, and may not apply to a particular situation based upon the circumstances. Although IEMA-OHS recommends the approaches outlined in this document, local decision makers may adopt approaches that differ from those presented in this guide provided they comply with all parts of applicable regulations. Interested parties may direct questions concerning this guidance to IEMA-OHS, Office of Nuclear Safety, Water Treatment Residuals Program, 1301 Knotts St, Springfield IL 62703 or ema.RadiumResiduals@illinois.gov. Any IEMA-OHS decisions regarding a particular water system or waste stream will be made based on the applicable statutes and regulations. IEMA-OHS will continue to review and update this guidance as appropriate.

III. Background Information

The following information discusses the origins of regulations concerning radium-226 and radium-228 (naturally occurring radioactive materials) in treatment residuals and why Part 622 was promulgated.

The Radionuclides Rule

The revised Radionuclides Rule, 40 Code of Federal Regulations 141 (Rule), became effective on December 8, 2003. U.S. Environmental Protection Agency’s revisions to the Rule provided

standards intended to ensure that all customers served by community water systems (CWSs) receive water that meets the Maximum Contaminant Levels (MCL) for radionuclides in drinking water. Regulated radionuclides include radium-226, radium-228, gross alpha particle activity, uranium, and beta particle and photon radioactivity. According to the Rule, CWSs in Illinois should have completed initial compliance monitoring by December 8, 2007.

While most systems were in compliance with the revised Rule; some systems, primarily those located in the northern third of the state, had elevated levels of naturally occurring radionuclides and were required to install new or upgrade existing treatment systems or technologies to meet these revised standards. The treatment processes necessary to remove radium from the drinking water produced residuals containing elevated concentrations of those regulated radionuclides. This phenomenon is commonly associated with sewage sludge. However, communities should also be aware that in the process of treating drinking water, the radionuclides will also accumulate in the drinking water treatment media (spent resins, spent filter media, spent membranes, and lime sludge) – often at much higher concentrations than that found in the wastewater treatment plant (WWTP) sludge itself.

32 Illinois Administrative Code 330

The Office of Nuclear Safety, within the IEMA-OHS, is mandated to protect Illinois residents from the potentially harmful effects of ionizing radiation. The protection of both public health and the environment from the accumulation and uncontrolled release of radioactive materials is addressed, in part, through 32 Illinois Administrative Code 330 by requiring registration/licensure of radioactive materials. Hereafter, 32 Illinois Administrative Code 330 will be referred to simply as “Part 330”. Note this is the larger set of regulations of which Section 330.40(d) was a subsection.

Treating water or sewage containing naturally occurring radionuclides increases the radionuclide concentrations in the residual streams. These residual streams are called Technologically Enhanced Naturally Occurring Radioactive Materials (TENORM); naturally occurring materials whose radionuclide concentrations or potential for exposure to humans or the environment are enhanced as a result of human activities. When radium-226 and radium-228 are concentrated and, consequently, TENORM is generated under the circumstances above, it falls under the scope of oversight and regulation of Part 622. In the absence of Part 622, there is no quantity or concentration of radium-226 or radium-228 that is excluded from regulation and ultimately, licensure through Part 330.

32 Illinois Administrative Code 330.40(d) – (Replaced by 32 Illinois Administrative Code 622)

Before being replaced by Part 622, Section 330.40(d) provided exemption criteria for those entities possessing, generating, storing, or transporting water or wastewater treatment residuals with technologically enhanced radium-226 and radium-228 (Note – Section 330.40(d) is currently in the process of being abolished). Residuals produced through the treatment of drinking water or wastewater that contained less than or equal to 200 picocuries/gram (dry weight basis or “DWB”) were exempt from the licensing requirements otherwise imposed by Part 330. Section 330.40(d) specified conditions for disposal, transport, sampling, and reporting of these treatment residuals that

had to be followed in order to demonstrate compliance and remain an exempt entity. In addition to serving as regulatory relief from licensure, Section 330.40(d) was also designed to prevent the accumulation of radium-226 and radium-228 in the environment to levels that could cause worker exposure issues and/or potentially impact the future use of contaminated properties or land application sites. As such, Section 330.40(d) detailed specific requirements on the disposal of treatment residuals containing combined radium (the sum of radium-226 and radium-228).

32 Illinois Administrative Code 622

Part 622 was promulgated as a result of issues identified by IEMA-OHS since the implementation of Section 330.40(d). Through its collection of data from water treatment facilities and discussions with stakeholders, IEMA-OHS has identified the need for worker protection and training due to residuals having higher levels of radioactivity than originally anticipated. Part 622 outlines the registration requirements, establishes a framework for determining water treatment residual disposal options, provides requirements for worker protection including signage and criteria for training programs, outlines radon monitoring requirements, and allows for the exemption from licensing previously provided for in Part 330.40(d). In addition, IEMA-OHS has eliminated reporting and sampling requirements that are duplicative of other State agency requirements.

Applicable Statutes and Regulations

Several regulating authorities have statutory responsibility regarding the disposal of treatment residuals as they pertain to contaminant levels, site runoff, groundwater contamination, vector attraction, setbacks, and waste classification. Treated water pH, total dissolved solids (TDS), total suspended solids (TSS), and heavy metal concentrations in the waste stream can also limit disposal options. Analogous to the metals loadings and restrictions placed on land application by the IEPA and the USEPA, IEMA-OHS has a regulatory requirement to track and limit the amount of combined radium accumulated in the environment.

IV. Guidance Document Information

The regulations discussed in this guidance set the minimum standards by which registrants must operate. WWTPs (by virtue of pretreatment standards) and municipalities have the authority to set more stringent standards. Local treatment and landfill disposal requirements may be stricter and significantly more complex than those presented in this guide. Persons producing or possessing treatment residuals containing radium are reminded to check with IEPA, IEMA-OHS, and receiving WWTPs before proceeding with treatment installation or modification and waste disposal processes to ensure they are meeting all relevant Federal, State, and local requirements.

The remainder of this guidance is dedicated to assisting the regulated community in reaching compliance with the provisions of this Part. For ease of use, Section VI of this document provides text from Part 622 followed by any applicable guidance information. To make it easily distinguishable, guidance information is contained within text boxes. Some Sections or sub-sections

of Part 622 may not require additional explanation, and therefore may not be followed by guidance information. If you have questions or concerns over Part 622, or this guidance, please contact the Agency for clarification. The Agency intends to maintain this guidance as a fluid document, updating information as the need arises. If multiple questions or concerns over a particular area of the rule or guidance are received, the Agency will make every reasonable effort to clarify the information contained in this guidance or amend the rule when necessary.

V. Guidance

Section 622.10 Purpose and Scope

This Part establishes requirements for the possession and disposal of water treatment residuals including requirements for worker protection and training. This Part applies to all entities that produce or possess water treatment residuals.

Section 622.20 Definitions

The following terms found in this Part have the definitions set forth in this Section:

"Agency" means the Illinois Emergency Management Agency and Office of Homeland Security.

"As low as is reasonably achievable" or "ALARA" means making every reasonable effort to maintain exposures to radiation as far below the dose limits of Sections 622.30 and 622.40 as is practical, consistent with the purpose for which the registered activity is undertaken, taking into account the state of technology and the economics of improvements in relation to the state of technology, the economics of improvements in relation to benefits to public health and safety and other societal and socioeconomic considerations, and to the use of nuclear energy and licensed or registered sources of radiation in the public interest.

"Combined Radium" means the sum of the results of the analysis for radium-226 and the analysis for radium-228.

"Curie" or "Ci" is as defined in 32 Ill. Adm. Code 310.20.

"Dry weight basis" is as defined in 32 Ill. Adm. Code 310.20.

"Groundwater" means underground water which occurs within the saturated zone and geologic materials where the fluid pressure in the pore space is equal to or greater than atmospheric pressure. [415 ILCS 5/3.210]

"IEPA" means the Illinois Environmental Protection Agency.

"Low-level radioactive waste" means the definition contained in Section 3 of the Low Level Radioactive Waste Management Act [420 ILCS 20].

"Naturally occurring radioactive material" or "NORM" means materials that are undisturbed as a result of human activities and that contain any of the primordial radionuclides or radioactive elements as they occur in nature, such as radium, uranium, thorium, potassium, and their radioactive decay products. NORM does not include accelerator-produced, byproduct, source, or special nuclear material.

"Occupied" means any frequently occupied areas, including but not limited to offices, conference rooms, and breakrooms, as well as restricted areas when entered by workers. "Occupied" does not include infrequently used areas such as storage rooms, stairwells, restrooms, utility closets, elevator shafts, or hallways unless posted as a restricted area.

"Picocurie" or "pCi" means the quantity of radioactive material producing 2.22 nuclear transformations per minute.

"Person" means any individual, corporation, partnership, firm, association, trust, estate, public or private institution, group, agency, political subdivision of this State, any other State or political subdivision or agency thereof, and any legal successor, representative, agent, or agency of the foregoing, other than the United States Nuclear Regulatory Commission, or any successor thereto, and other than federal government agencies licensed by the United States Nuclear Regulatory Commission, or any successor thereto. "Person" also includes a federal entity (and its contractors) if the federal entity agrees to be regulated by the State or as otherwise allowed under federal law. [420 ILCS 40/4(e)]

"Publicly regulated treatment works" means private companies that the Illinois Commerce Commission regulates as public utilities engaged in the disposal of domestic and industrial wastes.

"Publicly owned treatment works" or "POTW" is as defined in Subpart A of 35 Ill. Adm. Code 310.

"Registrant" means persons who, due to the nature of the water treatment residuals they produce or possess, have additional regulatory requirements under this Part.

"Rem" means the special unit of any of the quantities expressed as dose equivalent. The dose equivalent in rem is equal to the absorbed dose in rad multiplied by the quality factor (1 rem = 0.01 Sv).

"Sludge" means any solid, semisolid, or liquid waste generated from a municipal, commercial, or industrial wastewater treatment plant, water supply treatment plant,

or air pollution control facility or any other such waste having similar characteristics and effects. [415 ILCS 5/3.465]

"Technologically enhanced naturally occurring radioactive material" or "TENORM" means naturally occurring radioactive material whose radionuclide concentrations are increased by or as a result of past or present human practices. TENORM does not include background radiation or the natural radioactivity of rocks or soils. TENORM does not include "source material" and "by-product material" as both are defined in the Atomic Energy Act of 1954 (42 U.S.C. 2011 et seq.), as amended, and relevant regulations implemented by the NRC.

"Total effective dose equivalent" or "TEDE" means the sum of the deep dose equivalent for external exposures and the committed effective dose equivalent for internal exposures.

"Treatment" means, for purposes of water treatment residuals only, any process that changes the physical, chemical, microbiological, or radiological properties of water, is under the control of the supplier, and is not a point-of-use treatment device or a point-of-entry treatment device as defined in 35 Ill. Adm. Code 611.101. Treatment includes, but is not limited to, aeration, coagulation, sedimentation, filtration, activated carbon treatment, disinfection, and fluoridation.

"USEPA" means the United States Environmental Protection Agency.

"Wastewater" means sewage, industrial waste, or other waste, or any combination of these, whether treated or untreated, plus any admixed land runoff.

"Wastewater treatment facility" means a treatment works owned by a municipality, sanitary district, county, or State agency that treats domestic and industrial wastes collected by a publicly owned or regulated sewer system. For the purposes of this Part, "wastewater treatment facility" encompasses both publicly owned treatment works and publicly regulated treatment works.

"Water treatment facility" means a plant or facility whose primary function is to treat raw water and to produce potable water for distribution, together with all the other real and personal property reasonably necessary to collect, treat, or distribute the water.

"Water treatment residuals" or "WRS" means biosolids, sludge, filter media, anthracite, scales, or other solids, either alone or as a component of liquid mixtures or solutions, that are technologically enhanced in combined radium concentration (radium-226, radium-228 or associated progeny) as a result of the treatment of water or sewage containing naturally occurring radium from groundwater.

"Working level" or "WL" means any combination of short-lived radon daughters in 1 liter of air that will result in the ultimate emission of 1.3×10^5 MeV of potential alpha particle energy. The short-lived radon daughters are for:

radon-222: polonium-218, lead-214, bismuth-214 and polonium-214; and

radon-220: polonium-216, lead-212, bismuth-212 and polonium-212.

"Working level month" or "WLM" means an exposure to 1 working level (WL) for 170 hours. (2,000 working hours per year divided by 12 months per year is approximately equal to 170 hours per month.)

Section 622.30 Persons in Possession of Water Treatment Residuals

- a) The following persons shall register with the Agency within 60 days of producing or possessing water treatment residuals:
 - 1) Water treatment facilities permitted by the IEPA that treat groundwater with a treatment technology identified in subsections (a)(2)(B).

AGENCY NOTE: Persons who possess groundwater wells only as an emergency or backup source (i.e., a primary source of purchased or surface water) do not meet the registration requirements in subsection (a)(1) or (a)(2).

- 2) Water treatment facilities permitted by IEPA whose groundwater sources and utilized treatment technologies are identified in subsections (a)(2)(A) and (B):
 - A) Table 1. Aquifers designated to contribute elevated concentrations of radium to groundwater:
 - i) Cambrian
 - ii) Ordovician
 - iii) Devonian
 - iv) Silurian
 - v) Any other aquifer that gives rise to a maximum contaminant level for combined radium as specified in 35 Ill. Adm. Code 611.330.

B) Table 2. Treatment Technologies Capable of Concentrating Radium:

- i) Ion exchange
 - ii) Reverse osmosis
 - iii) Lime softening
 - iv) Green sand filtration
 - v) Co-precipitation with Barium sulfate
 - vi) Electrodialysis/electrodialysis reversal
 - vii) Pre-formed hydrous manganese oxide filtration
 - viii) Activated alumina
 - ix) Enhanced coagulation filtration
 - x) Any other treatment technology that increases the combined radium concentration in the media or resulting water treatment residuals beyond that which is naturally present.
- 3) Wastewater treatment facilities permitted by IEPA and receiving treatment process backwash from a water treatment facility described in subsection (a)(2).
- 4) IEPA-permitted municipal solid waste landfills if the water treatment residuals generated by a registrant identified in subsections (a)(1), (a)(2), or (a)(3) are disposed of in those landfills;
- 5) Land applicators permitted by IEPA who apply water treatment residuals generated by a registrant identified in subsections (a)(2) or (a)(3); and
- 6) Any other person that the Agency determines is required to register.

In order for a generator, applicator, or recipient of treatment residuals containing radium to be exempt from the licensing they must register directly with IEMA-OHS as specified in Section 622.30. There is no fee associated with registration under Part 622.

622.30 a)

Do you need to register?

The flow chart below is provided to assist drinking water treatment facilities, or CWSs, in determining if they are subject to the provisions of Section 622.30. Once a CWS has determined their need to register, those “downstream” from the resulting waste stream or those who receive and handle treatment residuals (WWTPs, land applicators, landfills, etc.) can determine their need to register as well.

Wastewater Treatment Plant (WWTP):

If a wastewater treatment facility receives a waste stream from a CWS designated in 622.30(a)(2), the wastewater facility must register with IEMA-OHS and is subject to the provisions of Part 622. Regardless of originating facility, if a WWTP has proven through laboratory analysis that they possess residuals in excess of 3.1 pCi/g, they are required to register with the Agency.

IEPA Permitted Landfills:

Owners and operators of IEPA permitted municipal solid waste landfills who receive water treatment residuals generated by a registrant identified in subsections (a)(1), (a)(2) or (a)(3) must register with IEMA-OHS and are subject to the provisions of Part 622. Generally speaking, if the landfill accepts treatment residuals from a generator identified in Subsection 622.30, the landfill is also required to register.

Land Applicators of Treatment Residuals:

Land applicators permitted by IEPA who apply water treatment residuals generated by a registrant identified in 622.30(a)(2) or (a)(3) must register with IEMA-OHS and are subject to the provisions of Part 622.

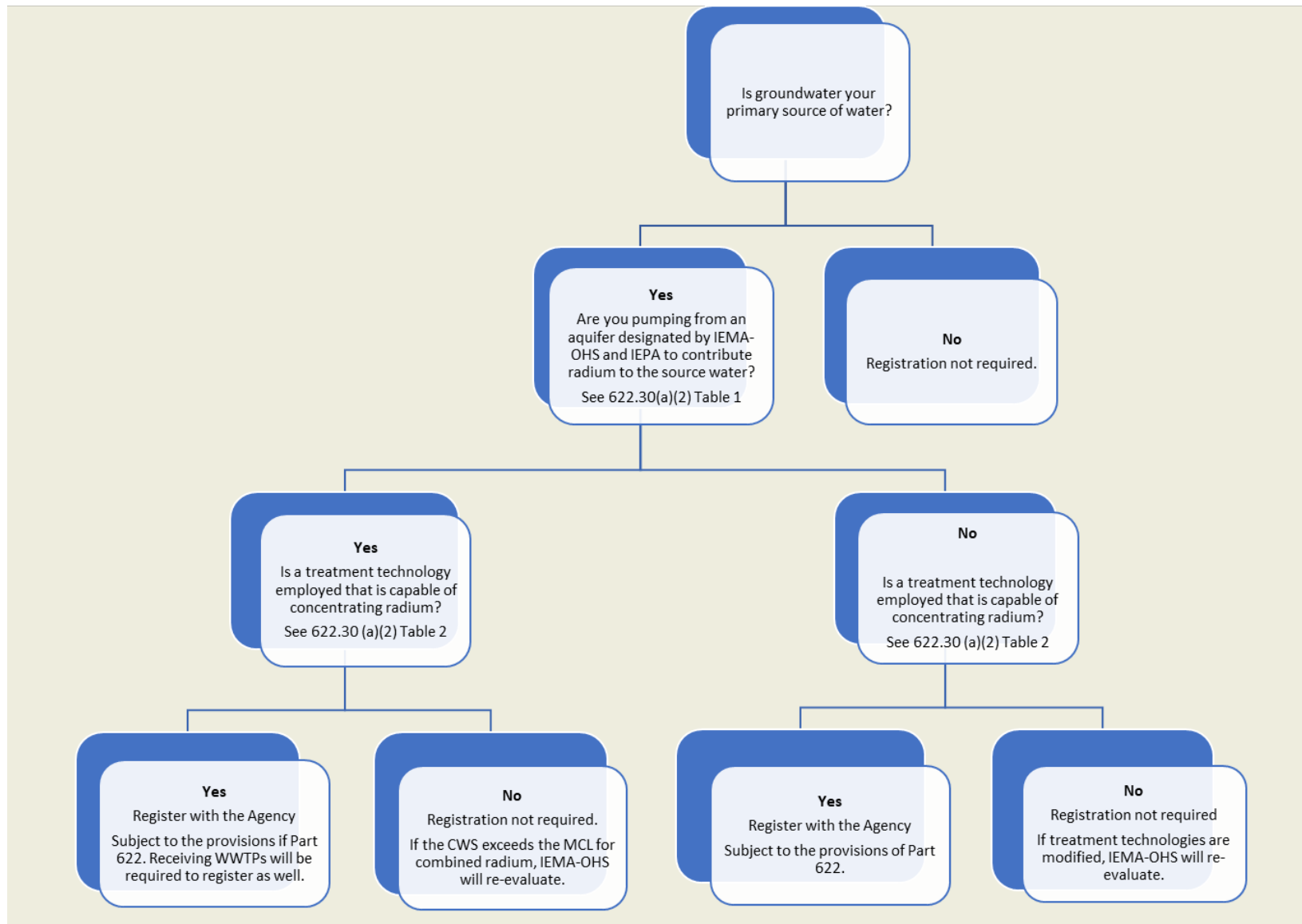
Others:

Additional persons may be required to register and comply with the provisions of Part 622 should it be determined that they produce or are in possession of residuals or sludges resulting from the treatment of water or sewage containing radium occurring naturally from groundwater.

How do I register?

Persons that have previously registered with the Agency under 32 Illinois Administrative Code 330.40(d) are not required to re-register under Part 622. Since the vast majority of persons required to register have previously done so, there will likely be a limited number of persons seeking to register under Part 622. If a facility needs to register or has a question about their registration status, please contact the Agency. If registration is required, Agency staff will collect the necessary information and complete the registration process for you. As mentioned previously, there are no fees associated with becoming a registrant.

622.30 a)



- b) Registrants in compliance with Section 622.30 who elect to dispose of water treatment residuals at a licensed low-level radioactive waste disposal facility will be exempted by the addition of Section 622.30(m).

Subsection (b) allows for the exemption from licensing provided that they remain compliant with the provisions of this Part. Persons or entities failing to register, as required by this subsection, will be deemed non-exempt from the licensure and fee requirements of the Radiation Protection Act of 1990 [420 ILCS 40] and 32 Ill. Adm. Code 330 and 331.

622.30 b)

- c) Registrants may dispose or repurpose water treatment residuals under the provisions of this subsection (c) and the requirements of Title 35 of the Illinois Administrative Code, Subtitles C and G, as implemented by IEPA:

Subsection (c) outlines the disposal options available to a registrant. The combined concentration of radium in the waste stream and the type of waste produced (solid or liquid), dictate which disposal options are available for disposal. Each disposal option is addressed individually in this section.

622.30 c)

- 1) If the concentration of combined radium in the water treatment residuals is greater than 3.1 pCi/g and less than or equal to 100 pCi/g (dry weight basis), water treatment residuals may be:

AGENCY NOTE: Water treatment residuals with a combined radium concentration less than or equal to 3.1 pCi/g (dry weight basis) are not subject to the disposal requirements in this Section. However, registrants must maintain records of the combined radium concentration and the location where the material was disposed of.

- A) Disposed at a facility authorized to receive such material under any federal or State solid or hazardous waste laws provided:

- i) Combined radium concentration in pCi/g (dry weight basis) has been determined by a laboratory meeting the accreditation requirements in subsection (e)(1) with methods approved by the USEPA in Title 40 of the Code of Federal Regulations or by a screening method approved by the Agency in accordance with subsections (c)(1)(A)(ii);

Analytical methods approved by the Agency can be found in Appendix D of this document.

622.30 c) 1) A) i)

There are currently no screening methods approved by the Agency. As screening methods are approved, this guidance document will be updated with information pertaining to the approved screening method.

622.30 c) 1) A) i)

- ii) A registrant may apply to the Agency for approval to use a screening method instead of laboratory analysis to determine the combined radium concentration of water treatment residuals. Each application shall include: a description of the water treatment residuals being screened, including the physical and chemical properties of the material; a description of the proposed screening method including instruments or equipment to be used, calculations performed, and procedures for how a representative combined radium concentration can be obtained; and analyses and procedures to ensure that doses are maintained ALARA and within the dose limits in this Section;
- iii) Water treatment residuals transported in compliance with the Illinois Vehicle Code [625 ILCS 5/15-109];
- iv) Water treatment residuals that are easily dispersible are packaged or stabilized to prevent dispersion during transportation and/or landfill placement; and

- v) There is at least 10 feet of non-contaminated overburden between the water treatment residuals and grade level (at the time of landfill closure).

Generators of treatment residuals should be aware that waste disposal facility owners can refuse to accept any waste and have the discretion to return any waste to the generator. As facilities become more aware of issues surrounding disposal of radioactive materials, many are now using monitors to scan incoming trucks for radiation. In some cases, wastes that had previously been accepted were found to contain elevated levels of TENORM. If the monitors are triggered, the source must be identified and evaluated. Communications with the disposal facility prior to shipment of residuals is advisable.

Identifying the appropriate landfill:

Solid waste landfills:

Municipal solid waste landfills (MSWLF) may have restrictions on the amount of radioactivity they accept. Their ability to accept specific wastes should therefore be verified. These landfills may accept non-hazardous, solid, and TENORM wastes from all water systems, and hazardous waste from Conditionally Exempt Small Quantity Generators (see the MSWLF requirements at 40 CFR 258). Industrial solid waste landfills may also accept non-hazardous solid TENORM waste and may be better equipped to handle such waste as it is more like the waste that industrial landfills typically handle (e.g., sludges and ash). A list of municipal solid waste landfills (for non-hazardous waste) can be found at <https://epa.illinois.gov/topics/waste-management/landfills/landfill-capacity.html>.

Hazardous waste landfills:

Systems using treatment technologies that remove contaminants such as arsenic, in addition to radionuclides, could potentially generate hazardous waste. Hazardous waste from Large and Small Quantity Generators must meet RCRA Land Disposal Restriction treatment standards (40 CFR 268.40) prior to disposal in a hazardous waste landfill. Facilities permitted under Subtitle C may accept hazardous waste (though not mixed waste) from all generator classes and vary in their ability to accept treatment residuals containing radium. If hazardous residuals contain source material above 0.05% in weight or other Atomic Energy Act (AEA) materials, they must be disposed of at a facility authorized to accept mixed waste.

If RCRA contaminants are found in concentrations that dictate hazardous waste disposal, contact the IEPA for further instruction.

622.30 c) 1) A)

Testing for free liquids:

Generators must ensure that the treatment residuals they are disposing of meet IEPA disposal requirements. Systems must perform the Paint Filter Liquids Test (or PFLT; EPA SW 846 Method 9095B) to determine if the waste contains any “free liquids” because solid waste landfills cannot accept waste that contains free liquids. If free liquids are present, the system will need to employ an intermediate processing method and determine an appropriate method of disposal for the liquid residuals generated by dewatering.

622.30 c) 1) A)

- B) Used for soil conditioning purposes on agricultural cropland (e.g., corn, soybeans) provided:
 - i) Land application is performed in accordance with and under the authorization of a current IEPA land application permit;
 - ii) Water treatment residuals are transported in compliance with the Illinois Vehicle Code [625 ILCS 5/15-109];
 - iii) The combined radium concentration of the water treatment residuals (in pCi/g, dry weight basis) has been determined by a laboratory meeting the accreditation standards in subsection (e)(1) with methods approved by the USEPA in Title 40 of the Code of Federal Regulations or by a screening method approved by the Agency in accordance with subsection (c)(1)(B)(iv);

Analytical methods approved by the Agency can be found in Appendix D of this document.

622.30 c) 1) B) iii)

There are currently no screening methods approved by the Agency. As screening methods are approved, this guidance document will be updated with information pertaining to the approved screening method.

622.30 c) 1) B) iii)

- iv) A registrant may apply to the Agency for approval to use a screening method instead of laboratory analysis to determine the combined radium concentration of water treatment

residuals. Each application shall include: a description of the water treatment residuals being screened, including the physical and chemical properties of the material; a description of the proposed screening method including instruments or equipment to be used, calculations performed, and procedures for how a representative combined radium concentration can be obtained; and analyses and procedures to ensure that doses are maintained ALARA and within the dose limits in Section 622.30.

- v) Water treatment residuals shall be incorporated in accordance with the registrant's land application permit. All water treatment residuals applied to land for soil conditioning purposes under this subsection (c)(1)(B)(v) shall be mixed with soil such that the limits specified in items (vi) and (viii) are not exceeded;
- vi) The concentration of combined radium in the water treatment residuals and the application rate is such that, after the water treatment residuals are mixed with soil, the cumulative increase of the combined radium concentration in the soil does not exceed 1.0 pCi/g (compliance with this Section shall be calculated as an addition of 1778 microcuries per acre, dry weight basis);

Due to the fact radium is not very mobile in the soil profile or in the uptake of plants (except tobacco), the concentrations in the soil do not diminish well over time. Therefore, the Agency has placed a cumulative increase limit of the combined radium concentration in the soil from all applicators and applications at 1.0 pCi/g. Once a field has reached a maximum of 1.0 pCi/g increase in combined radium concentration, an alternative source of fertilization will have to be utilized.

Example - The background (natural) combined radium concentration in the soil of a field that will receive water treatment residuals is determined to be 1.9 pCi/g. After several years of water treatment residual applications and calculating the increase, it is determined that the field's combined radium concentration is now 2.9 pCi/g. Due to the application of the maximum 1.0 pCi/g of combined radium, no additional applications of biosolids generated by a registrant under 622.30 can be made to this piece of land. Additional sampling can be performed to verify the increase, or to determine if applications can resume.

622.30 c) 1) B) vi)

- vii) This increased limit applies to the sum of all land applications of water treatment residuals on a specific tax parcel of land;

The registrant is responsible for tracking the applications of water treatment residuals, and the subsequent accumulation of radium in the soil. It is the responsibility of the registrant to ensure that all applications to a given field are accounted for, including applications from other applicators or facilities. Discussions with landowners and coordination with other facilities may be necessary to meet this requirement.

622.30 c) 1) B) vii)

- viii) At no time shall the application of water treatment residuals result in the combined radium concentration in the soil exceeding 3.1 pCi/g (the mean natural background as determined by the Agency of 2.1 pCi/g and the soil concentration increase limit of 1.0 pCi/g due to water treatment residuals application);

Through soil sample collection and analytical testing throughout the state, the mean natural combined radium “background” concentration for the state has been determined by the Agency to be 2.1 pCi/g. A soil concentration increase limit of 1.0 pCi/g due to water treatment residuals application sets the ceiling for combined radium concentration in soil at 3.1 pCi/g.

Regardless of the background radium content in a particular field, the ceiling for combined radium concentration in the soil is set at 3.1 pCi/g. In other words, if the background soil concentration of combined radium is determined through sampling to be greater than the state average of 2.1 pCi/g, the cumulative increase of 1.0 pCi/g allowed in subsection (v) would no longer apply.

622.30 c) 1) B) viii)

Example #1:

The background combined radium concentration in your field's soil is determined to be 2.5 pCi/g. The total additional accumulation that would be permitted through the application of residuals would be 0.6 pCi/g, at which point the ceiling concentration of 3.1 pCi/g would be met. Additional sampling can be performed to verify the total concentration in the field, or to determine if applications can resume.

622.30 c) 1) B) viii)

Example #2:

The background combined radium concentration in your field's soil is determined to be 3.2 pCi/g. Since the field has a natural combined radium concentration above the 3.1 pCi/g ceiling, residuals would not be permitted to be applied to this field.

Field radium concentrations cannot be managed on an individual composite result basis. The resulting patchwork of eligible ground would greatly reduce, if not eliminate, land applications to that parcel. For that reason, averaging can be used to determine the overall concentration of radium in pCi/g for a field. Some results may be slightly over 3.1 pCi/g. It is important to note, at this point, that when soil reaches 5 pCi/g above background the site may fall under USEPA CERCLA cleanup standards and require site remediation. The reasons above dictate that once a field has an overall average of 3.1 pCi/g, land application of radium-laden water treatment residuals is prohibited. This prevents 'hot spots' from developing in fields which may impact ground use, market value, and clean up actions.

622.30 c) 1) B) viii)

- ix) The landowner or an authorized agent of the landowner must acknowledge awareness that water treatment residuals are being applied to the land (this acknowledgement must be updated as landownership changes). The acknowledgement shall contain, at a minimum, the language provided in 622.APPENDIX A;

Section 622.30 requires that the landowner or an authorized agent must acknowledge that they are aware that treatment residuals containing radium are being applied to their land. This form is available as an Addendum to this guidance and as Appendix A to Part 622. If an alternative form is used, it must contain the language provide in the Agency provided Form. The landowner acknowledgement is specific to the application of treatment residuals containing radium and is in addition to any notification forms currently required under separate regulations. Additionally, 35 Illinois Administrative Code 391 releases generators or applicators from notifying landowners in contractual situations – there is no such release of notification requirements in Section 622.30. This acknowledgement must be completed prior to the application of water treatment residuals and must be updated as land ownership changes.

622.30 c) 1) B) ix)

- x) Before using a parcel of land for the application of water treatment residuals for the first time, the registrant must determine the combined radium concentration in the soil;
- xi) Soil sample collection shall be conducted to be representative of the entire water treatment residual application site at a depth of 12 inches and may be submitted for analysis as a single composite sample;
- xii) Land receiving application of water treatment residuals shall not be used for the cultivation of tobacco; and

Due to the documented propensity of tobacco to uptake radium-226 in the plant leaf and the resulting exposure pathway to man, the cultivation of tobacco plants on fields receiving land applications of treatment residuals containing radium is prohibited.

622.30 c) 1) B) xii)

- xiii) When calculating the increase in combined radium concentration, a soil density value of 90 pounds/cubic foot and a mixing depth of 1 foot shall be used unless the registrant is utilizing site-specific soil density values. Corrections to the cumulative increase of combined radium may be adjusted for the decay of radium-228.

The following sample calculations are an adaption from 35 Illinois Administrative Code 391 appendices; additional sample calculations can be found in Appendix D and E. Assumptions afforded by IEPA for loading rates of metals and land application rates are, likewise, afforded by IEMA-OHS: (density of dry weight sludge = density of water) and are reflected in the example calculations below:

$$\text{Increase in Soil Radium Concentration} = \text{Total (pCi) Applied per Acre (DWB)} \\ (1,778,293,440 \text{ grams soil/acre} + \text{Grams of Sludge Applied per Acre})$$

622.30 c) 1) B) xiii)

If an additional sludge mass with non-technologically enhanced concentrations of radium is used to, effectively, dilute the concentration of radium in the treatment residuals; there would be a corresponding increase in overall volume. Due to the fact the number of dry or wet tons applied per acre is still limited by agronomic usage, there is a corresponding decrease in the amount of radium applied per acre.

A field receiving the land application of treatment residuals containing radium is ultimately limited by a maximum of 1778 microCuries of combined radium per acre. For the purposes of compliance with Section 622.30, the lifetime maximum 1778 microCuries of combined radium per acre can be applied as 19.6 tons (17,780,000 grams) at 100 pCi/g or 196 tons at 10 pCi/g.

IEMA-OHS does not advocate the blending of sludges to afford a generator land application of a treatment residual with an initial concentration above 100 pCi/g (DWB). However, due to common practice of aggregate application from multiple generators, this scenario may arrive by consequence. If the combined radium applied per acre is calculated and tracked in accordance with Section 622.30, the environmental deposition of combined radium is maintained within regulatory limits.

622.30 c) 1) B) xiii)

Grams of Soil per Acre

$$\begin{array}{lclclcl} 43,560 \text{ ft}^2/\text{acre} & \times & 1 \text{ Foot Mixing Depth} & \times & 90 \text{ lbs}/\text{ft}^3 & \\ (\text{Density of Soil}) & \times & 453.60 \text{ grams}/\text{lb} = & & 1,778,293,440 \text{ grams soil}/\text{acre} & \end{array}$$

* IEMA-OHS notes the inconsistency in significant figures above and displays contributing variables only to show the derivation of the constant to be used in calculations:
1,778,293,440 grams soil/acre .

Grams of Sludge Applied per Acre***

Wet Basis:

$$\begin{array}{lclclcl} \text{Gallons Sludge Applied per Acre} & \times & \text{DE}^{**} & \times & 8.345 \text{ lbs}/\text{gallon (Assumed)} & \\ \text{density of sludge)} & \times & 453.60 \text{ grams}/\text{lb} = & & \text{Dry grams of Sludge Applied} & \\ \text{per Acre} & & & & & \end{array}$$

Dry Basis:

$$\begin{array}{lclclcl} \text{Dry Tons Applied per Acre} & \times & 2000 \text{ lbs}/\text{ton} & \times & 453.60 \text{ grams}/\text{lb} & \\ \text{Dry grams of Sludge Applied per Acre} & & & & & \end{array}$$

Total pCi (pCi) Applied per Acre (DWB)

$$\begin{array}{lcl} \text{Ra226 pCi/g} + \text{Ra228 pCi/g from Composite Sludge Result (DWB)} & \times & \text{Dry grams of} \\ \text{Sludge Applied per Acre (obtained from above)} & = & \text{Total pCi Applied per Acre (DWB)} \end{array}$$

* If it is necessary to convert laboratory results from a wet basis to a dry basis, see Section III.C of 35 IAC 391, Appendix D

** DE = Decimal Equivalent. The total % Solids divided by 100. (i.e., 5% total solids = 0.05 DE)

*** The intent of the formula above was to arrive at a number of “grams of sludge applied per acre” based upon the dry weight of the sludge in which the technologically enhanced radium is distributed. If a land applicator or generator wishes to instead use the cumulative dry weight of all sludges applied per acre (“Grams of Sludge Applied per Acre” in the denominator of the formula is calculated from all the sludge applied to the field not just the sludge with technologically enhanced levels of radium), the overall concentration of combined radium would be reduced. IEMA-OHS has considered two factors that indicate either method of calculation is acceptable:

622.30 c) 1) B) xiii)

- C) Disposed by release into sanitary sewerage.

The material must be readily soluble, or a readily dispersible biological material in water.

622.30 c) 1) C)

- D) Disposed using an alternative method approved by the Agency before disposal, under 32 Ill. Adm. Code 340.1020.
- 2) If the concentration of combined radium in the water treatment residuals is greater than 100 pCi/g (dry weight basis) and less than or equal to 200 pCi/g (dry weight basis), water treatment residuals may be disposed of:
 - A) Using an alternative method approved by the Agency before disposal, under 32 Ill. Adm. Code 340.1020;
 - B) In an IEPA-permitted facility authorized to receive such material. Disposals shall:
 - i) Be reviewed and approved by the Agency in advance.
 - ii) Comply with all requirements in subsection (c)(1)(A).

Testing for free liquids:

Generators must ensure that the treatment residuals they are disposing of meet IEPA disposal requirements. Systems must perform the Paint Filter Liquids Test (or PFLT; EPA SW 846 Method 9095) to determine if the waste contains any “free liquids” because solid waste landfills cannot accept waste that contains free liquids. If free liquids are present, the system will need to employ an intermediate processing method and determine an appropriate method of disposal for the liquid residuals generated by dewatering.

622.30 c) 2)

- C) By release into sanitary sewerage.

The material must be readily soluble, or a readily dispersible biological material in water.

622.30 c) 2) C)

- D) At a facility authorized to dispose of such material under any federal or State solid or hazardous waste laws as long as the registrant ensures compliance with 32 Ill. Adm. Code 340.1060, as applicable.

A generator may elect to have the residuals disposed of at a facility licensed or permitted to accept low-level radioactive waste or TENORM; however, they are then subject to the registration requirements specified in Section 4 and the fees specified in Section 13 of the Illinois Low Level Radioactive Waste Management Act [420 ILCS 20/13], as well as the reporting requirements of 32 Illinois Administrative Code 609 and 620.

622.30 c) 2) D)

While most liquid wastes (including acid neutralization water, backwash water, brine, concentrate, and rinse water) are discharged to a WWTP; systems may want to evaluate if this is the most economical course of action given the impact to solid waste residuals. In determining compliance with Part 622, systems should keep in mind that the characteristics and contaminant concentrations of the residuals will help to define a system's disposal options. To a limited extent, these characteristics can be influenced by the operation of the facility. The characteristics and contaminant concentrations will vary according to:

- The concentration of radionuclides in the source water (sometimes varies with pumping demand and co-contaminant concentrations)
- Frequency of resin/media/membrane replacement
- How efficient the treatment is at removing radionuclides
- Loading to the treatment unit
- Frequency of regeneration (for ion exchange and activated alumina)
- Frequency of filter backwash (for treatment processes using granular media filters)

Although not required, facilities may want to evaluate if the variables above are able to be manipulated or managed. This evaluation may provide more cost-effective solutions for facilities that produce treatment residuals with very high concentrations of combined radium.

622.30 c)

- d) Registrants identified in subsection (a)(2), which requires workers, contractors, or other persons to come into contact with water treatment residuals during routine and maintenance work shall sample the residuals and receive results before the next scheduled service, or as soon as practicable for emergency work, to determine compliance under this Section and Section 622.40 and to identify potential worker exposure concerns.
- e) All analysis of water treatment residuals shall be conducted:
 - 1) By a laboratory certified to perform radiological analysis by the U.S. Environmental Protection Agency, the International Organization of Standardization (ISO 17025- general requirements for the competence of testing and calibration laboratories), or the National Environmental Laboratory Accreditation Conference (NELAC). The combined radium concentration will be determined by a method approved by the Agency.

Approved analytical methods are listed and will be maintained in Appendix D of this Guidance document. If a registrant believes that an analytical method is available that should be approved for use, please reach out to the Agency to evaluate its addition to the list of approved methods.

622.30 e)1)

The laboratory contracted to perform analyses should be contacted in advance to determine sample turn-around times, minimum sample size, sample preparation, and storage requirements.

Laboratory analyses are reported on either a wet weight basis or on a dry weight basis. Radium-226 and radium-228 are expressed in units of activity, commonly picocuries (Curies, Ci, are the actual unit and the pico- prefix gives an appropriate whole number for measurements at or near environmentally encountered levels.). Be aware that some laboratories report results on an "as-received" basis. Registrants should consult the laboratory to confirm whether the results are being reported on a wet or dry basis. At environmental levels, the units for a wet weight basis are, typically, picocuries per liter (pCi/L - activity per volume). The units for a dry weight basis are picocuries per gram of solids (picocuries/gram – pCi/g).

If the need arises to convert results from wet to dry basis, conversion relationships are provided below and in 35 Illinois Administrative Code 391. Appendix D. The Agency allows for the assumption that the specific gravity of liquid and most dry sludges to be 1.0 (equal to water).

The decimal equivalent (DE) of the percent Total Solids (TS) equals the percentage divided by 100.

$$\frac{\% \text{ TS}}{100} = \text{DE of Total Solids}$$

$$\text{Example: } \frac{5\% \text{ TS}}{100} = 0.05 \text{ DE}$$

Wet Weight to Dry Weight Basis

$$\frac{\text{pCi/L}}{\text{DE}} = \text{pCi/g (dry weight basis)}$$

$$\text{Example: } \frac{0.88 \text{ pCi/L Ra}^{226} + 0.07 \text{ pCi/L Ra}^{228}}{.05 \text{ DE}} = 19 \text{ pCi/g combined radium (DWB)}$$

622.30 e) 1)

- 2) At a frequency specified in the registrant's IEPA land application permit. If an IEPA permit does not specify a radium sampling frequency, or for landfill or alternative disposals approved by the Agency, sample frequency shall be no less than one representative sample per year.

For landfill or alternative disposal approvals, sample analysis results obtained from samples collected prior to removal and subsequently left in an operating treatment system will require additional investigation into their suitability for these disposal options. Results over one year old will require resampling due to the uncertainty in the amount of additional radium concentrated in the media over that timeframe.

622.30 e) 2)

- 3) Utilizing a sampling methodology that ensures analyses are representative of the water treatment residuals being disposed of or repurposed. The registrant shall:
 - A) Utilize applicable guidance, such as EPA SW-846, American Water Works Association B100, or USEPA's RCRA Waste Sampling Guidance, where procedures for representative sampling are absent (i.e., those for disposal of water treatment resins or filters);
 - B) To the extent practicable, collect samples before removing the water treatment residuals from the treatment system; and
 - C) Ensure composite samples comply with the following requirements:
 - i) Sub-samples comprising a composite shall be drawn from homogenous waste (i.e., process waste that has been shown to be homogenous);
 - ii) If homogeneity cannot be confirmed, then a representative composite sample comprised of six sub-samples shall be taken to determine the average concentration;
 - iii) No single measurement used to calculate an average shall exceed five times the exemption criteria (i.e., 1000 pCi/g); and

- iv) Each waste container is considered a separate waste volume (i.e., two waste volumes cannot be averaged).

The appropriate method for sampling is intentionally not specified, due to the variability in media composition. It is up to the registrant to determine if the media is homogenous or not, and if not, to determine what constitutes a “representative composite sample” for the waste being sampled.

622.30 e)3)C)

To maintain integrity of a filter system, when determining radium concentration of media intended to remain in service or sampling to determine compliance with 622.30 and 622.40, support sand and gravel does not need to be sampled but must be sampled prior to disposal.

622.30 e)3)C)

- f) Nothing in this Section relieves the registrant from complying with all other applicable federal, State and local government regulations governing toxic or hazardous properties of water treatment residuals that are disposed of or repurposed under this Section.

Subsection (f) provides the registrant with a reminder that other federal, state, and local regulations exist that may impact the disposal or repurposing of water treatment residuals, and that this rule does not relieve the registrant from their obligation to comply with all applicable regulations.

622.30 f)

- g) No person producing or possessing water treatment residuals shall cause violations of the requirements of Title 35 of the Illinois Administrative Code, Subtitles C and G, as implemented by the IEPA.
- h) The total effective dose equivalent to workers or individual members of the public from the registrant’s operation shall not exceed 1 millisievert (0.1 rem) in any year, exclusive of the dose contribution from:
 - 1) Background radiation;

- 2) Any medical administration the individual has received;
- 3) Exposure to individuals administered radioactive material and released in accordance with 32 Ill. Adm. Code 335;
- 4) Voluntary participation in medical research programs;
- 5) A radioactive material licensee's disposal of radioactive material into sanitary sewerage under 32 Ill. Adm. Code 340.1030; and
- 6) Radon and its progeny.

The dose limits are based on limits specified in 32 Ill. Adm. Code 340.310 (Dose Limits for Individual Members of the Public).

The registrant shall use, to the extent practicable, procedures and engineering controls based upon sound radiation protection principles to achieve occupational doses and public doses that are as low as is reasonably achievable (ALARA).

Based on the concentration limits applicable to those registered only under 622.30, the quantity of material likely to be on-site at one time, and the limited time that workers or members of the public will be in close proximity to the material, as long as registrants make an effort to keep doses ALARA, there is no expectation that the 1 millisievert (0.1 rem) in any year total effective dose equivalent (TEDE) will be exceeded. Therefore, unless additional information is obtained that leads the registrant or the Agency to believe that TEDE is being approached or exceeded, there is no need for registrants to conduct TEDE calculations. If it is determined that TEDE calculations are necessary, the Agency can assist the registrant in determining the TEDE.

622.30 h)

- i) Registrants shall limit radon exposure to workers.
 - 1) Registrants identified in subsections (a)(1), (a)(2), and (a)(3) shall conduct radon measurements in accordance with 32 Ill. Adm. Code 422 by [date certain], and at least once every five calendar years following the initial testing.

All registrants must conduct initial radon testing. Current registrants must conduct this initial testing within one year of this Part being enacted. New registrants must conduct the initial radon testing within one year of their registration date.

Specific questions regarding radon or radon testing can be directed to the IEMA-OHS Radon Program at (217) 785-9889 or ema.radon.licensing@illinois.gov.

622.30 i) 1)

- A) Measurements shall be conducted immediately before exchanging of exhausted filter media, or if the media is not scheduled to be exchanged during the measurement window, as close to the end of the measurement window as practical to allow for maximum loading of radium onto the filter media.
- B) Radon concentrations shall be retested following the guidance outlined above within a year of any of the following circumstances occurring:

Retesting must be done within 365 days of the event occurrence; it is not based on a calendar year.

622.30 i) 1) B)

- i) A new addition is constructed or alterations for building reconfiguration or rehabilitation occur;
- ii) A ground contact area not previously tested is occupied;
- iii) Treatment technologies capable of concentrating radium are newly installed or altered. Altering treatment technologies does not include activities such as replacing worn-out equipment or filter media while leaving the remainder of the system unchanged;
- iv) A facility begins receiving treatment process backwash from a new (additional) water treatment facility or alterations are made to the treatment technologies at existing facilities that supply treatment process backwash. Alterations to treatment technologies do not include activities such as replacing worn-

out equipment or filter media while leaving the remainder of the system unchanged;

- v) The use of a new or different primary water source drawn from an aquifer designated to contribute elevated concentrations of radium to groundwater;
- vi) Heating or cooling systems are altered with changes to air distribution or pressure relationships;
- vii) Ventilation is altered by extensive weatherization, changes to mechanical systems, or comparable procedures;
- viii) Alterations or renovations resulting in sizable openings are made to the facility's foundation, or flooring or natural settlement occurs causing major cracks to develop; or
- ix) An installed mitigation system is altered or repaired.

AGENCY NOTE: Agency recommends radon mitigation when radon concentrations in routinely occupied areas are found to be greater than 4.0 pCi/L, and recommends considering mitigation for concentrations between 2.0 and 4.0 pCi/L.

- 2) Registrants shall ensure that worker exposure from radon within all occupied areas does not exceed 30 pCi/L or 0.3 WL, based on continuous workplace exposure for 40 hours per week, 52 weeks per year, and shall not exceed 4 WLM over a 12-month period, using an equilibrium ratio of 50 percent to convert radon exposure to WLM.

Equations for use in determining WL and WLM:

- $$WL = \frac{\text{Radon concentration (in } \frac{\text{pCi}}{\text{L}}) \times \text{Equilibrium Ratio}}{100}$$

If the equilibrium ratio is assumed to be 0.5, WL is calculated using the following equation:

$$WL = \frac{\text{Radon concentration (in } \frac{\text{pCi}}{\text{L}})}{200}$$

- $$\text{WLM Exposure} = \frac{WL (\text{Working Level} \times \text{Exposure Time (in Hours)})}{170 (\text{Hours/Month})}$$

622.30 i)2)

- j) Persons producing or possessing water treatment residuals shall not cause contamination of any area exceeding the values specified in Appendix A of 32 Ill. Adm. Code 340.

If contamination of any area in excess of the values specified is discovered, the Agency must be notified in accordance with 622.80. The registrant will provide the Agency with details pertaining to the contamination, the cause of the contamination, the Registrants plan for decontamination, and changes made to operating procedures to ensure that contamination from the same issue does not occur again. Once the decontamination is complete, the Agency will conduct verification surveys and/or sampling to determine compliance.

622.30 j)

- k) For fixed facilities, registrants shall comply with 32 Ill. Adm. Code 340.920(e) and post each area, tank, basin, or room in which an amount of material exceeding ten times the quantity of radium-226 and radium-228 specified in Appendix C to 10 CFR 20, effective January 1, 2004, is used or stored with a conspicuous sign or signs bearing the radiation symbol and the words "CAUTION RADIOACTIVE MATERIALS" or "DANGER RADIOACTIVE MATERIALS". Areas visible to the public may be posted within the confines of the barrier (fencing, hatch, etc.) but must remain visible to workers entering the restricted area;

AGENCY NOTE: The referenced value is 1.0 microcurie. This equates to 5 kg at 200 pCi/g.

Areas or rooms that meet the criteria outlined in 32 Ill. Adm. Code 340.920(e) must be posted regardless of whether they are occupied and the plant's operational status.

Staging water treatment residuals at a land application site prior to application is not considered storage and would not require compliance with the posting requirement.

622.30 k)

- l) Registrants shall comply with 32 Ill. Adm. Code 310.60 through 310.90, the Radon Industry Licensing Act [420 ILCS 44] and 32 Ill. Adm. Code 422.
- m) Registrants in compliance with Section 622.30 are exempt from the requirements of 32 Ill. Adm. Code 340.1060(e).

Section 622.40 Worker Protection and Disposal Requirements for Water Treatment Residuals Greater than 200 pCi/g

- a) This Section only applies to persons producing or possessing water treatment residuals with concentrations of combined radium greater than 200 pCi/g (dry weight basis).

In addition to the requirements of this Section, all requirements of 622.30 apply to persons producing or in possession of water treatment residuals with concentrations of combined radium greater than 200 pCi/g (dry weight basis).

622.40 a)

- b) Persons producing or in possession of water treatment residuals identified in subsection (a) shall:

- 1) Register with the Agency within 60 days of becoming subject to subsection (a) in a format specified by the Agency;

This is a separate registration from the registration requirements found in 622.30 (a). Persons required to register under 622.40 must provide the facility name, IEPA permit number and a copy of the sample results to the Agency via the dedicated water treatment residuals email inbox ema.RadiumResiduals@illinois.gov. The 60-day period begins when the Registrant receives confirmation that they have produced or are in possession of water treatment residuals with a combined radium concentration greater than 200 pCi/g (dry weight basis). Receipt of sample results from the analyzing laboratory shall be considered confirmation.

622.40 b) 1)

- 2) Limit Dose to Workers and Members of the Public. Registrants shall conduct operations so that:
 - A) The dose in any unrestricted area from external sources, exclusive of the dose contributions from patients administered radioactive material and released in accordance with 32 Ill. Adm. Code 335, does not exceed 0.02 millisievert (0.002 rem) in any single hour.
 - A) Before allowing a worker or a member of the public to enter a restricted area, instructions are given on radiation hazards and protective measures to that individual. These instructions must comply with subsection (b)(11).
 - C) Persons entering restricted areas or performing work in contact with water treatment residuals identified in subsection (a) are supplied with appropriate personal protective equipment (PPE). PPE shall include, at a minimum, protective barriers to prevent inadvertent ingestion or inhalation of airborne particles of radioactive material as well as to limit the spread of contamination from the work area.

The level of PPE required will vary depending on the scope of work being conducted. The potential for inadvertent ingestion, inhalation, or spread of contamination should be assessed prior to work in restricted areas or in contact with water treatment residuals. PPE in excess of the minimum requirements can be determined based off of this assessment.

622.40 b) 2) C)

- D) Procedures are in place to ensure doses to workers are kept as low as reasonably achievable and in compliance with this Part. Emergency work that results in work duties or exposures outside the scope of TENORM awareness training provided for workers as outlined in Section 622.50(a) shall be reported to the Agency within 45 days. The report shall include proposed revisions to the registrant's training agenda or operating procedures necessary to maintain compliance with this Part.

AGENCY NOTE: Calculation of doses for compliance with this subsection may be based upon calibrated radiation meter survey data and worker occupancy times, or work area monitoring, rather than an individual worker dosimetry program.

- 3) Employ institutional and engineered controls to limit exposure of water treatment residuals to personnel and the environment.
 - A) If, during the course of operation, noncompliance with the limits specified in subsection (b)(2) is discovered, the registrant shall submit alternative procedures to the Agency within 45 days after discovery.
 - B) Continued inability to comply with the protective limits specified in subsection (b)(2) may result in the Agency requiring the registrant to comply with the specific license requirements in 32 Ill. Adm. Code 330 and additional training required for workers.

Due to the serious nature of continued non-compliance with the worker and public protective limits specified, Registrants who are unable to comply with this requirement will no longer be exempt from licensing and will be required to obtain a specific license from the Agency.

622.40 b) 3) B)

- 4) Afford the Agency, at all reasonable times, the opportunity to inspect sources of radiation and the premises and facilities in which those sources of radiation are used or stored, and records maintained under this Section.

Inspection procedures are currently being created. As information pertaining to inspection frequency or other general inspection details become available, they will be added to this guidance document.

622.40 b) 4)

- 5) Perform radiation surveys to demonstrate compliance with this Section. Surveys shall be done to evaluate:

- A) Gamma radiation exposure rate in all occupied areas, at a minimum, of once per year;

All occupied areas include office areas, break areas, conference rooms, etc.

622.40 b) 5) A)

- B) Gamma radiation exposure rate in restricted areas before, during, and after work requiring entry; and
- C) Potential contamination of workers and the work area immediately following work in restricted areas.

In order to meet the contamination guidelines established in 32 Illinois Administrative Code 340 Appendix A, instrumentation should be used that reads in counts per minute (cpm). Please note that there are instruments that are designed with both exposure rate/dose rate and cpm read outs. Since both exposure rate and contamination surveys are required, registrants may want to consider acquiring an instrument with both read out options.

Contamination surveys of workers and the work area must be completed immediately following work conducted in a restricted area and prior to exiting the area to ensure that contamination is contained within the restricted area and that any necessary clean-up is completed.

The Agency recommends a survey target level for decontamination of 2x the existing background.

622.40 b) 5) C)

Exposure rate refers to the amount of radiation in the air per unit time. Dose rate refers to the biological effect on the body from exposure to radiation. For the purposes of measuring gamma radiation, exposure rate and dose rate have a 1:1 ratio and can be considered the same. Radiation surveys must be performed by an instrument that reads out in exposure rate (μR or mR) or dose rate (μrem or mrem).

622.40 b) 5)

- 6) Ensure use of calibrated radiation detection instruments. Instruments and equipment used for quantitative radiation measurements (e.g., exposure rate and contamination monitoring) shall be calibrated at intervals not to exceed 12 months for the radiation measured. To satisfy this requirement, the registrant shall:
 - A) Post a legible note on the instrument showing the date of calibration; and

Standard practice is for the person or company calibrating the equipment to place a calibration label on the instrument showing the date of calibration. However, it is the Registrants responsibility to ensure that the calibration label was applied and remains attached.

622.40 b) 6) A)

- B) Ensure that instrument calibrations are performed by persons specifically licensed by the Agency, the U.S. Nuclear Regulatory Commission, an Agreement State, or a Licensing State to perform such calibrations.
- 7) Provide notices and instructions to workers.
 - A) Each registrant shall post, in conspicuous places easily visible to workers, current copies of the following documents:
 - i) This Part;

- ii) Agency Form KLA.001 “Notice to Employees”;

Form KLA.001 “Notice to Employees” can be found at the following web address:

<https://www2.illinois.gov/iema/NRS/RadSafety/Pages/General.aspx>

622.40 b) 7) A) ii)

- iii) The operating procedures applicable to activities under the registration;
- iv) Any notice of violation or administrative order involving radiological working conditions and any response from the registrant; and

See 622.40(b)(7)(C) for further details on posting requirements for (iv).

622.40 b) 7) A) iv)

- v) All radiological surveys, analytical media analysis results, and radon testing results.
- B) If the posting of a document specified in subsection (b)(7)(A) is not practicable, the registrant may post a notice summarizing the documents and the location where the documents may be examined.
- C) The registrant shall post Agency notices of violation or administrative orders involving radiological working conditions, along with any responses from the registrant, within 5 working days after receipt of the notice or order. The registrant's response, if any, shall be posted within 5 working days after the registrant sends it to the Agency. The documents shall remain posted for a at least 5 working days or until action correcting the violation has been completed, whichever is later.

- D) All individuals whose job duties do not require entry into restricted areas or contact with material identified in subsection (a) shall be provided instruction which includes, at a minimum, the material identified in Section 622.50(a), (b), and (c). The initial instruction and annual refreshers must last at least one hour.

All individuals, as it pertains to this subsection, include all full-time employees. The need for part-time, temporary, or contractual employees to comply with this subsection will be left to the discretion of the individual identified in (b)(12). Justification as to how these determinations are made should be included in the Registrants records and will be reviewed by the Agency.

Initial instruction should be provided to new employees as soon as practicable.

622.40 b) 7) D)

- E) All individuals working in, or the performance of whose duties requires access to any portion of a restricted area or who frequent areas where radioactive material is used or stored shall be instructed, at a minimum, in all content described in Section 622.50.
- F) The registrant shall maintain records of initial and annual employee training for five years after the date of the training.
- 8) Shall identify a responsible individual with sufficient knowledge and authority to prevent unsafe practices, approve radiation safety-related issues and communicate promptly to an appropriate level of management. The designated official shall be responsible for ensuring the requirements specified in this Part are adequately implemented.

The responsible individual can be, but does not have to be, a Radiation Safety Officer (RSO). The individual should possess the knowledge needed to recognize and the authority to prevent unsafe practices. Documentation of the responsible individual's qualifications for the position must be maintained and will be reviewed by the Agency.

622.40 b) 8)

- c) Any person who receives, possesses, uses, or transfers water treatment residuals with concentrations of combined radium greater than 200 pCi/g (dry weight basis), and is not otherwise a registrant under Section 622.30 (including, but not limited to,

vendors, contractors, service providers, consultants, low-level radioactive waste brokers, or persons performing decommissioning work) shall obtain a radioactive material license 32 Ill. Adm. Code 330.

AGENCY NOTE: The requirement to obtain a license does not apply to the transportation of water treatment residuals. However, persons transporting water treatment residuals must comply with all other applicable federal, State and local government regulations.

The exemption from licensing provided by Part 622 only applies to persons outlined in Section 622.30; owners and operators of water treatment facilities, owners and operators of wastewater treatment facilities, owners and operators of IEPA permitted municipal solid waste landfills, land applicators permitted by IEPA, and any other person or entity that the Agency determines is required to register. Any other person, who produces, receives, possesses, uses or transfers water treatment residuals with concentrations of combined radium greater than 200 pCi/g (dry weight basis) will be required to obtain a radioactive materials license or be licensed by another state or the NRC.

622.40 c)

- d) The registrant shall notify the Agency before removing material identified in subsection (a) from the facility for disposal, treatment, or transport. Such notification shall include the location, quantity, proposed dates, and proposed method for disposal.

AGENCY NOTE: For the purposes of this subsection, "disposal, treatment, or transport" does not apply to discharge to a sanitary sewer.

- 1) Unless specifically authorized by a radioactive material license or elsewhere in this Section, registrants are not authorized to transport material identified in subsection (a) outside the site where the registrant is authorized to produce and possess the material.
- 2) Before releasing, repurposing, or repair of equipment (piping, pumps, tanks, etc.) that has been contaminated with material identified in subsection (a), the registrant shall remove or provide for the removal of such contaminants and ensure that:
 - A) The equipment is decontaminated to the lowest practicable level before release. Unless the Agency specifies another value, the

values specified in Appendix A of 32 Ill. Adm. Code 340 shall serve as guidelines for this purpose.

- B) The total amount of contamination does not exceed the quantities listed in Appendix C to 10 CFR 20.

AGENCY NOTE: Notification to the Agency is not required when transport is incidental to shipment for analytical services.

- e) Registrants may dispose of material by:
 - 1) Disposal by Release into Sanitary Sewerage. A registrant may discharge material into the sanitary sewer if each of the following conditions is satisfied:

The material must be readily soluble, or a readily dispersible biological material in water.

622.40 e) 1)

- A) The registrant provides information on the nature of the discharge to the water treatment facility and receives written authorization from that facility before discharge;

Documentation of the written authorization must be maintained in accordance with Section 622.70.

622.40 e) 1) A)

- B) Wastewater treatment facilities receiving discharges authorized this subsection are registered and in compliance with the provisions of Section 622.30; and

AGENCY NOTE: Discharges of material identified in subsection (a) to a wastewater treatment facility will require that facility to register under Section 622.30 due to the unquantified impact the material will have on the facility's water treatment residuals. Receiving wastewater treatment plants may have local pretreatment standards restricting such discharges.

- C) The total quantity of material identified in subsection (a) that the registrant releases into the sanitary sewer in a year does not exceed 1.0 Ci.

The total quantity of material released into the sanitary sewer may be determined through sampling of the released material, or through calculations based on the difference between raw and finished water concentrations. Registrants may use other methods to determine the total quantity of material released but will need to be able to demonstrate to the Agency how the total quantity was determined.

622.40 e) 1)C)

- 2) An alternative disposal method may be used if the Agency reviews and approves it beforehand under 32 Ill. Adm. Code 340.1020; or

Any disposal option that is not specifically outlined in Part 622 will be considered an alternative disposal and will need to be approved by the Agency prior to the disposals taking place. Approvals will be made based on the requirements of 32 Ill. Adm. Code 340.1020.

32 Ill. Adm. Code 340.1020 refers to licensed material, and although the material disposed of under this rule is registered instead of licensed, the same criteria for alternative disposal approvals will apply.

622.40 e) 2)

- 3) The material may be disposed of at a facility authorized to dispose of such material in accordance with any federal or State solid or hazardous waste laws as long as the following conditions are satisfied:
- A) Packaging, decommissioning, preparation of manifests, and shipment of material is performed by persons with a specific radioactive material license from the Agency, authorized Agreement State or the NRC to perform such work; and

- B) The registrant ensures compliance with 32 Ill. Adm. Code 340.1060, as applicable.

Registrants disposing of water treatment residuals in a low-level radioactive waste facility are subject to the registration requirements specified in Section 4 and the fees specified in Section 13 of the Illinois Low Level Radioactive Waste Management Act [420 ILCS 20/13] and are subject to the reporting requirements of 32 Illinois Administrative Code 609 and 620.

622.40 e) 3)

- f) Persons producing or possessing water treatment residuals shall not cause contamination of any area exceeding the values specified in Appendix A of 32 Ill. Adm. Code 340.

Registrants who fail to comply with this paragraph, may be subject to the provisions found in 622.80.

622.40 f)

Section 622.50 TENORM Awareness Training for Registrants

- a) For those registrants identified in Section 622.40, TENORM awareness training (1-2 hours at a minimum) shall be included as part of the facility's health and safety training program and conducted before starting of any job duties associated with a radiological hazard.

This requirement has been added to Part 622 in an effort to increase worker safety. Data acquired by the Agency, along with workplace safety concerns brought to the Agency's attention by Registrants, registered facility employees, and other stakeholders indicated that workplace safety measures and training needed to be included in Part 622 to ensure the safety of employees at facilities that have water treatment residuals with a combined radium concentration > 200 pCi/g. TENORM awareness training shall be provided to all Section 622.40 registered facility's employees. The training shall be provided as soon as practical after an employee is hired.

Documentation of all initial and refresher training, as well as the signed employee statement acknowledging receipt of the training shall be maintained in accordance with Section 622.70.

622.50 a)

- b) TENORM Awareness Training shall contain, at a minimum, policies and procedures for each facility, including the management policy to maintain all personnel exposure as low as reasonably achievable. Additionally, workers shall be:
- 1) Kept informed of the storage, transfer, or use of sources of radiation and the identity of restricted areas;
 - 2) Instructed, at appropriate levels of detail, in the health protection problems associated with exposure to radiation or radioactive material, in the risks of radiation exposure to the embryo and fetus, in precautions or procedures to minimize exposure, and in the purposes and functions of protective devices employed;
 - 3) Instructed in, and instructed to observe to the extent within the worker's control, the requirements in Section 622.40 for the protection of personnel from exposure to radiation or radioactive material;
 - 4) Instructed to report promptly to the licensee or registrant any condition that may constitute, lead to, or cause a violation of the Radiation Protection Act of 1990 [420 ILCS 40], the requirements of Section 622.40 or unnecessary exposure (i.e., exposure that results when prescribed safety measures are not followed) to radiation or radioactive material;

It is the expectation of the Agency that the Registrant promote a culture of safety and the reporting of conditions that could endanger worker's safety and/or potentially violate the requirements listed in (b)(4).

622.50 b) 4)

- 5) Advised of the mechanisms in place to ensure workers' exposures within the limits established in Sections 622.30(i)(2) and 622.40(b)(2).
- c) These instructions shall be of sufficient detail to avoid radiological hazards and shall be given directly to each worker either in writing or in an orientation course, with the workers signing a statement that they have received the information listed in subsection (b) and understand it. Refresher training that covers all of the required topics shall be provided at intervals not to exceed 12 months.

- d) In addition to TENORM Awareness Training, training for workers whose job duties may involve entering restricted areas or contact with material identified in Section 622.40(a) shall include the following:

This additional training or proof that workers have received comparable training is required for all personnel who enter restricted areas or who have contact with material > 200 pCi/g including temporary or part-time workers and contractors.

622.50 d)

- 1) Fundamentals of Radiation Safety:
 - A) Introduction to NORM and TENORM;
 - B) Characteristics of alpha, beta, and gamma radiation;
 - C) Units of radiation dose and quantity of radioactivity associated with TENORM;
 - D) Hazards of exposure to different kinds of radiation;
 - E) Levels of radiation from TENORM sources of radiation;
 - F) Methods of controlling radiation dose through time, distance and shielding, ventilation, decontamination, and source reduction to reduce doses as low as practicable; and
 - G) Methods of avoiding intake or exposure to radiation through the use of personal protective equipment, proper working procedures, and decontamination.
- 2) Radiation Detection Instruments, including:
 - A) Use, operation, and limitations of radiation survey instruments for alpha, beta and gamma radiation;
 - B) Survey techniques, including ambient and frisking methods;
 - C) Surveying and sampling for NORM and TENORM; and
 - D) Monitoring equipment and action levels for radon.

- 3) Proper Use of Personnel Protective Equipment (PPE), including:
 - A) Different types of PPE;
 - B) Donning of PPE;
 - C) Removal of PPE;
 - D) Decontamination techniques; and
 - E) Use of respiratory protection equipment and radon mitigation as needed.
- 4) Identification of areas requiring posting and labeling, including identification of known and potential TENORM-containing areas. This includes pumps and piping where mineral scale accumulates; lagoons, flocculation tanks, and sedimentation tanks where residual sludge accumulates; filters, pumping stations, and storage tanks where scales and sludge accumulate; facilities where filter backwash, brines, or other contaminated water accumulates; facilities that are enclosed (radon); and residuals processing or handling areas.

See 622.40 b) 7) for additional posting requirements.

622.50 d) 4)

- 5) Containerization, storage, and disposal of TENORM wastes.
- 6) Requirements of pertinent federal and State of Illinois regulations.
- 7) Topics and discussions of assigned activities during normal and abnormal situations involving exposure to TENORM that can reasonably be expected to occur during work activities.

- e) Recommended Training for Instructors. Instructors of TENORM courses should have adequate and commensurate experience in field operations associated with TENORM activities at water and wastewater facilities. The field experience work needs to include sufficient time in radiation protection and the use of radiation detection equipment.

It is the responsibility of the registrant to ensure that the instructor selected is qualified to provide the required training. Qualifications of the instructor should be documented and may be evaluated during Agency inspections.

Registrants may utilize an online training program to provide the required training for employees. The online training must cover the required topics and be offered by a reputable organization or training program. Registrants will be expected to provide a copy of the training or a link to the training materials used to the Agency during inspections.

622.50 e)

Section 622.60 General Variance

A variance is a temporary exemption from this Part, that the Agency may grant with or without conditions for a period of up to five years upon the presentation of adequate proof by the petitioner that compliance with a requirement would impose an undue hardship. A person filing a petition for a variance shall provide the information in subsections (a) through (h) to the Agency. If the petitioner believes that any of the required information does not apply to the specific variance requested, the petitioner shall include an explanation.

AGENCY NOTE: The filing of a petition for a variance does not stay enforcement of a requirement of this Part.

Subsection 622.60 discusses the applicability, requirements, and guidelines to be used when a general variance (temporary exemption) from the requirements of this Part is requested. The purpose of the general variance is to help relieve an unintended and unreasonable hardship placed on a registrant due to the requirements of certain portions of this Part. It is not a permanent exemption to any requirement and may only be granted with or without conditions for up to a period of five years. A shorter timeframe may be granted as deemed appropriate by the Agency.

Every effort to avoid petitioning for a general variance should be explored prior to petitioning the Agency.

Agency inspections will be necessary to ensure that the registrant is adhering to any requirements outlined in the general variance. Failure to comply, may terminate the variance.

622.60

- a) A statement describing the requirement from which the petitioner seeks a variance. The statement must include the citation to that requirement;
- b) A complete and concise description of the nature of the petitioner's activity that is the subject of the proposed variance, including:
 - 1) Location of, and area affected by, the petitioner's activity;
 - 2) Location of points of disposal or repurposing, and, as applicable, the identification of the receiving waterway or land;
 - 3) Identification of any prior variance issued to the petitioner and, if known, the petitioner's predecessors, concerning similar relief;
 - 4) An explanation of other permits or licenses held by any other federal, state, or local agency that is affected by this variance request;
 - 5) Nature and amount of the materials used in the process or activity for which the petitioner seeks a variance, and a full description of the particular process or activity in which the materials are used;
 - 6) Description of the relevant measures to mitigate the accumulation of TENORM already in use; and

- 7) Nature and amount of disposal, discharges, or releases of the material in question currently generated by the petitioner's activity.
- c) A description of the efforts that would be necessary for the petitioner to achieve immediate compliance with the requirement at issue. All possible compliance alternatives, with the corresponding costs for each alternative, shall be identified. The description of compliance alternatives shall include the availability of alternate methods of compliance, the extent that the methods were studied, and the comparative factors leading to the selection of the proposed alternative for compliance. The description of the costs of immediate compliance should include the overall capital costs and the annualized capital and operating costs, if applicable;
- d) Facts setting forth the reasons the petitioner believes immediate compliance with the requirement would impose an arbitrary or unreasonable hardship;
- e) A detailed description of the compliance plan, including:
 - 1) Discussion of the proposed equipment or proposed alternative measures to mitigate TENORM accumulation to be undertaken to achieve full compliance with the requirement;
 - 2) Schedule for the implementation of all phases of the proposed alternative compliance measures from initiation of design to program completion; and
 - 3) The estimated costs involved for each phase and the total cost to achieve compliance.
- f) A description of the environmental impact of the petitioner's activity, including:
 - 1) Nature and amount of disposals, discharges, or releases of the material in question if the Agency grants the requested variance, compared to that identified in subsection (b)(7);
 - 2) Quantitative demonstration that actions undertaken during the period of variance will not result in any individual members of the public receiving more than 1 millisievert (0.1 rem) TEDE annually (excluding the contribution from radon) from all licensed or registered sources of radiation, including water treatment residuals; and
 - 3) A statement of the measures to be undertaken during the period of the variance to minimize the impact of the discharge of contaminants on human, plant, and animal life in the affected area, including the numerical interim discharge limitations that can be achieved during the period of the variance.

- g) A proposed beginning and ending date for the variance. If the petitioner requests that the term of the variance begin on any date other than the date on which the Agency takes final action on the petition, a detailed explanation and justification for the alternative beginning date; and
- h) Any other information the Agency deems necessary.

Section 622.70 Maintenance of Records & Inspections

- a) Maintain records. Each registrant shall maintain records showing compliance with this Part for five years. Records may be stored in electronic media with the capability to produce legible, accurate, and complete records during the required retention period. Records such as letters, drawings, and specifications shall include all pertinent information such as stamps, initials, and signatures.
 - 1) Each registrant with a combined radium concentration greater than 3.1 pCi/g (dry weight basis) shall maintain records of the following:
 - A) Registrants who dispose of water treatment residuals in an IEPA-permitted municipal solid waste landfill or a facility authorized to dispose of that material in accordance with any federal or State solid or hazardous waste laws:
 - i) Quantity of water treatment residuals disposed of;
 - ii) Concentration of combined radium in pCi/g (dry weight basis) contained in the water treatment residuals;
 - iii) Dates the water treatment residuals were disposed of in a landfill;
 - iv) Name and location of the landfill receiving the water treatment residuals; and
 - v) Any additional records showing compliance with this Part requested by the Agency.
 - B) Registrants who land apply water treatment residuals:
 - i) Tax parcel identification number of lands utilized for application of water treatment residuals;
 - ii) County, township, section, and range in which the tax parcel lies;

- iii) Tillable acres for the tax parcel;
 - iv) A signed landowner acknowledgement form for the tax parcel;
 - v) Total dry tons of water treatment residuals applied to the tax parcel;
 - vi) For each application, the concentration of radium-226 and radium-228 in pCi/g (dry weight basis) contained in the water treatment residuals;
 - vii) Dates the water treatment residuals were land applied;
 - viii) The cumulative increase and total combined radium concentration in the soil for each tax parcel having received application of water treatment residuals; and
 - ix) Any additional records showing compliance with this Part requested by the Agency.
- 2) Registrants identified in Section 622.40 who dispose of residuals via release into sanitary sewerage shall maintain documentation demonstrating that the total quantity of material released in a year does not exceed 1.0 Ci.
 - 3) Registrants who dispose or repurpose water treatment residuals approved by the Agency under 32 Ill. Adm. Code 340.1020 shall maintain documentation in accordance with this Section.
 - 4) All Registrants shall maintain documentation pertaining to radon measurements.

- b) Registrants shall make records available for Agency inspection in accordance with Section 27 of the Radiation Protection Act of 1990 [420 ILCS 40/27]. In addition, the registrant shall afford the Agency, at all reasonable times, an opportunity to inspect sources of radiation, and the premises and facilities in which those sources of radiation are used or stored, and records maintained under this Section.

All facilities will be inspected. The type and frequency of inspection will be determined by factors such as 662.40 registration status, previous inspection findings, water treatment residuals average radium concentration, etc. The expectation is to inspect all registrants at least once every five years. Inspections may be as simple as conducting a desk audit to review documents via email or may be as thorough as conducting a site visit to inspect records, interview individuals, verify dose rates, along with other potential inspection items.

622.70 b)

- c) Registrants shall post or make available to employees all records of radiation survey measurements, water treatment residuals analysis results, and radon measurements.

Section 622.80 Noncompliance and Reporting of Incidents

- a) Each registrant shall report to the Agency any noncompliance with this Part within 30 days after the noncompliance is discovered.
- b) Each registrant shall, within 30 days of discovery of the event, report to the Agency each event involving loss of control of water treatment residuals possessed by the registrant that may have caused, or threatens to cause, an unplanned contamination event outside of a restricted area exceeding the values specified in Appendix A of 32 Ill. Adm. Code 340.

AGENCY NOTE: Reports can be made to EMA.RadiumResiduals@illinois.gov or the 24-hour IEMA-OHS Communications Center (217-782-7860).

- c) Persons found to have caused or contributed to violations of the requirements of this Part may be required to:
 - 1) Remediate under the Agency's rules in Title 32 of the Illinois Administrative Code;
 - 2) Reimburse for remediation efforts initiated on the person's behalf under 32 Ill. Adm. Code 310; and

- 3) Obtain a radioactive material license in accordance with 32 Ill. Adm. Code 330.

Violations of any Section, Paragraph, sub-paragraph, etc. of this Part may lead to any or all of the listed requirements being imposed. Note: Failure to register with the Agency, if required, is a violation of this Part, and may be subject to the conditions listed above.

622.80 c)

Section 622.90 Notifications to the Agency

All notifications to the Agency concerning the requirements of this Part shall be sent to EMA.RadiumResiduals@illinois.gov.

Section 622.APPENDIX A Landowner Acknowledgement Form

At a minimum, the following language shall be included in the landowner acknowledgement form required in Section 622.30(c)(1)(B)(ix). Failure to include this language and to have the landowner sign and date shall invalidate the acknowledgement.

The Illinois Environmental Protection Agency, as well as the U.S. Environmental Protection Agency, requires the water treatment residuals you are receiving to be monitored for trace metals, organic and inorganic chemicals, and pathogens. In addition, the Illinois Emergency Management Agency and Office of Homeland Security (IEMA-OHS) requires the monitoring of radium under 32 Ill. Adm. Code 622 (Part 622). Radium is naturally present in soil and groundwater. When removed from water and land-applied, these water treatment residuals could elevate the radium content in the soil above natural levels.

IEMA-OHS, as the regulatory agency for ionizing radiation, requires that land-applied water treatment residuals be monitored for radium, including the cumulative amount of radium, deposited on agricultural fields. Fields that approach the regulatory limit of 3.1 pCi/g are required to utilize alternative sources of fertilizer (i.e., water treatment residuals without elevated radium from water). The additional monitoring and land application provisions of Part 622 ensure that the public is protected from significant health, environmental, and agricultural impacts.

This form serves as an acknowledgement of awareness by the landowner, or authorized agent of the landowner, that biosolids applied to fields for beneficial nutrient purposes contain radium. For further information, you may contact IEMA-OHS at EMA.RadiumResiduals@illinois.gov.

I hereby acknowledge my awareness of the above conditions resulting from application of treatment residuals to my property.

SIGNATURE OF LANDOWNER OR LANDOWNER'S DESIGNEE

PRINTED NAME

DATE

Appendix A

Identifying Aquifers that Contribute Radium to Source Water

Concentrations of naturally occurring radium-226 and radium-228 in excess of the US EPA standard for drinking water of 5 pCi/L have been detected in water from deep aquifers used for public supply that underlie parts of northern Illinois (fig. 1). This graphic is from the US Geological Survey (USGS) Fact Sheet 137-99, Sept. 1999 and, consequently, shows the predominate areas in Illinois where radium treatment is necessary for municipalities drawing water from a deep well. In general, the same aquifer below the southern boundary, as shown in Figure 1, is too saline for potable use due to increasing depth within the Illinois Basin as you move south.

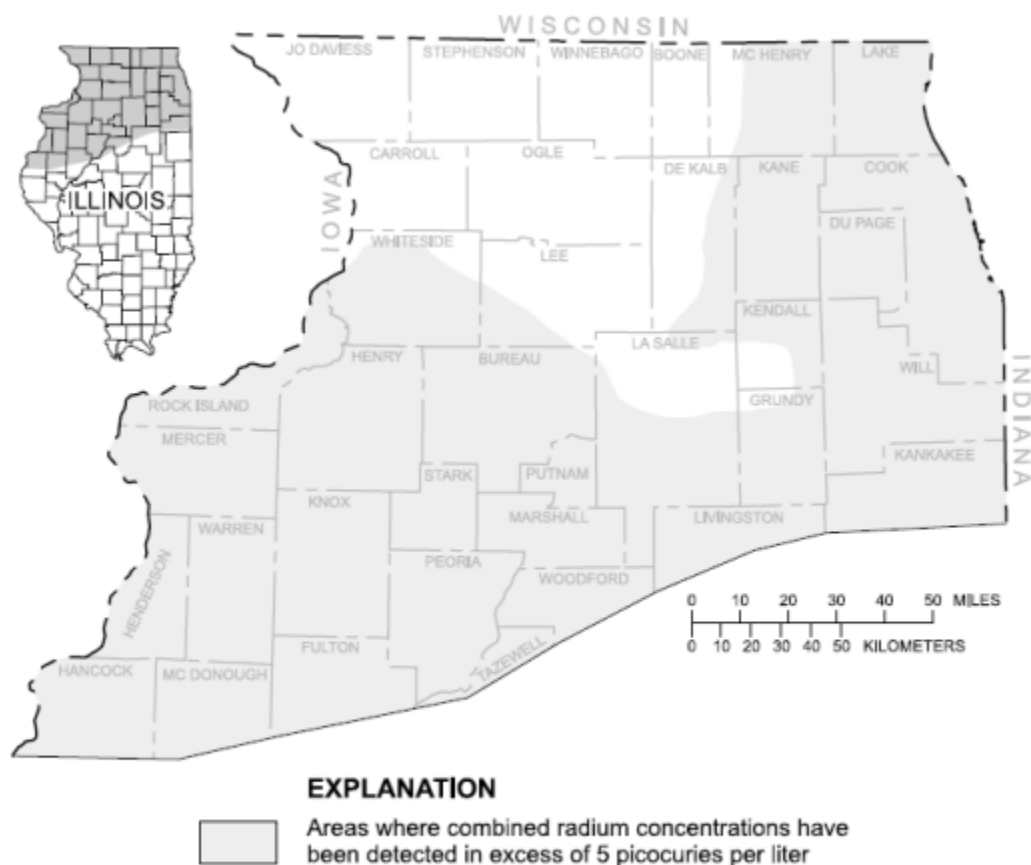
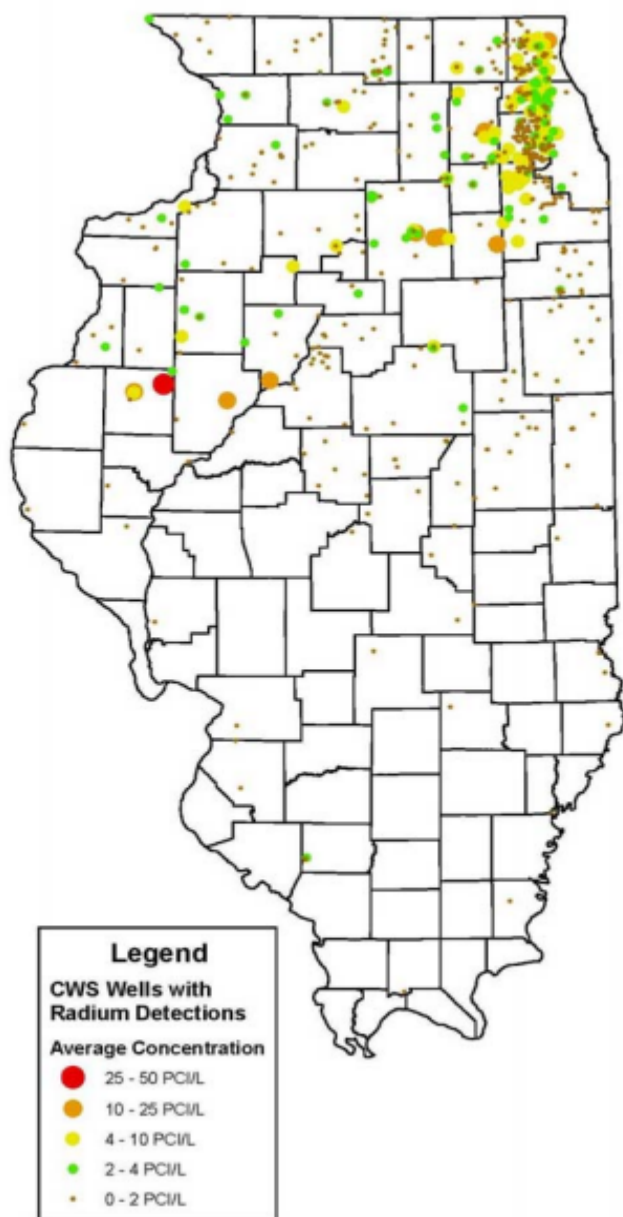


Figure 1. Areas where radium concentrations in excess of 5 picocuries per liter have been detected in aquifers used for public-water supply in northern Illinois.

The area where elevated radium concentrations may be present in northern Illinois extends from Kankakee, Livingston, Woodford, Tazewell, Fulton, McDonough, and Hancock Counties north to the Wisconsin State line. The primary aquifers that contribute to these elevated concentrations of radium are the Mt. Simon and Cambrian-Ordovician.



IEMA-OHS has worked with the Illinois Environmental Protection Agency (IEPA) to further analyze available raw water data from municipal wells around the state. Approximately 644 wells distributed across the State were sampled to determine untreated source water radium concentrations. This information included well depth, aquifer confinement and aquifer type or time stratigraphic description. Summarized in the graphic on the left, the data depicts the distribution of radium concentrations in aquifers across the State. Radium is present in southern Illinois aquifers as well and at times, can accumulate to levels that that present disposal problems. This is especially true when a treatment technology is employed that is capable of concentrating the radium over time (see Appendix B). IEMA-OHS utilizes municipal well information (utilization of the Cambrian-Ordovician and Mt Simon aquifer, depth of the well, and aquifer confinement) to determine the likelihood radium will be present in the source water. One of the two primary factors IEMA-OHS uses to

determine if a municipality must comply with the provisions of Part 622 is the aquifer from which they draw. Aquifers that contribute raw water above the US EPA drinking water standard of 5 pCi/L often require treatment installation. By virtue of treatment installation,

the radium is further concentrated and accumulates in treatment residuals. This, consequently, results in most of the regulated community lying in the USGS graphic shown above. Albeit lower levels, other aquifers (such as the Pennsylvanian and Southern Illinois aquifers, due to their location and depth within the Illinois Basin) can contain radium as well. While not generally requiring treatment for radium, installation of a treatment technology capable of concentrating radium may result in accumulation of radium in the treatment residuals. IEMA-OHS has witnessed southern Illinois communities with raw water radium as low as 1.1 pCi/L concentrate radium in their treatment residuals to well over 200 pCi/g.

Aquifers Contributing Radium to Source Water

IEMA-OHS utilizes studies performed by USGS¹² as well as information maintained and produced by IEPA on the aquifer each CWS draws from (if any) to determine “aquifers contributing elevated concentrations of radium to the source water”. These are primarily the Mt. Simon and Cambrian Ordovician deep sandstone aquifers. However, the sand and gravel deposits in the glacial drift as well as fractures and crevices in the shallow Silurian or Maquoketa dolomite bedrock have shown elevated concentrations of radium. Of the 644 IEPA wells tested, (69) exhibited average concentrations above 5 pCi/L. The contributing aquifers for these wells were the Devonian and Silurian systems in only two cases. Every other well obtained their source water from the Ordovician and Cambrian systems.

IEMA-OHS and IEPA analyzed aquifers contributing source water beneath 5 pCi/L to determine areas where, despite lower concentrations of radium, treatment technologies could concentrate the radium over time. For average radium concentrations beneath 5 pCi/L, the Cambrian and Ordovician (Canadian series) systems comprise only 3.10% of the test population. The Ordovician (Cincinnatian and Champlainian series) comprise 18.3% and average approximately 3.0 pCi/L. The Devonian and Silurian systems comprise 32.5% of the aquifers supplying raw water with concentrations less than 5.0 pCi/L and average approximately 1.6 pCi/L. The remainder of the production wells draw from aquifers throughout the quaternary system. The low probability of the Cambrian and Ordovician systems to contribute water beneath 5 pCi/L in the dataset agrees with the studies and evaluations of the USGS studies. Therefore, IEMA-OHS has designated the Ordovician (Cincinnatian, Champlainian, and Canadian Series) and Cambrian systems as aquifers that contribute elevated concentrations of radium to the source water. This classification may change as site specific aquifer characteristics may vary.

The municipal wells in use by Illinois communities have been compared to the depth, aquifer confinement, and aquifer type of those shown to contribute significant amounts of radium (> 5pCi/L). 5 pCi/L is utilized due to the fact that above this concentration,

treatment is required by US EPA which will further concentrate the radium onto a treatment residual. There are instances of detectable levels (1 to 3 pCi/L) of radium in other aquifers (Pennsylvanian and quaternary systems); however, the levels detected, at this time, typically do not warrant treatment installation. (Incidentally, if no treatment is installed, there is not a media on which to accumulate radium). IEMA-OHS will continue to monitor the radium content of aquifers throughout the state, by virtue of maximum contaminant level violations, to assess the likelihood of treatment residual accumulation.

Appendix B

Treatment Technologies Capable of Concentrating Radium

As the groundwater is removed from an aquifer, the CWS may treat the water for compliance with US EPA maximum contaminant levels as well as aesthetic quality. If treating for radium, the reject water, backwash, brine, and process water are often discharged to a wastewater treatment plant for ultimate disposition in a sludge. The radium from the aquifer, aside from what is distributed in the finished drinking water, resides in the drinking water treatment plant media and wastewater treatment residuals. Depending on the time the media spends in service, the backwash frequency, the operational procedures employed, and the amount of water treated; combined radium may accumulate to levels that warrant not only additional requirements stipulated in Part 622, but low-level radioactive waste disposal (> 200 pCi/g).

Table 1: Residual Type by Treatment Technology

Treatment	Types of Residuals							
	Solid			Liquid				
	Spent Resins & Media	Spent Membranes	Sludge	Brine	Backwash Water	Rinse Water	Acid Neutralization Water	Concentrate
Ion Exchange	X			X	X	X		
Reverse Osmosis		X						X
Lime Softening	X		X		X			
Green Sand Filtration	X		X		X			
Co-precipitation with Barium Sulfate	X		X		X			
Electrodialysis/ Electrodialysis Reversal		X						X
Hydrous Manganese Oxide Filtration	X		X		X			
Activated Alumina	X			X	X	X	X	
Coagulation/Filtration	X		X		X			
Granular Activated Carbon	X			X	X	X		
Adsorbitive Media	X			X	X	X		
Pressure and Sand Filtration	X		X		X			

It should be noted, that by installing a treatment technology capable of concentrating radium, any aquifer with detectable concentrations of radium in the raw water may give rise to treatment residuals with elevated radium. An example would be a system that utilizes anthracite for water quality and draws from the Pennsylvanian system. Test well data (from Appendix A) indicates radium concentrations in this aquifer can average as high as 2.8 pCi/L. If left in service for extended periods of time, the radium will accumulate on the treatment media to levels warranting disposal in accordance with Part 622. Therefore, although the Cambrian and Ordovician aquifers are the primary aquifers designated by IEMA-OHS and IEPA to contribute elevated amounts of radium to the source water, systems employing treatment technologies capable of concentrating radium are required to register under Part 622.

Proximity to an aquifer identified in Appendix A as ‘contributing radium to the source water’ does not necessarily mandate a CWS to comply with Part 622. Furthermore, a CWS in southern Illinois drawing from an aquifer with less than 5 pCi/L may be required to comply with provisions of Part 622. When a treatment technology is utilized that preferentially removes radium, any aquifer may give rise to treatment residuals with technologically enhanced levels of radium if left in service for a long enough period of time. Higher levels of radium in the source water require less time in contact with treatment media to accumulate to levels warranting disposal in accordance with Part 622.

The treatment technologies listed in Table 1 are identified by USEPA as capable of producing solid residuals (including spent resins, spent filter media, spent membranes, and sludges) and liquid residuals (including brines, backwash water, rinse water, acid neutralization streams, and concentrates). Approximately 28 percent of water treatment processes remove radionuclides from water. Those of most concern are lime softening, ion exchange, and activated charcoal. IEMA-OHS has initially used this information as indicators of technologies that may create treatment residuals necessary of regulation under Part 622. Table 1 is not a comprehensive or exhaustive listing as anthracite and gravel have been shown to accumulate combined radium when left in service for extended periods of time. Additionally, initial testing indicates reverse osmosis filters may not require disposal in accordance with Part 622 – although the reject water will. Facilities are encouraged to test their media as often as facility operations allow. Table 1 will be modified as data becomes available to IEMA-OHS and treatment technologies evolve.

All treatment residuals will have some radium as a result of the radionuclide’s natural abundance. However, when the supply of radium is elevated (by virtue of the aquifer) and technologically enhanced (by virtue of treatment technology), the residuals are under the regulatory scope of Part 622. Absence of a treatment technology that is capable of

concentrating radium is only currently foreseeable avenue in which treatment residuals remain at environmentally encountered levels (i.e., not technologically enhanced).

APPENDIX C

Explanation of IEMA-OHS Facility Monitoring Criteria

Appendix A and B detail the impact aquifer and treatment technology, respectively, play in radium concentration of treatment residuals. IEMA-OHS utilizes the Safe Drinking Water Information System (SDWIS), as maintained by IEPA, to monitor changes in drinking water facilities.

Radium concentrations in treatment residuals increase when the source water is drawn from an aquifer contributing radium and a treatment technology is employed that concentrates radium. If any aspect of this scenario changes for a facility, the facility may fall under the scope of Part 622. The following changes do not necessarily cause a facility to produce treatment residuals nor do they dictate a system will be under the regulatory scope of Part 622. However, the following examples are indicators of facility changes that IEMA-OHS monitors to evaluate if a facility should dispose of their treatment residuals in accordance with Part 622.

- A new maximum contaminant level violation (MCL) for combined radium. This indicates the aquifer used is contributing water with elevated levels of combined radium. Often treatment will be required to mitigate the MCL, resulting in treatment residuals containing radium.
- Well changes. New deep wells drilled into the aquifers designated by IEMA-OHS to contribute radium to source water, blending of well sources, switching wells to 'inactive', and increasing demand on a well all effect the potential regulation of a CWS under Part 622.
- Installation or removal of a treatment technology. Due to the fact even low amounts of radium in a source water may be concentrated over time, the installation of a treatment technology capable of concentrating radium may initiate a system to dispose of treatment residuals in accordance with Part 622. The likelihood of treatment residuals being regulated under Part 622 increases if the CWS also draws from an aquifer designated by IEMA-OHS to contribute radium to the source water.

Appendix D

Approved Analytical Methods

Approved Analytical Methods

There is no federal requirement to test waste residuals specifically for radionuclides, and no specific federal regulation governing landfill disposal of water treatment plant solids or sludges containing radium. The responsibility to determine the most appropriate analytical method for testing water treatment plant waste containing radium (and possibly source material) and any requirements or guidelines for disposal is currently designated to the individual states. As such, IEMA-OHS has completed a review of applicable guidance and regulations to compile a list of appropriate analytical methods.

USEPA publishes a list of analytical methods for radionuclides in 40 CFR 141.25 that are approved for determining compliance with the maximum contaminant levels in drinking water. Tables 2 and 3 provide summary information on all approved methods from 40 CFR 141.25 for radium-226 and 228. Of the approved methods, two (method 4, EPA 1979; and method 10 (method 7 for Ra-228), RA-02) are also applicable to soils or ‘dry basis’ treatment residuals. Method 901.1, although not listed in the tables below, is a gamma spectrometry method approved for the analysis of gamma emitters in drinking water. Although approved for drinking water, method 901.1, can be modified for the analysis of other media types, and therefore has been approved by the Agency for the analysis of water treatment residuals.

The method descriptions are intended to serve as an easy reference guide. If registrants require additional information, they should consult with the laboratory, refer to the US EPA’s *COMPENDIUM OF EPA APPROVED ANALYTICAL METHODS FOR MEASURING RADIONUCLIDES IN DRINKING WATER* or contact the Agency.

Table 2: 40 CFR 141.25 Analytical Methods for Radium-226 and Radium-228

Contaminant	Methodology	Reference (Method of Page Number)								
		EPA ¹	EPA ²	EPA ³	EPA ⁴	SM ⁵	ASTM ⁶	USGS ⁷	DOE ⁸	Other
Radium 226	Radon emanation	903.1	p. 16	Ra-04	p. 19	305, 7500-Ra C, 7500-Ra C-01	D3454-97	R-1141-76	Ra-04	NY ⁹ ,
	Radiochemical	903.0	p. 13	Ra-03		304, 7500-Ra B, 7500-Ra B-01	D2460-97	R-1140-76		GA ¹⁴
Radium 228	Radiochemical	904.0	p. 24	Ra-05	p. 19	7500-Ra D, 7500-Ra D-01		R-1142-76		NY ⁹ , NJ ¹⁰ , GA ¹⁴

Table 3: Alternative Testing Methods Approved for Analyses Under the Safe Drinking Water Act (Appendix A to Subpart C of 40 CFR Part 141)

Contaminant	Methodology	EPA method	SM 21st edition ¹	SM 22nd edition, ²⁸ SM 23rd edition, ⁴⁹ SM 24th edition ⁶⁶	ASTM ⁴	SM online ³
Radium 226	Radon emanation	903.1, Rev. 1.0 ⁵³	7500-Ra C	7500-Ra C	D 3454-05, -18, D 3454-21	
	Radiochemical	903.0, Rev. 1.0 ⁵⁴	7500-Ra B	7500-Ra B	D 2460-07	
	Gamma Spectrometry			7500-Ra E		7500-Ra E-07.
Radium 228	Radiochemical	904.0, Rev. 1.0 ⁶²	7500-Ra D	7500-Ra D		
	Gamma Spectrometry			7500-Ra E		7500-Ra E-07.

Appendix E

IEMA-OHS Contact Information

Please send general inquiries to the Agency's designated Water Treatment Residuals email inbox at ema.RadiumResiduals@illinois.gov.

For emergencies such as contamination or exposure events, please use the Agency's 24-hour number (217) 786-7860.