

ILLINOIS POLLUTION CONTROL BOARD

April 7, 2005

IN THE MATTER OF:)
)
REVISIONS TO RADIUM WATER QUALITY) R04-21
STANDARDS: PROPOSED NEW 35 ILL. ADM.) (Rulemaking – Water)
CODE 302.307 and AMENDMENTS TO)
35 ILL. ADM. CODE 302.207 and 302.525)

Proposed Rule. Second First Notice.

OPINION AND ORDER OF THE BOARD (by N.J. Melas):

Today the Board proposes its own revised general use water quality standard for radium based on the testimony and comments the Board has received since first-notice publication. At first-notice, the Board adopted the proposal filed by the Illinois Environmental Protection Agency (Agency). The Agency proposed to change the general use and Lake Michigan water quality standards for radium from 1 picocurie per liter (pCi/L) radium 226 to 5 pCi/L combined radium 226 and 228 and apply the proposed standards specifically to surface waters used for public and food processing water supplies.

As a result of first-notice comments and because of the extent of the changes to the first-notice proposal, the Board finds it appropriate to publish the proposal for a second first-notice. Out of 38 public comments, 36 were filed with the Board subsequent to first-notice publication. The Board finds that the changes in today's rules from those originally proposed are warranted and that a second first-notice will maximize the opportunity for public comment on the amended proposal. The testimony and comments clearly indicate a need for further research and analysis. The record also demonstrates a need to maintain a general use water quality standard, protective both of human health and riparian mammals in the environment. Yet, compliance must also be reasonable for Northern Illinois publicly owned treatment works located in areas where naturally occurring radium is prevalent in source water. The Board finds that today's proposal meets those objectives.

The Board does not anticipate holding additional hearings in this proceeding, but any person may request an additional hearing. 5 ILCS 100/5-40(b)(5); 35 Ill. Adm. Code 102.412(b). Second first-notice publication in the *Illinois Register* will begin period of at least 45 days for interested persons to file public comments with the Board. The Board will withdraw first-notice publication of this rulemaking that appeared in the *Illinois Register* on July 8, 2004.

The Board first gives this rulemaking's procedural history before providing an overview of the change in water quality standards and discussing the specific provisions of the first-notice proposal.

PROCEDURAL HISTORY

On January 13, 2004, the Agency filed a proposal to amend Part 302 of the Board's water quality standards.¹ The Agency proposed to change the general use and Lake Michigan water quality standards for radium from 1 picocurie per liter (pCi/L) radium 226 to 5 pCi/L combined radium 226 and 228 and apply the proposed standards specifically to surface waters used for public and food processing water supplies. According to the Agency, these changes would make the radium water quality standards consistent with the federal finished water maximum contaminant level (MCL) and ensure the protection of surface water intakes for raw drinking water in the State. The Agency argued the proposed changes would also relieve a regulatory burden for many existing publicly owned treatment works (POTWs) that receive, treat, and discharge wastewater from public water supplies that remove radium from high radium groundwater.

The Board accepted this proposal for hearing on January 22, 2004. The Board has held five days of hearings before the Board hearing officer, members, and staff. The first hearing was held on April 1, 2004, at the James R. Thompson Center in Chicago.² The second hearing was held on May 6, 2004, at the Board's offices in Springfield.³ Both hearings allowed the proponent and any other interested party the opportunity to present testimony on the merits and economic impact of the rulemaking proposal.

On June 2, 2004, WRT Environmental (Illinois), L.L.C. (WRT Environmental) moved the Board for an additional merit hearing. On July 8, 2004, the Board adopted the Agency's proposal for publication of first-notice in the *Illinois Register*, but noted by hearing officer order that the Board would grant WRT Environmental's motion for a third hearing. First notice was published in the *Illinois Register* on August 6, 2004. 28 Ill. Reg. 32, pg. 10887, *eff.* Aug. 6, 2004. First-notice publication in the *Illinois Register* began a public comment period for interested persons to file comments with the Board. The Board granted the motion and held a third hearing on August 25, 2004, in Springfield.⁴ The Board gave notice of hearings a fourth time and they continued on October 21 and 22, 2004, in Chicago.⁵

The Hearing Witnesses

The Agency presented three witnesses at the various hearings. Mr. Jerry Kuhn is the manager of the permit section, responsible for reviewing community water supplies' construction permit applications, for the Division of Public Water Supply of the Agency. Mr. Bob Mosher is an aquatic biologist in the Agency's Water Quality Standards Unit. Mr. Blaine

¹ The Agency's Statement of Reasons included in the rulemaking proposal will be cited as "Statement at _."

² The transcript of the first hearing will be cited as "Tr.1 at _."

³ The transcript of the second hearing will be cited as "Tr.2 at _."

⁴ The transcript of the third hearing will be cited as "Tr.3 at _."

⁵ The transcript of the fourth hearing will be cited as "Tr.4 at _."

Kinsley is a manager of the Industrial Unit in the Division of Water Pollution Control permit section.

WRT Environmental opposes the Agency's proposal because all radium or uranium removal processes generate radioactive residuals. Yet, WRT Environmental contends that many communities do not have the expertise to safely handle, transport, or dispose of radioactive residuals. At the third and fourth hearings, the participants discussed the technical feasibility, economic reasonableness, and environmental impact of the proposal, and the infeasibility or unreasonableness of the existing standards. Three witnesses testified on behalf of WRT Environmental: Mr. Ted Adams, Mr. Charles Williams, and Dr. Brian Anderson.

Mr. Dennis Duffield presented testimony on behalf of the City of Joliet (Joliet). Joliet contends that WRT Environmental presents information related to treatment technologies that can be used to meet the radium public water supply standards and to provide an alternative to the resulting sludge. Joliet argues, however, that treatment technologies have nothing to do with this rulemaking, which addresses only the general use water quality standards for radium in surface waters.

At the fourth hearing, the Environmental Law & Policy Center and the Sierra Club (collectively, environmental groups) testified in favor of WRT Environmental's proposal. Both Mr. Albert Ettinger, on behalf of the Environmental Law and Policy Center, and Dr. Cynthia Skrukud, on behalf of the Sierra Club, provided testimony.

Dr. Abdul Khalique, a radiation chemist, provided both public comment and testimony on behalf of the Metropolitan Water Reclamation District of Greater Chicago (MWRDGC).

Mr. Doug Dobbmeyer, on behalf of Clean Water, was present at the third and fourth hearings. Mr. Dobbmeyer presented a public comment in opposition to the Agency's proposal.

Throughout the four hearings, the Board received a total of 17 exhibits. Because of the technical nature of this rulemaking, the Board requested and received changes to the hearing transcripts. The Agency, WRT Environmental, the MWRDGC, and Joliet all submitted changes to the hearing transcripts. The Board received and posted the corrected transcripts on December 7, 2004.

Summary of Public Comments

The Board received a total of 37 public comments in this proceeding as well as a motion by Joliet to file an additional public comment after the close of the first-notice public comment period.⁶

⁶ On December 22, 2004, Joliet moved the Board to submit additional comments after the end of the public comment period. On January 4, 2005, WRT opposed the motion, stating that if the Board considers the late public comment, the Board should also consider a response by Mr. Ted Adams. Neither party submitted affidavits supporting the additional public comment. The Board accepts the additional public comments from both parties and considers the comments

	Supports Agency Proposal	Opposes Agency Proposal	Seeks More Information
1.	Village of Channahon (PC 5)	WRT Environmental L.L.C. (PC 1)	Citizens Against Ruining the Environment (CARE) (PC 4)
2.	Metropolitan Water Reclamation District of Greater Chicago (PC 7)	Environmental Law and Policy Center and Sierra Club (PC 2)	Kane County (PC 6)
3.	Illinois Association of Wastewater Agencies (IAWA) (PC 10)	Clean Water – Illinois (PC 9)	Openlands Project (PC 8)
4.	Village of Romeoville (PC 13) (but with a numerical standard)	Des Plaines River Valley Restoration Project (PC 25)	Illinois Farm Bureau (PC 16)
5.	Village of Manhattan (PC 14)	Citizens for Conservation (PC 25)	John A. Djerf, P.E. (PC 20)
6.	Village of Hampshire (PC 15)	Illinois Audubon Society (PC 25)	
7.	Howard J. Hamilton, P.E.-CFM (PC 17)	Prairie Woods Audubon Society (PC 25)	
8.	Robert E. Hamilton, P.E. (PC 18)	Illinois Division Izaak Walton League of America (PC 25)	
9.	Albert J. Zanzola, P.E. (PC 19)		
10.	Curtis A. Craigmile, P.E. (PC 21)		
11.	City of Braidwood (PC 22) (but with a general use standard)		
12.	Village of Minooka (PC 23)		
13.	Illinois Emergency Management Agency (PC 24) (supports limit of 5pCi/L for food and water processing supplies, but proposes an interim general use water quality standard of 60pCi/L)		
14.	Village of Sugar Grove (PC 30)		

below. The Board refers to the additional public comment submitted by the City of Joliet as PC 36, and the responsive public comment filed by WRT Environmental as PC 37.

15.	Village of Montgomery (PC 31)		
16.	United City of Yorkville (PC 32)		
17.	Illinois Water Utility Council (PC 34)		
18.	City of Batavia (PC 35)		

OVERVIEW OF THE PROPOSED CHANGES IN RADIUM WATER QUALITY STANDARDS FOR SECOND FIRST-NOTICE

Today the Board proposes a general use water quality standard of 3.75 pCi/L combined radium 226 and 228 to replace of the existing radium 226 standard of 1 pCi/L. This new standard will apply to all general use waters of the State as well as the Lake Michigan Basin. Further, today's proposal applies a combined radium standard of 30 pCi/L to stream segments that receive discharge from POTWs receiving wastewater discharge from public drinking water supplies using groundwater with a high radium concentration. The 30 pCi/L combined radium 226 and 228 standard will apply from the point of discharge to one mile downstream of the discharge outfall.

The Board finds that the proposal for second first-notice will be protective of the sensitive designated use of the State's waters. Additionally, the Board finds that the proposal will also achieve the Agency's goal of relieving a regulatory burden for many existing POTWs that may not comply with the existing general use radium water quality standards. POTWs that receive wastewater from public drinking water supplies using high radium groundwater as the potable raw water source will benefit because the proposed rulemaking will provide a higher combined radium standard for stream segments receiving their discharge.

AGENCY PROPOSAL AND PRE-FIRST-NOTICE COMMENTS

In July 2004, the Board adopted the Agency's proposal without making any substantive changes. In summary, that proposal eliminated the existing general use water quality standard for radium 226 at Section 302.207, but retained the standards for strontium 90 and gross beta. Second, the proposal established a new public and food processing water supply standard of 5 pCi/L of combined radium 226 and 228 at Section 302.307 that corresponds to the federal finished drinking water MCL.⁷ Statement at 7. The proposal also deleted the radium 226 standard from the Lake Michigan basin water quality standards at Section 302.525.

The July 2004 proposal retained the existing radioactivity standards for both Strontium 90 and gross beta for the Lake Michigan basin. In summary, the first notice changes would set a radium standard that protects only surface water intakes for raw drinking water at the same level applicable to finished drinking water. Statement at 8.

⁷ This federal drinking water standard became effective December 8, 2003. National Primary Drinking Water Regulations; Radionuclide; Final Rule, 65 Fed. Reg. 76707 (Dec. 7, 2000).

In the proposal, the Agency stated that radium is a naturally occurring radioactive metal that exists in several isotopes, and is commonly found in Illinois groundwater. The Agency stated that its basis for making the proposed standard applicable only to public and food processing supplies is that there is no indication that radium is anything but a threat to human health via drinking water. The Agency further noted that radium is a known carcinogen and, accordingly, standards that protect drinking water are necessary. Statement at 9. Other than human health, the Agency stated it was not able to find any evidence of any other use impacted besides drinking. Tr.4 at 256. The Agency states its research proves that Illinois is unique compared to other states with radium regulations in having aquatic life water quality standards. Statement at 9. Therefore, according to the Agency, the proposed changes protect all uses that radium may impact. Statement at 9. However, the Agency stated it would look at more information that would provide the Agency with guidelines for a different number if one exists.

Before the Board's first-notice opinion and order, WRT Environmental submitted comments in opposition to the Agency's proposal and moved the Board for a third hearing. PC 1. Additionally, the environmental groups supported the motion for a third hearing and opined in comments that the record was inadequate. PC 2.

FIRST-NOTICE COMMENTS

The participants in this rulemaking raised a number of issues concerning the proposed amendments after the adoption of the first notice opinion and order on July 8, 2004. These issues include whether data exists regarding the impacts of radium on aquatic life, what level of protection is necessary to protect human health and the environment, the safety of POTW workers, the land application of sludge containing radium, and available radium removal technologies. In post-hearing comments, the participants also suggested various alternatives to the Agency's proposal that was adopted by the Board at first notice. The testimony and comments presented by the participants are summarized below, accompanied by the Board's findings.

The Nature of Radium in Illinois

By way of background, the Agency relates that the Board adopted the 1 pCi/L general use water quality standard for radium 226 in 1972. Statement at 3; citing *In re Water Quality Standards Revisions*, R71-14 (Jan. 6, 1972). The same standard appeared in the Lake Michigan Basin water quality standards in 1997. The standard has applied to Lake Michigan since 1972, but the 1997 regulation merely reflected a change in format of how Lake Michigan standards were presented in the Board's rules. The Agency contends that a federal source called the Green Book (Report of the Committee of Water Quality Criteria. April 1, 1968) appears to be the source for the Board's general use water quality standards of 1972. Statement at 5. The Green Book recommends a "permissible" value of 3 pCi/L for radium 226 and a "desirable value" of <1 pCi/L. These values for strontium 90 are 10 and <2 pCi/L, and for gross beta, 1000 and <100 pCi/L. These values were intended to provide guidance for setting standards for raw water quality at point of intake. Statement at 5. When the Board adopted the radium standards, the

Board chose the more stringent “desirable values” and also made the standards generally applicable. *Id.*

The current federal finished drinking water Maximum Contaminant Level (MCL) for radium 226 plus radium 228 is 5 pCi/L. Drinking water must meet this standard at the consumer’s water tap. Since the MCL is a finished water standard, the Agency argues that protecting nearly all intake waters at 1 pCi/L, the current Illinois general water quality standard, is excessively stringent. Statement at 6.

Radium is a recognized human carcinogen. Tr.4 at 25. Mr. Williams and Mr. Adams, on behalf of WRT Environmental, both agree that radium is a “bone-seeker” that replaces calcium in the bone and its decay gives off particles that cause bone cancer. Tr.3 at 124. The principle pathway in which radium enters the body is ingestion and inhalation. *Id.*; Tr.4 at 160. Radium undergoes radioactive decay. The half-life of radium 226 is 1,600 years while radium 228 has a half-life of 5.7 years. During the decay process, alpha, beta, and gamma radiation are released. Tr.4 at 16, 259. Radium 226 emits alpha radiation and radium 228 emits beta radiation. Alpha particles can travel only a short distance and cannot travel through skin. Beta particles can penetrate through skin, but they cannot go all the way through the body. Tr.3 at 101. Gamma radiation can go all the way through the body.

Radium exists at levels exceeding the existing general use water quality standard of 1 pCi/L in some Illinois streams below sewage treatment plants serving communities that utilize high radium groundwater as the raw water source for drinking water. Statement at 2. Discharges into larger streams generally receive enough dilution to meet the standard. For example, recent stream concentrations in the Fox River measured less than 1 pCi/L. Statement at 2-3. Most Illinois community water supply facilities with high concentrations of radionuclides in the source water are located in the northern half of the State of Illinois and in a region that stretches from Henderson County in the west to Cook and Lake Counties in the northeast. Statement at 3. Sewage treatment discharges to very small streams where no dilution is present have the potential to contain as much as 5 to 10 pCi/L depending on concentrations in the groundwater and efficiency of treatment in removing radium to the sewage sludge. *Id.*

Mr. Williams states the average concentration of combined radium 226 and 228 at various sites in Illinois is 12.8 pCi/L, and the highest level that WRT Environmental has encountered in Illinois averages 22.6 pCi/L. Hearing Exh. 5, Table 1. WRT Environmental derived these numbers from testing it conducted at various sites in Illinois. *Id.*

The City of Joliet draws its raw water from an aquifer with a naturally occurring high radium content. The radium concentration in the City of Joliet water supply is between 6 pCi/L and 10 pCi/L. City of Joliet Supplemental Information, Exh. 4. At hearing, Joliet emphasized the need for the resolution of this rulemaking. Joliet stated that the communities in Northern Illinois are required to comply with the drinking water standard and in order to achieve compliance, they must select a treatment method. According to Joliet, any delay in the selection of a treatment method will result in violations of compliance commitments and consent decrees with the Agency, result in fines, and force users to continue to drink water that exceeds the drinking water standard. Tr.4 at 387.

Joliet contends that by proposing the rule change, the Agency is not allowing additional radium to be discharged into waters of the State. Instead, the regulations appropriately recognize that the existing discharges of radium and allow communities to continue a practice that has occurred over many years. Tr.4 at 390-91. Joliet asserts that the separation and recombining of the radium with the water does not alter the impact on the environment but protects the health of the water consumer.

Evidence of Adverse Impacts of Radium on Aquatic Biota

In the proposal, the Agency contends it found no evidence that any other use was impacted by radium other than humans via the consumption of drinking water. In comments and at hearing, the parties disputed this conclusion, arguing there exist many studies, models, and other literature regarding the impacts of radium on the aquatic biota. For example, WRT Environmental contends there are 50 years of data identifying the various negative impacts of radiation upon a broad spectrum of plants and animals. Tr.3 at 16. The Agency states that after consulting the ECOTOX database,⁸ it found no toxicological studies on radium. Tr.4 at 358. According to the Agency, the studies it uses to derive water quality standards are done in a laboratory setting, repeatable, and performed in accordance with the United States Environmental Protection Agency (USEPA) guidance and methodologies. Further, the results of the studies are almost always published in peer-reviewed journals. Tr.4 at 282. The Agency also notes that it is not a research entity. Tr.4 at 357. It is the United States Environmental Protection Agency that has the laboratories and scientists to perform research. *Id.*

In post-hearing comments, the environmental groups stated that the scientific community has expressed concern about the effects of radium on non-human life forms as evidenced by years of detailed study, resulting in numerous peer-reviewed publications. PC 28, Exh. 1, 4. The environmental groups state that the record establishes that a water quality standard is needed to protect aquatic life and riparian wildlife.

At the third hearing, WRT Environmental discussed various models and studies regarding the impact of radium on aquatic and terrestrial life. The first is a publication by the National Council on Radiation Protection (NCRP) entitled the “Effects of Ionizing Radiation on Aquatic Organisms.” Hearing Exh. 10. The second document is a technical standard put together by the Department of Energy’s (DOE) Biota Dose Assessment Committee (BDAC). Hearing Exh. 15. The third is a report prepared for the Southwest Florida Water Management District addressing the potential impacts of radium exposure to aquatic life (Florida study). Hearing Exh. 14, Attachment D. The Board discusses each of these documents in more detail below.

⁸ The ECOTOXicology database (ECOTOX) is a source for locating single chemical toxicity data for aquatic life, terrestrial plants and wildlife. ECOTOX was created and is maintained by the USEPA, Office of Research and Development (ORD), and the National Health and Environmental Effects Research Laboratory's (NHEERL's) Mid-Continent Ecology Division.

NCRP Report

The NCRP report provides guidance for establishing a dose rate below which deleterious effects of ionizing radiation on aquatic life are found. Hearing Exh. 10. The NCRP report advocates measuring the impact of radiation on species populations rather than on individual organisms of aquatic life. Hearing Exh. 10 at 36. Mr. Adams maintains that the NCRP report includes information on the effects of ionizing radiation on aquatic life. The NCRP report recommends a reference level of 0.4 mGy per hour (approximately 1 rad per day) for protection of aquatic life from chronic radiation exposure. Hearing Exh. 10 at 38. The Agency stated that using the NCRP report, a former Agency employee interpreted the threshold level of radium to be 22,000 pCi/L. Tr.4 at 285-86. This demonstrates, according to the Agency, that aquatic life is not the most sensitive species.

Department of Energy Technical Standard

The DOE's Biota Dose Assessment Committee (BDAC) prepared the DOE technical standard. Hearing Exh. 15. The technical standard is a graded approach to evaluate compliance with specified limits on radiation dose to populations of aquatic animals, terrestrial plants, and terrestrial animals due to anthropogenic sources at DOE sites. The DOE standard provides radiation exposure levels for the protection of biota from the effects of ionizing radiation. WRT Environmental submitted the DOE technical standard and presented testimony on the relevance of that standard with respect to radium impacts on aquatic and terrestrial life.

Dr. Anderson believes the DOE technical standard is the appropriate methodology to use to calculate the threshold level of combined radium 226 and 228 that would be protective of the environment. Hearing Exh. 13. Dr. Anderson explained that the threshold, as described by the BDAC, is the level of radiation exposure below which no population level effects on the biota have been documented. Tr.4 at 54-55. Dr. Anderson explained that the technical standard is a methodology, not an observational or experimental study. Tr.4 at 59. Dr. Anderson agreed with the Agency that he found no toxicological studies analyzing the impacts of radium. He opines this is true because radium is too dangerous to work with. *Id.* Dr. Anderson defined toxicological studies as analyzing the impacts of a specific dose of radiation on a species.

Dr. Anderson and Dr. Adams stated that the DOE technical standard provides a methodology for deriving a bioconcentration guide (BCG)⁹ for riparian and aquatic animals. The assumptions used to derive the BCG for radium show the riparian mammal, not the aquatic animal as the limiting organism. Dr. Anderson explained that the riparian mammal seems to be the most limiting organism because of bioconcentration. Tr.4 at 263-65, 273.

The Agency's Mr. Mosher agrees that riparian mammals living in or near the water are probably the group of organisms with the most sensitive use. Tr.4 at 276, 286. Mr. Mosher

⁹ A BCG is the limiting concentration of a radionuclide in soil, sediment, or water that would not cause dose limits for protection of populations of aquatic and terrestrial biota to be exceeded. Hearing Exh. 15.

highlights two default assumptions in the DOE technical standard as being particularly conservative, making the standard impractical to use as a basis for a state water quality standard. First, Mr. Mosher states the standard assumes that the riparian mammal must live in the middle of the stream that receives the radium discharge for its entire life. Tr.4 at 295. The assumption is that the animal is exposed to the stream 24 hours a day and eats only from the stream.

Second, the standard assumes that the concentration of radium in the stream is constant in a 7Q10 zero stream.¹⁰ Mr. Mosher states that 7Q10 is a concept built into the Board's regulations that drives lots of things that the Agency does. It is a worst-case scenario the Agency uses in establishing permit limits. Tr.4 at 298-99. Mr. Mosher states that the Agency believes the worst case in a sewage plant discharge will be about ten picocuries per liter of radium. Mr. Mosher explains that in Northern Illinois, it is only an extremely small portion of the time that the flow will be a 7Q10 zero flow; *i.e.* when the stream flow will be only the effluent flow. Therefore, asserts Mr. Mosher, in reality the riparian mammal in Northern Illinois will receive the full dosage (of 10 pCi/L) for only a small part of the year. Tr.4 at 299. In contrast, the technical standard assumes a full dosage all of the time.

In post-hearing comments, Dr. Anderson and the environmental groups dispute some of the Agency's conclusions regarding underlying assumptions of the technical standard. Dr. Anderson states that for the category of riparian animals, the standard recognizes "that the riparian pathways of exposure combine aspects of both the terrestrial and aquatic systems." PC 26, Anderson comment at 2; citing Hearing Exh. 15, Module 3, pg. 2. Therefore, argues Dr. Anderson, "the organism doesn't have to be immersed in the contaminated water or the contaminated sediments to be exposed." PC 26, Anderson comment at 2. Dr. Anderson explains that the default value for the screening criterion is based on the assumption of 100% residence time for the riparian animal, some mammals in fact fully meet this criterion. For example, small mammals with limited home ranges such as mice, voles, and shrews. *Id.*

Dr. Anderson and the environmental groups both state that the DOE standard is liberal because it reflects the dose below which no *population level effects* rather than individual effects have been observed. Consequently, argues Dr. Anderson, the screening criterion does not meet the requirements of the Illinois Endangered Species Protection Act to protect *individuals* of listed species. PC 26, Anderson comment at 2; PC 28 at 8.

The environmental groups claim there are additional liberal assumptions. They state that levels of up to 23 different radionuclides present in the water and sediment determine radiation exposure, and the DOE technical standard general screen is based only on contribution from radium 226 and 228. PC 28 at 8. Further, the assumption that radiation exposure from water and sediment is uniform and continuous (Hearing Exh. 15, module 1, pg. 12, table 2.2) may in fact be overly lenient because it measures only soluble radium, not highly radioactive particulates that may be discharged by wastewater treatment plants. PC 28 at 8.

¹⁰ A 7Q10 stream flow is the average low stream flow suspected in a seven-day period with a ten-year recurrence interval. Tr.4 at 297.

The environmental groups state that the DOE technical standard demonstrates that any Illinois general use or Lake Michigan basin water quality standard for radium should be designed to protect riparian organisms in freshwater aquatic systems. PC 28 at 4. Using the river otter as the indicator species and applying the DOE Technical Standard, the environmental groups determined that a combined concentration of 3.7 pCi/L of radium 226 and 228 in the water column does not exceed the biota dose limits for those two radionuclides. PC 28 at 6-7, Exh. 9. The environmental groups note that the DOE technical standard, while its principal use is to demonstrate that DOE activities comply with biota dose limits for protection plant and animal populations, can be used for Clean Water Act applications such as mixing zone assessments. PC 28 at 7; *citing* DOE Technical Standard, p. M1-17, M1-20.

Joliet contends the DOE Standard submitted by WRT Environmental is not an appropriate basis for water quality standards because it provides very conservative results. PC 29 at 4.

Southwest Florida Water Management District Study

WRT Environmental also introduced the Florida study. The Florida study found that levels of radium in some freshwater mussels in lakes recharged with groundwater containing low levels of radium 226 (< 5 pCi/L) ranged from 9 to 205 pCi per gram. Hearing Exh. 14, Attachment D. WRT asserted that radium levels were high enough that the mollusks would qualify as low-level radioactive waste. Hearing Exh. 13 at 2. WRT also noted that the radium levels in the very range that meet the BDAC biota dose limit may adversely affect mussels, including mussels such as those listed as endangered or threatened in Illinois. Tr.4 at 28.

The Agency noted that the Florida study merely recorded radium concentrations but made no conclusions about whether any adverse environmental impacts were observed in the mussels or riparian mammals inhabiting the area. The Agency concluded that the research was based on a unique ecosystem that could not be extrapolated to Illinois streams or even Illinois lakes. PC 33 at 6.

Board Discussion on Evidence of Adverse Impacts of Radium on Aquatic Biota

While the ECOTOX database that the Agency regularly consults in deriving water quality standards may not contain toxicological studies demonstrating the impacts of radium on aquatic life, the record clearly shows that evidence exists, such as methodologies for assessing biota dose limits and literature regarding the effects of radiation on the environment. The DOE technical standard provides radiation dose limits for the protection of aquatic life and terrestrial animals. In addition, the Florida study indicates that radium concentrations in lake water of less than 5 pCi/L resulted in an internal dose for lake mussels of 5.5 rad per day; considerably higher than the 1 rad per day limit set for aquatic animals by the DOE technical standard.

Although these studies are not the kinds the Agency typically uses to derive water quality standards, the Board finds that they demonstrate that radium can adversely impact aquatic biota, in addition to humans. The Board realizes that the DOE technical standard incorporates some conservative assumptions. However, the Board also finds that because radium is

bioconcentrating and bioaccumulating and persists in the environment for so long (radium 226 has a half-life of 1,600 years), conservative assumptions are appropriate to protect human health and the environment at this time.

Level of Protection of the Illinois Radium Water Quality Standard

At hearing and in public comments, the parties discussed whether the general use water quality standard for radium should be protective of humans or the environment. The Agency testified that by setting the radium water quality standard for public and food processing water supplies at the same level as the drinking water MCL, this rulemaking will allow community water supplies to come into compliance with the Safe Drinking Water Act while preventing these same water supplies from creating non-compliance issues for POTWs. The Agency notes that the rulemaking would still protect surface water quality. Tr.1 at 13-14.

Agency Proposal

The Agency's position is that water quality standards are only required where there are actual environmental conditions in the waters of the State that are somewhat near the threshold of harmful effects to aquatic life. Tr.4 at 286. Where, like in Illinois, the threshold for radium is much higher than what exists in the environment, there is no need for a standard. *Id.* Mr. Mosher stated that a former Agency employee applied the model in Exhibit 10, "Effects of Ionizing Radiation on Aquatic Organisms," and came up with 22,000 picocuries per liter radium as the threshold of harmful effects to aquatic life. Tr.4 at 286; *see also* Responses to Pre-Filed Questions of Sierra Club and Environmental Law & Policy Center to the Illinois Environmental Protection Agency, Hearing Exh. 12.

As mentioned above, Mr. Mosher agrees that riparian mammals, not aquatic life, are the limiting organisms. But, he argues that the default assumptions in the DOE technical standard are conservative, making the standard impractical to use as a basis for a state water quality standard.

Regarding radium water quality standards in other states, Mr. Mosher asserts no other state agencies he contacted have standards for any other reason than to protect humans via the consumption of drinking water. In every case, according to Mr. Mosher, the standards were adopted in the 1970s. Tr.4 at 305.

MWRDGC's Support for Agency Proposal

Dr. Abdul Khalique, a radiation chemist, testified on behalf of the MWRDGC. At hearing and in post-hearing comments, the MWRDGC supports the Agency's proposal stating it is adequately protective of human health. Dr. Khalique notes that the U.S. Environmental Protection Agency and Illinois maximum contaminant level concentrations for radium 226 and radium 228 in drinking water are 5 pCi/L. Dr. Khalique testifies that the 5 pCi/L radium 226 and 228 combined standard will result in an equivalent of 4 mrem per year for humans, a limit that is,

by applying the DOE Technical Standard dose rate of 1 rad per day, thousands of times more stringent than necessary to protect aquatic animals and terrestrial plants. PC 11 at 3.

The MWRDGC maintains that radiation protection standards have been expressly developed for the protection of human health; by protecting humans, radiation standards are adequately protective of the environment as well. MWRDGC states that two authorities support this principle: the Biological Effects of Ionizing Radiation Report, National Academy of Sciences, 1972, and the International Commission on Radiological Protection Report, 1991. PC 11.

Joliet's Support for Agency Proposal

Overall, Joliet supports the Agency's proposal and disagrees with maintaining a numeric water quality standard. According to Joliet, whether the standard is 60 pCi/L or 3.75 pCi/L none of the proposed standards are supported by adequate scientific basis. Joliet argues that because the highest reported radium concentration from a deep well in Illinois is less than 40 pCi/L combined radium 226 and 228, a limit of 60 pCi/L combined radium 226 and 228 will not require any facilities to modify their operations. Joliet asserts that in order to come into compliance with a lower water quality standard, communities will have to increase the costs of projects required to come into compliance with the drinking water standard. PC 29 at 6.

WRT Environmental's Support for Existing Standard

In response, WRT's Mr. Adams warns that when considering exposure to radium, five picocuries of radium to a human is not the same as five picocuries to a mussel. He states that humans drink the water; mussels live in it. Tr.4 at 237. The real measurement in determining whether a radium standard is protective of human health *and* the environment is measured by assessing exposure to the animal, not the concentration of radium in the water. *Id.*

According to WRT Environmental in its closing comments, the Agency simply did not adequately consider the factors set forth in Section 27(a) of the Act. PC 27 at 5. WRT Environmental asserts that the Agency did not adequately consider the existing physical conditions or the character of the areas involved, including land uses, zoning classifications, the nature of the receiving body of water and the technical and economic reasonableness of measuring or reducing radium. *Id.*

Contrary to the Agency's testimony, WRT's Mr. Williams states Illinois is not unique in having a water quality standard for radium based on the protection of aquatic life, and provides some examples. Mr. Williams asserts that Florida's surface water standard of 5 pCi/L includes Class II waters which are protected for shellfish propagation or harvesting as well as Class III waters which are protected for the propagation and maintenance of a healthy well-balanced population of fish and wildlife. Mr. Williams contends that the stated goal of Ohio's water quality criterion for radium in the Ohio River, 4 pCi/L, includes the preservation of warmwater habitat. Hearing Exh. 5.

According to Mr. Williams, the current radium standard is very low, perhaps even unrealistically low. Tr.3 at 77. He states that the Illinois standard is one of the lowest he has encountered. Tr.3 at 88. However, Mr. Williams also states that allowing unlimited discharge is “definitely unrealistically high.” Tr.3 at 77.

Environmental Groups for Protecting Riparian Mammals

In their post-hearing briefs, the environmental groups contend that “despite four hearings, the information available to the Board is not adequate to make a confident scientific judgment as to the proper general use water quality standard to adopt for radium.” The environmental groups maintain, however, that the record does establish that a general use water quality standard is necessary to protect aquatic life and riparian wildlife. The environmental groups state that water quality standards must protect the most sensitive use of the water body. PC at 1; citing 40 C.F.R. 131.11; *In re* Petition of Illinois Power Co. for Adjusted Standards from 35 Ill. Adm. Code 302.208(e), AS 92-7 (Oct. 7, 1993). According to the environmental groups, the most sensitive use of the water body is riparian wildlife, such as river otters, that use water bodies for almost all of their food and drink.

The environmental groups explain that river otters exist in Illinois, and they are listed on the State’s endangered and threatened species list. PC 28 at 5. The river otters spend greater than 80% of their life, which range between 10 to 15 years, in water. The environmental groups contend that the exposure time is sufficiently long for an otter to be at risk for tumor induction. *Id.* at 6. For these reasons, state the environmental groups, the numeric standard necessary to protect riparian wildlife must be more stringent than that necessary to protect humans by way of consuming drinking water. PC 28 at 2.

The environmental groups state that the Board often considers uses other than drinking water by humans in promulgating water quality standards. The environmental groups state that, contrary to the Agency’s proposal, the scientific community has expressed concern with the effects of radium on non-human life forms that live in or near bodies of water. PC 28 at 3. In support, the environmental groups attached a literature review done by a senior environmental scientist for the Southwest Florida Water Management District. PC 28, Exh. 1. Further support, argue the environmental groups, is that in recognizing the threat of radiation to non-humans, the U.S. Department of Energy has promulgated a radiation dose limit of 1 rad per day (rad/d) for the protection of aquatic animals and 0.1 rad/d for terrestrial animals (based on mammals’ higher sensitivity to radiation). PC 28.

IEMA for Protecting Human Health

In a public comment, Illinois Emergency Management Agency (IEMA) stated it agrees with the Agency that the existing general use water quality standard for radium 226 (1 pCi/L) is too low, given Illinois’ drinking water standard (5 pCi/L) and the existing levels of radium in natural background. According to IEMA, the general use water quality standard should be set for the protection of human health. IEMA states that it tests most community drinking waters in the state and tests indicate that natural background radium concentrations in Northern Illinois range from less than detectable to about 25 to 30 pCi/L. PC 24.

IEMA agrees with the Agency's proposal to change the public and food processing water supply standard to 5 pCi/L. However, IEMA does not agree with eliminating the general use water quality standard because eliminating the standard could allow significant sources of discharge to go unchecked. PC 24 at 2. IEMA argues that while radiation exposures to aquatic biota may be legitimate concerns, the protection of aquatic biota was not an original objective of the general use water quality standard for radium. If the Board wishes to support such a policy shift, asserts IEMA, the initiative must be supported by specific Illinois environmental data, which this rulemaking lacks.

Board Discussion on Level of Protection

The Board regularly considers the protection of aquatic life in promulgating water quality standards. For example, the Board adopted the water quality criteria for sulfate and TDS in order to sufficiently protect aquatic life and public water supplies. *See* Effluent Criteria, R70-8; Water Quality Standards, R71-14; Water Quality Standards Revisions for Interstate Waters (SWB 14), R71-20, slip op. at 7, 8 (Mar. 7, 1972). Federal and state laws and regulations require the consideration of any harm a standard may cause to aquatic life or the propagation of fish and wildlife when adopting water quality standards. For example, Section 11 of the Act states:

Pollution of the waters of this State constitutes a menace to public health and welfare, creates public nuisances, is harmful to wildlife, fish, and aquatic life, impairs domestic agricultural, industrial, recreational, and other legitimate beneficial uses of water, depresses property values, and offends the senses

The Clean Water Act provides guidance to states revising or adopting new water quality standards:

Such standards shall be established taking into consideration their use and value for public water supplies, propagation of fish and wildlife, recreational purposes, and agricultural, industrial, and other purposes, and also taking into consideration their use and value for navigation. 33 U.S.C. 1313(c)(2)(A).

Regulations implementing the Clean Water Act on the issue of establishing water quality standards provide that "for waters with multiple use designations, the criteria shall support the most sensitive use." 40 C.F.R. 131.11(a). Finally, Section 302.202 of the Board's general use water quality standards states:

The General Use standards will protect the State's water for aquatic life . . . , wildlife, agricultural use, secondary contact use and most industrial uses and ensure the aesthetic quality of the State's aquatic environment. 35 Ill. Adm. Code 302.202.

After discussions regarding what use is the most sensitive use with respect to radium in the waters of the Illinois, the Board agrees with the conclusions of the environmental groups and the Agency that the riparian mammal is the most impacted use. Because the riparian mammal

forages in the stream and relies on the stream for all or most of its food, its use is more sensitive than humans' to the effects of radium. The record shows that the reproduction processes, gametic formation through embryonic development, are likely to be the most limiting endpoint in terms of survival of a population. Hearing Exh. 15 M1-5. . Hearing Exh. 10 at 61. Further, it is clear from the record that riparian mammals such as the river otter exist in Illinois and that the populations are endangered. Therefore, the Board finds it is appropriate to promulgate a water quality standard protective of the environment, including riparian mammals, as well as human health.

Further, the Board agrees with the environmental groups and WRT Environmental that the DOE technical standard provides the necessary guidance to establish a water quality standard for radium 226 and 228 for Illinois' general use waters and the Lake Michigan basin that would be protective of both human health and the environment.

Although the technical standard was developed by BDAC for use at DOE sites, the Board finds that the standard's biota dose limits provides sufficient scientific basis and support for establishing general use water quality standard for radium. Since Illinois-specific water quality data and studies concerning radium are not available, the technical standard is a sound interim approach. As observed by the environmental groups and WRT Environmental, a combined concentration of 3.75 pCi/L or less would meet the biota dose limit for riparian animals. Although this combined concentration does not include any potential contribution from radium in sediments, the Board believes that a general use standard based on BCGs for radium in water is protective of human health and the environment.

Relief For Publicly Owned Treatment Works

A significant reason why the Agency proposed to amend the radium water quality standards is to provide relief for POTWs that receive wastewater from public water supplies (PWS) using high radium groundwater as the potable raw water source. These PWS treat high radium well water to meet Safe Drinking Water Act MCLs. The residuals from the treatment system are generally discharged into the sanitary sewer system, treated at the POTW, and discharged to a receiving stream, with sludge being land applied or landfilled.

The Agency states that existing treatment technologies used by POTWs appear to have an impact on reducing the radium level in the influent. Statement at 13-14. As an example, the Agency states that a 1985 study of five Wisconsin communities shows that POTWs utilizing biological treatment may remove anywhere from 29 to 97% of the influent radium. Where high radium groundwater is utilized, radium in treated sewage effluent is expected at concentrations exceeding the existing General Use standard. Statement at 14.

The participants generally agreed that the most problematic situation are the POTWs discharging to 7Q10 no-flow streams. Tr.at 223. A 7Q10 stream flow is a very rare stream flow event. Tr.at 297.

The Agency's Mr. Mosher states it is the POTWs that receive high radium groundwater and are located on small, zero or low 7Q10 stream flow streams that are more likely to violate

the radium standard in their sewage treatment plant discharge if the present regulation is maintained. Tr.4 at 377-78. The Agency, however, does not know what the concentration of radium would be in the discharge from POTWs. Tr.4 at 379. Further, while over 100 communities in Illinois do not meet the radium drinking water standard, not all of the POTWs in those communities are located on zero-flow or low 7Q10 streams. Tr.1 at 39-40; Tr.4 at 229.

Dr. Anderson suggested that the Board keep a general use water quality standard and apply an effluent standard to POTWs or require POTWs to go through the Board's site-specific rulemaking procedure. In post-hearing comments, WRT Environmental suggests that the Board should "follow the 'Precautionary Principle' and follow an approach that provides relief only to those who need relief, and then only under conditions that can be monitored and verified." PC 27 at 19. WRT Environmental suggests new rule language that provides relief only to municipalities operating a POTW that receives wastewater from communities with groundwater containing radium over the existing drinking water standard. According to WRT Environmental, this solution would not reward any other facilities or sources that did not participate in this proceeding "hoping to catch the benefits of the regulatory roll-back." PC 27 at 20.

Joliet states that if the Board decides to establish a combined radium 226 and 228 standard at 3.75 pCi/L, many of the affected water supplies and wastewater treatment plants would be forced to modify their operations. PC 29 at 5. These modifications would increase the cost of the projects that communities are required to implement to comply with the drinking water standards. In order to address POTW concerns, Joliet recommends a general use standard for combined radium 226 and 228 of 30 pCi/L, and a standard of 36 pCi/L for streams receiving discharges limited to 800 hours per year.

Worker Safety

One issue the parties discussed at length relates to worker safety issues that arise from handling sludge potentially contaminated by radium. Joliet stated that sludge containing radium at the Joliet POTW facility is collected and handled as a liquid, and is not open to the air until truck loading. The truck loading takes place outdoors at the Joliet wastewater treatment plant so the concentration of radon does not build up. Tr.4 at 393-394.

Mr. Ted Adams, on behalf of WRT Environmental, testified that the treatment of raw water with high levels of radium creates safety and liability issues at both the water treatment plant and the POTW. It is the handling and disposal of contaminated sludge that poses a significant concern, both economic and regulatory, to the POTWs and their workers. Tr.3 at 11. Mr. Adams concludes that radium-contaminated water treatment sludge or residuals should not be disposed of in the sanitary sewer, but should instead be disposed of in an environmentally safe, secure, and isolated permitted landfill or licensed disposal facility. Tr.3 at 24.

The Agency asserts that the safety of workers in plants treating high radium groundwater is an issue that should be addressed by OSHA, not the Board or the Agency in this rulemaking. Tr.3 at 7-8.

Joliet's additional public comment included a letter from Mr. Port, a certified health physicist, to rebut information included in WRT's post-hearing public comment. In Mr. Port's opinion, the Illinois Emergency Management Agency's Division of Nuclear Safety is among the most respected Agreement State programs in the country. Mr. Port follows up that comment by stating the Board should turn to IEMA for input on non-public and worker radiation safety. IEMA has standards for protection against radiation to the environment (60 pCi/L) and to sewage (600 pCi/L). Mr. Port believes Mr. Adams exaggerated the skin dose to the public by more than five orders of magnitude and overstates the risk as well. Joliet Mot., Exh. 1 at 3.

Disposal of Wastewater Treatment Sludge

The parties also discussed various sludge disposal options consisting of either treatment technologies or land application. Dr. Anderson believes that the land application of waste treatment sludge that exhibits high concentrations of radium creates the possibility of bioaccumulation in indigenous vegetation or in planted crops or uptake by birds, snakes, turtles, or shrews when these animals eat earthworms. Hearing Exh. 13.

WRT Environmental introduced a letter from IEMA indicating that WRT's customers must be registered as generators of low-level radioactive waste and licensed under Illinois law. Hearing Exh. 11. Mr. Williams stated that whether IEMA will regulate water treatment plants that treat groundwater containing high levels of radium is uncertain. However, Mr. Adams identified both a federal and state standard that apply to facilities licensed by the U.S. Nuclear Regulatory Commission (NRC) that regulate the dispersion of radioactive materials in sanitary sewer systems. Hearing Exh. 4, Exh. B. Both 10 C.F.R. 20.2003 and 32 Ill. Adm. Code 340.1030(a)(1) prohibit the disposal by a licensee of non-soluble radioactive material into a sanitary sewer. *Id.*

A Memorandum of Agreement (MOA) between the Agency and IEMA sets the criteria for the level of radium in sludge mixed with soil for agricultural use. According to the MOA, the incremental increase of radium concentration in the soil must not exceed 0.1 pCi/g. The MWRDGC opines that the MOA standard is extremely conservative. PC 11 at 4. For example, argues the MWRDGC, a level of 25 mrem per year (established by the NRC to designate a decommissioned facility suitable for unrestricted use) or 10 mrem per year from all radionuclides (established by the Interagency Steering Committee on Radiation Standards as the threshold below which no further steps are warranted) are appropriate levels for biosolids. PC 11 at 4. The MWRDGC also cites to the IDNS' decontamination guideline of 5 pCi/g dry soil for radium 226. *Id.*; citing 32 Ill. Adm. Code 340.Appendix A. In conclusion, the MWRDGC believes that a guidance limit of 0.1 pCi/g dry weight of radium 226 in sludge is overly stringent. PC 11 at 5.

According to the Agency, under a memorandum of agreement with the Department of Nuclear Safety, anything under 5 pCi/g is acceptable by Illinois permitted landfills. Sludge containing between five and 15 pCi/g is also still acceptable as long as there is ten feet of uncontaminated overburden. Hearing Exh. 5 attach. 1; Tr.4 at 318. Further, the Agency contends that this rulemaking is not the appropriate forum to discuss the issues of radium and sludge. The Agency asserts this topic is not within the scope of the proposal and is better dealt with in amendments to the Agency's land application of sludge rules. Tr.3 at 7.

Board Discussion on Relief for POTWs

The Board recognizes the existence of a naturally-occurring radium belt in Northern Illinois. The Board realizes that due to the federally-mandated drinking water standard of 5 pCi/L combined radium 226 and 228, public water supplies in Northern Illinois are often faced with the duty to remove radium. The removal of radium by public water supplies can result in the discharge of high radium concentration wastewater into POTWs via sewer systems. Issues such as POTW worker safety and disposal of sludge containing radium are important to discuss because the Board must consider the negative impacts, if any, a rulemaking would have on human health and the environment. However, the Board notes that the Agency and IEMA have separate rules that address the land application of sludge containing radium (35 Ill. Adm. Code Part 391) and worker safety at facilities licensed to handle radioactive materials (35 Ill. Adm. Code Part 340). Such rules are not part of this rulemaking docket. Therefore, the Board will not discuss these issues in further detail.

It is evident from the record that, while POTWs reduce the radium concentration in their effluent to some degree with existing treatment systems, the POTWs may not be able to meet the current 1 pCi/L radium 226 water quality standard. The Board agrees with the Agency that POTWs in communities using high radium groundwater as the raw water source must receive regulatory relief. As discussed in further detail below, the Board provides this relief within the framework of a general use radium water quality standard.

Available Water Treatment Technologies for Removing Radium

As discussed in the Board's first notice opinion and order, the Agency states that community water supplies that exceed the MCL of 5 pCi/L combined radium 226 and 228 have three basic options to lower radium levels: (1) blending the high radium source water with an unaffected source of water; (2) acquiring an alternative source for drinking water; or (3) installing treatment for the source water. Statement at 12. The Agency notes that the USEPA considers ion exchange, reverse osmosis and lime softening as the best available technologies to meet public water supply requirements for radium. Small system (facilities servicing less than 10,000 people) compliance technologies also include green sand filtration, hydrous manganese oxide filtration, and enhanced coagulation/filtration. The Agency states that almost all radium in drinking water pumped from the ground ends up either in sewage sludge or effluent. Statement at 14.

Hydrous Manganese Oxide (HMO) is the preferred treatment technology of Joliet. Joliet states the HMO process removes radium from the drinking water by co-precipitating radium with pre-formed hydrous manganese oxide. Hearing Exh. 3 at 3. In this process, a solution of HMO is mixed with the well water and forms a precipitate. The radium attaches to the precipitate. Next, the filters collect the precipitate and begin to filter water at a slower rate. Joliet continues that the flow of water is then reversed and the precipitate is washed from the filter and collected. This wastewater from the water treatment process, containing the radium removed from the drinking water, is then discharged to the sanitary sewer. According to Joliet, the backwash combines with discharge from homes and businesses in the sanitary sewer and becomes the

influent to the wastewater treatment plants. Since the radium is removed and subsequently recombined, there is no change in the quantity of radium anticipated to arrive at the wastewater treatment plants. Hearing Exh. 3 at 3-4.

WRT Environmental describes several treatment technologies that it claims can effectively reduce or eliminate the disposal of radium removed from drinking water onto the land and into the streams of Illinois. Hearing Exh. 5 at 9. WRT Environmental discussed the following processes: (1) reverse osmosis; (2) ion exchange; (3) hydrous manganese oxide; (4) lime softening; and (5) an absorbent media removal process.

WRT Environmental states the five treatment processes it described remove radium without creating a residual to be disposed of down the sewer. Hearing Exh. 5 at 12. The residuals from these processes are instead disposed of in a low level radioactive landfill.

Joliet is concerned with WRT Environmental's proposed treatment methods. Joliet contends that a pilot test of the treatment method at its facility resulted in an increase in of radon in the system. Joliet opined that this indicates an increase in the radon that will be delivered to customers. Joliet continues that this issue is critical because radon is dangerous to humans by way of inhalation. PC 29 at 7.

Board Discussion on Available Water Treatment Technologies

The record shows that several radium removal treatment technologies are available to public water supplies and POTWs depending on the size of the facility and the concentration of radium in the groundwater or surface water. Circumstances may vary and the Board does not recommend a particular technology over any other. However, the testimony and comments in the record regarding treatment technologies may be useful to communities that need to meet the drinking water standard and/or the general use water quality standard.

Costs of the Proposal

As discussed in the Board's first notice opinion and order, the Agency believes its proposal would have a positive economic impact since it both increases the water quality standard for radium 226 and 228 and limits the waters to which the standard applies. Statement at 15. Because the proposal sets a radium level of 5 pCi/L for surface waters being used by public drinking water supplies, the Agency states that the proposed changes require no new technology. Thus, the Agency contends, its proposal would not negatively impact any existing sources. *Id.* The Agency justifies the proposal based on the cost of monitoring to the Agency.

At hearing, Joliet testified that "[i]n 1995, the U.S. Nuclear Regulatory Commission estimated that the cost to society for radiation exposure was \$2,000 per person rem. That would be for each person exposed to one rem. If I equate that to today's dollars, that's about \$2,500." Tr.4 at 396.

Mr. Williams commented on what he thought were the costs of the Agency's proposal, both economic and environmental. Mr. Williams stated that if POTWs dispose of sludge

containing radium into the public water systems, the POTWs and the state of Illinois can expect to have several increased costs: (1) the uncontrolled discharge of radium residuals could be a liability issue to municipalities and POTWs; (2) POTW workers will require training, personnel exposure monitoring and medical monitoring as occupational radiation workers; (3) sewer sludge handling areas will require ongoing testing; (4) the POTW may be required to obtain a radioactive materials license; (5) application of sewer sludge to farmland will require ongoing monitoring; and (6) sewer pipes and lines and the POTW itself may require decontamination. These costs, argues Mr. Williams, are the practical costs of the Agency's proposal. Tr.4 at 35-36.

Dr. Adams also stated there is an environmental cost. In order to flush filtrate materials down the sewer, the water treatment plants must pump 5 to 25% of the quantity of water being pumped for human consumption to perform the backflushing operation. According to Dr. Adams, areas already relying on deep aquifers for potable water supply are in the same areas where groundwater is a limited resource. Tr.4 at 36.

In contrast, Mr. Williams states that the cost of treatment systems that do not dispose of radium to the sewer or streams is competitive or lower than systems that do. For example, Mr. Williams states that the communities of Oswego and Elburn claimed they will save \$2 and \$2.6 million, respectively, over the life of their treatment technology contract. *See* Hearing Exh. 5 at 18.

According to the public comments, the costs of radium removal are high, and are costs that will be felt by local communities and residents. The City of Batavia stated it will spend more than \$15 million to meet the drinking water standard. PC 35. The Village of Romeoville has committed to spend \$11,251,000 in capital costs and \$40,287,000 in operating and maintenance costs (for a total of \$51,538,000) over the next 20 years to meet the drinking water standard. PC 13.

Board Discussion on Costs of the Proposal

The cost of radium removal varies greatly depending on the concentration of radium in a community's groundwater and the size of a facility. Any costs of removing radium from groundwater are incurred to come into compliance with Safe Drinking Water Act regulations. Further, the Board finds that the proposed radium 226 and 228 water quality standard will have minimal, if any cost impact on POTWs since the proposed rule allows a higher concentration of combined radium, 30 pCi/L, for stream segments receiving discharges from affected POTWs. Nonetheless, radium is a bioconcentrating and bioaccumulating radioactive metal and known human carcinogen. Accordingly, the Board finds that the cost to human health and the environment from discharging concentrations of radium above protective levels in the waters of our state is even greater.

The Participants' Recommendations

In post-hearing public comments, the following parties made suggestions regarding the Agency's proposal. Each of the parties' suggestions is summarized below.

The Agency

The Agency asks the Board to correct a “mistaken” regulation that has been on the books for 30 years and not require the wastewater treatment community to comply with a water quality standard more stringent than the Board’s drinking water standard. The Agency maintains that all available information suggests that human consumption is the most sensitive use for this parameter. The Agency urges the Board to send this rulemaking to second notice as originally proposed.

WRT Environmental

WRT argues that the DOE technical standard is the only approach that properly determines “safe” levels of exposure for aquatic life and riparian mammals. WRT maintains that applying the standard assuming a contribution from sediment, the combined radium limit would be approximately 1.36 pCi/L, which is very close to the existing standard of 1pCi/L radium 226.

Thus, WRT Environmental urges the Board to keep the existing standard for radium 226 and adopt a new subsection (c) to Section 302.207 of the Board’s rules. The new language would provide relief only to municipalities operating a POTW that receives wastewater from communities with groundwater containing radium over the existing standard. WRT Environmental proposes to limit the POTWs’ effluent in these certain communities to 2.72-3.75 pCi/L combined radium 226 and 228. Under WRT Environmental’s proposal, POTWs would only be allowed to discharge radium removal residuals in compliance with the sewer discharge limitations contained in 32 Ill. Adm. Code 340.1030(a). PC 27 at 20.

The City of Joliet

At hearing Joliet concluded that if there must be a general use water quality limit for radium, the number must be between 15 and 30 pCi/L radium 226 and 228 combined. In its post-hearing comments, Joliet emphasizes its support for the Agency’s proposal. Joliet notes that the Illinois Division of Nuclear Safety of the Illinois Department of Emergency Management has standards for the discharge into sanitary sewers (600 pCi/L combined radium 226 and 228) that were based on limits set by the U.S. Nuclear Regulatory Commission (NRC). The NRC has set a limit for the discharge of effluent to streams at a level of 60 pCi/L: a limit not adopted by Illinois.

Joliet contends that the water quality standard for food and water processing intakes should be 5.0 pCi/L combined radium 226 and 228, and the standard for all other streams should be 60 pCi/L. Joliet argues that because the highest reported radium concentration from a deep well in Illinois is less than 40 pCi/L combined radium 226 and 228, a limit of 60 pCi/L combined radium 226 and 228 will not require any facilities to modify their operations. PC 29 at 6. Should the Board choose a more conservative standard, Joliet suggests the Board could apply a safety factor of 2.0, resulting in a water quality standard for all streams other than food and water processing intakes of 30 pCi/L. Further, Joliet suggests that the water quality standard for discharges limited to a duration of less than 800 hours per year must be less than 36 pCi/L combined radium 226 and 228.

Environmental Groups

The environmental groups recommend that the Board maintain general use and Lake Michigan basin water quality standards for radium and set such standards at 3.7 pCi/L combined radium 226 and 228, to ensure that high levels of radium are not discharged into Illinois waterways. PC 28 at 3. They explain that 3.7 pCi/L is derived from the general screening model of the RAD-BCG calculator contained in the DOE technical standard. PC 28 at 6. The combined concentration of 3.7 pCi/L of radium does not exceed the BCGs listed for the two radionuclides in the technical standard, assuming there is no radiation contribution from any other radionuclide source.

Illinois Emergency Management Agency

IEMA agrees with the Agency's proposal to change the public and food processing water supply standard to 5 pCi/L. However, IEMA does not agree with eliminating the general use water quality standard because eliminating the standard could allow significant sources of discharge to go unchecked. PC 24 at 2. According to IEMA, the Board should adopt an interim standard for the protection of human health based on the federal NRC standard. 10 C.F.R. part 20, Appendix B, Table 2. IEMA has adopted this standard into Illinois radiation protection regulations applicable to radioactive materials licensees who discharge into surface waters. The standard is 60 pCi/L combined radium 226 and 228 and relates to the radiation dose to humans. 32 Ill. Adm. Code 340. This concentration of radium, if ingested continuously over the course of a year, would produce a total effective dose equivalent of 50 millirem, half the dose equivalent limit for members of the general public. PC 24 at 2.

DISCUSSION OF SECOND FIRST-NOTICE PROPOSAL

Below the Board analyzes the participants' recommendations, and the issues raised at hearing and in public comments. The Board will also discuss the second first-notice changes and give reasons for the changes.

Protecting Human Health and the Environment

The Board finds that evidence exists demonstrating that radium negatively impacts aquatic life and riparian mammals, in addition to humans. Further, based on the record, the Board also finds that any water quality standard for radium should be protective of both the environment, including riparian mammals, and human health. Thus, the Board finds that while the Agency's proposal is protective of human health, the proposal fails to protect the most sensitive use of the State's waters by eliminating the radium 226 standard for general use waters. The Board believes that a general use water quality standard for radium 226 and 228 must be retained to afford protection to most sensitive use, the protection of riparian mammals.

The DOE Technical Standard

The Board finds that the DOE technical standard provides the necessary guidance to establish a water quality standard for radium 226 and 228 applicable to general use waters and the Lake Michigan basin. As noted by the participants, the DOE technical standard provides a graded approach (including screening methods and methods for detailed analyses) and related guidance to evaluate compliance with specified limits on radiation dose to populations of aquatic animals, terrestrial plants, and terrestrial animals due to anthropogenic sources at DOE sites. The technical standard uses the following biota dose limits within a graded approach to demonstrate that populations of plants and animals are adequately protected from the effects of ionizing radiation: 1 rad/d (10 mGy/d) for aquatic animals and terrestrial plants; and 0.1 rad/d (1 mGy/d) for terrestrial animals.

The DOE technical standard provides BCGs for various radionuclides, including radium 226 and 228. BCG represents the limiting radionuclide concentration in environmental media that would not result in an exceedence of the DOE's established or recommended dose limits. During the screening level phase of the graded approach, the sum of the ratios of the measured concentration of each radionuclide to its corresponding BCG for each medium is summed across media. If the total sum of fractions is less than 1.0, the dose to an aquatic or terrestrial receptor is below the biota dose limit. Exh. 15 at M1-34. Under the DOE technical standard, an exceedence of the screening level would entail further investigation including site-specific evaluation.

The General Use Water Quality Limit

In order to promulgate a water quality standard for radium that is protective of the environment as well as human health, the Board will retain a general use water quality standard, but increase the standard to 3.75 pCi/L. As discussed above, this limit is based on the DOE technical standard that meets the biota dose limit of 0.1 rad/d for riparian animals. Based on the evidence in the record, the Board finds this general use standard will be protective of human health and the environment, including aquatic life and riparian mammals, and ensure that high levels of radium cannot be discharged into Illinois waterways.

Relief for POTWs

The Board considered a number of options for providing relief to POTWs, including a blanket exemption from general use radium water quality standards, setting effluent limits, and specifying mixing zones in accordance with 35 Ill. Adm. Code 302.102. However, since the noncompliance issues are mostly associated with POTWs discharging into low flow streams, the Board finds a Section 302.102 mixing zone would not address POTW concerns. Instead, the Board finds that specifying a zone of mixing allowing a radium concentration above the proposed general use standard better addresses the POTWs' concerns. The Board proposes a distance of 1 mile downstream from the point of POTW discharge as the zone of mixing within which the combined radium 226 and 228 concentration must not exceed 30 pCi/L. This limit is based on IEMA's recommendation of using the NRC limit and Joliet's suggestion of applying a factor of safety of 2. While the Board presently believes that a 1-mile segment of the stream should provide an adequate mixing zone for POTW discharges to comply with the proposed

general use standard of 3.75 pCi/L, the Board invites comments from the participants on this provision.

The Board agrees with the Agency and WRT Environmental that the public was given adequate opportunity to participate in this rulemaking and no sources other than POTWs and public interest groups indicated any support or opposition to the Agency's proposal. The Board recognizes that public water supplies may choose treatment technologies that require the disposal of media in a landfill or may send wastewater effluent containing elevated levels of radium into the sanitary sewer system causing compliance issues for POTWs. Accordingly, as described above, the Board creates a separate 1-mile water quality standard downstream of POTWs in communities using source water containing a high concentration of radium. However, the radium concentration must meet the general use standard at one mile downstream of the point of discharge. The Board finds this provision allows such POTWs to continue operations without incurring significant costs, while at the same time protecting human health and the environment.

The Board considered IEMA's suggestion of adopting an interim standard until more data is available to promulgate a permanent radium standard. The Board, however, believes the record is adequate to support today's findings without giving the regulation interim status. Accordingly, the Board proposes the rulemaking language below for second first notice, inviting the public to comment on the proposed changes.

CONCLUSION

To protect all designated uses of Illinois waters, the Board proposes a new general use water quality standard of 3.75 pCi/L combined radium 226 and 228, for second first-notice adoption. The Board's proposal sets a limit of 30 pCi/L combined radium 226 and 228 for any stream receiving discharge from a POTW that accepts wastewater from communities using high radium groundwater as raw drinking water. This 30 pCi/L combined radium standard applies for the first mile downstream of the point of discharge. Beyond one mile, the 3.75 pCi/L combined radium general use water quality standard applies. The proposal also applies the 3.75 pCi/L standard to the Lake Michigan basin.

As mentioned above, the Board does not anticipate holding additional hearings in this proceeding, but any party may request an additional hearing. Second first-notice publication in the *Illinois Register* will begin a period of at least 45 days for interested persons to file public comments with the Board.

ORDER

The Board proposes for first notice the following amendments to 35 Ill. Adm. Code 302 and directs the Clerk to file the proposed rules with the Secretary of State for publication in the *Illinois Register*. Proposed deletions to the current rules are stricken, and proposed additions are underlined.

TITLE 35: ENVIRONMENTAL PROTECTION
SUBTITLE C: WATER POLLUTION

CHAPTER I: POLLUTION CONTROL BOARD

PART 302
WATER QUALITY STANDARDS

SUBPART A: GENERAL WATER QUALITY PROVISIONS

Section	
302.100	Definitions
302.101	Scope and Applicability
302.102	Allowed Mixing, Mixing Zones and ZIDs
302.103	Stream Flows
302.104	Main River Temperatures
302.105	Antidegradation

SUBPART B: GENERAL USE WATER QUALITY STANDARDS

Section	
302.201	Scope and Applicability
302.202	Purpose
302.203	Offensive Conditions
302.204	pH
302.205	Phosphorus
302.206	Dissolved Oxygen
302.207	Radioactivity
302.208	Numeric Standards for Chemical Constituents
302.209	Fecal Coliform
302.210	Other Toxic Substances
302.211	Temperature
302.212	Total Ammonia Nitrogen
302.213	Effluent Modified Waters (Ammonia)(Repealed)

SUBPART C: PUBLIC AND FOOD PROCESSING WATER SUPPLY STANDARDS

Section	
302.301	Scope and Applicability
302.302	Algicide Permits
302.303	Finished Water Standards
302.304	Chemical Constituents
302.305	Other Contaminants
302.306	Fecal Coliform

SUBPART D: SECONDARY CONTACT AND INDIGENOUS AQUATIC LIFE
STANDARDS

Section

302.401	Scope and Applicability
302.402	Purpose
302.403	Unnatural Sludge
302.404	pH
302.405	Dissolved Oxygen
302.406	Fecal Coliform (Repealed)
302.407	Chemical Constituents
302.408	Temperature
302.409	Cyanide
302.410	Substances Toxic to Aquatic Life

SUBPART E: LAKE MICHIGAN BASIN WATER QUALITY STANDARDS

Section	
302.501	Scope, Applicability, and Definitions
302.502	Dissolved Oxygen
302.503	pH
302.504	Chemical Constituents
302.505	Fecal Coliform
302.506	Temperature
302.507	Thermal Standards for Existing Sources on January 1, 1971
302.508	Thermal Standards for Sources Under Construction But Not In Operation on January 1, 1971
302.509	Other Sources
302.510	Incorporations by Reference
302.515	Offensive Conditions
302.520	Regulation and Designation of Bioaccumulative Chemicals of Concern (BCCs)
302.521	Supplemental Antidegradation Provisions for Bioaccumulative Chemicals of Concern (BCCs)
302.525	Radioactivity
302.530	Supplemental Mixing Provisions for Bioaccumulative Chemicals of Concern (BCCs)
302.535	Ammonia Nitrogen
302.540	Other Toxic Substances
302.545	Data Requirements
302.550	Analytical Testing
302.553	Determining the Lake Michigan Aquatic Toxicity Criteria or Values - General Procedures
302.555	Determining the Tier I Lake Michigan Acute Aquatic Toxicity Criterion (LMAATC): Independent of Water Chemistry
302.560	Determining the Tier I Lake Michigan Basin Acute Aquatic Life Toxicity Criterion (LMAATC): Dependent on Water Chemistry
302.563	Determining the Tier II Lake Michigan Basin Acute Aquatic Life Toxicity Value (LMAATV)

- 302.565 Determining the Lake Michigan Basin Chronic Aquatic Life Toxicity Criterion (LMCATC) or the Lake Michigan Basin Chronic Aquatic Life Toxicity Value (LMCATV)
- 302.570 Procedures for Deriving Bioaccumulation Factors for the Lake Michigan Basin
- 302.575 Procedures for Deriving Tier I Water Quality Criteria and Values in the Lake Michigan Basin to Protect Wildlife
- 302.580 Procedures for Deriving Water Quality Criteria and Values in the Lake Michigan Basin to Protect Human Health – General
- 302.585 Procedures for Determining the Lake Michigan Basin Human Health Threshold Criterion (LMHHTC) and the Lake Michigan Basin Human Health Threshold Value (LMHHTV)
- 302.590 Procedures for Determining the Lake Michigan Basin Human Health Nonthreshold Criterion (LMHHNC) or the Lake Michigan Basin Human Health Nonthreshold Value (LMHHNV)
- 302.595 Listing of Bioaccumulative Chemicals of Concern, Derived Criteria and Values

SUBPART F: PROCEDURES FOR DETERMINING WATER QUALITY CRITERIA

Section

- 302.601 Scope and Applicability
- 302.603 Definitions
- 302.604 Mathematical Abbreviations
- 302.606 Data Requirements
- 302.612 Determining the Acute Aquatic Toxicity Criterion for an Individual Substance – General Procedures
- 302.615 Determining the Acute Aquatic Toxicity Criterion - Toxicity Independent of Water Chemistry
- 302.618 Determining the Acute Aquatic Toxicity Criterion - Toxicity Dependent on Water Chemistry
- 302.621 Determining the Acute Aquatic Toxicity Criterion - Procedure for Combinations of Substances
- 302.627 Determining the Chronic Aquatic Toxicity Criterion for an Individual Substance - General Procedures
- 302.630 Determining the Chronic Aquatic Toxicity Criterion - Procedure for Combinations of Substances
- 302.633 The Wild and Domestic Animal Protection Criterion
- 302.642 The Human Threshold Criterion
- 302.645 Determining the Acceptable Daily Intake
- 302.648 Determining the Human Threshold Criterion
- 302.651 The Human Nonthreshold Criterion
- 302.654 Determining the Risk Associated Intake
- 302.657 Determining the Human Nonthreshold Criterion
- 302.658 Stream Flow for Application of Human Nonthreshold Criterion
- 302.660 Bioconcentration Factor
- 302.663 Determination of Bioconcentration Factor
- 302.666 Utilizing the Bioconcentration Factor

302.669 Listing of Derived Criteria

APPENDIX A	References to Previous Rules
APPENDIX B	Sources of Codified Sections
APPENDIX C	Maximum total ammonia nitrogen concentrations allowable for certain combinations of pH and temperature
TABLE A	pH-Dependent Values of the AS (Acute Standard)
TABLE B	Temperature and pH-Dependent Values of the CS (Chronic Standard) for Fish Early Life Stages Absent
TABLE C	Temperature and pH-Dependent Values of the CS (Chronic Standard) for Fish Early Life Stages Present

AUTHORITY: Implementing Section 13 and authorized by Sections 11(b) and 27 of the Environmental Protection Act [415 ILCS 5/13, 11(b), and 27]

SOURCE: Filed with the Secretary of State January 1, 1978; amended at 2 Ill. Reg. 44, p. 151, effective November 2, 1978; amended at 3 Ill. Reg. 20, p. 95, effective May 17, 1979; amended at 3 Ill. Reg. 25, p. 190, effective June 21, 1979; codified at 6 Ill. Reg. 7818; amended at 6 Ill. Reg. 11161, effective September 7, 1982; amended at 6 Ill. Reg. 13750, effective October 26, 1982; amended at 8 Ill. Reg. 1629, effective January 18, 1984; peremptory amendments at 10 Ill. Reg. 461, effective December 23, 1985; amended at R87-27 at 12 Ill. Reg. 9911, effective May 27, 1988; amended at R85-29 at 12 Ill. Reg. 12082, effective July 11, 1988; amended in R88-1 at 13 Ill. Reg. 5998, effective April 18, 1989; amended in R88-21(A) at 14 Ill. Reg. 2899, effective February 13, 1990; amended in R88-21(B) at 14 Ill. Reg. 11974, effective July 9, 1990; amended in R94-1(A) at 20 Ill. Reg. 7682, effective May 24, 1996; amended in R94-1(B) at 21 Ill. Reg. 370, effective December 23, 1996; expedited correction at 21 Ill. Reg. 6273, effective December 23, 1996; amended in R97-25 at 22 Ill. Reg. 1356, effective December 24, 1997; amended in R99-8 at 23 Ill. Reg. 11249, effective August 26, 1999; amended in R01-13 at 26 Ill. Reg. 3505, effective February 22, 2002; amended in R02-19 at 26 Ill. Reg. 16931, effective November 8, 2002; amended in R02-11 at 27 Ill. Reg. 166, effective December 20, 2002; amended in R_____ at _____ Ill. Reg. _____, effective _____.

SUBPART B: GENERAL USE WATER QUALITY STANDARDS

Section 302.207 Radioactivity

- a) Gross beta (STORET number 03501) concentration shall not exceed 100 picocuries per liter (pCi/L).
- b) ~~Concentrations of radium 226 (STORET number 09501) and strontium 90 (STORET number 13501) concentration must not exceed 1 and 2 picocuries per liter (pCi/L) respectively.~~
- c) Radium 226 and 228 (STORET number 11503) combined concentration must not exceed 3.75 picocuries per liter (pCi/L), except as provided in subsection (d) of this Section.

- d) The concentration of combined radium 226 and 228 must not exceed 30 pCi/L in waters receiving discharge from a publicly owned treatment works (POTW) for up to one mile downstream of the POTW discharge outfall, if the POTW receives wastewater from any community that extracts, for drinking water use, groundwater containing radium 226 and 228 combined at concentration levels exceeding 3.75 pCi/L.

(Source: Amended at _____ Ill. Reg. _____, effective _____)

SUBPART E: LAKE MICHIGAN BASIN WATER QUALITY STANDARDS

Section 302.525 Radioactivity

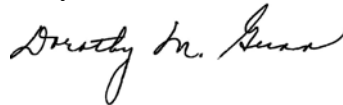
Except as provided in Section 302.102, all waters of the Lake Michigan Basin must meet the following concentrations in any sample:

- a) Gross beta (STORET number 03501) concentrations must not exceed 100 picocuries per liter (pCi/L).
- b) ~~Concentrations of radium 226 (STORET number 09501) and sStrontium 90 (STORET number 13501) concentration shall not exceed 1 and 2 picocuries per liter (pCi/L) respectively.~~
- c) Radium 226 and 228 (STORET number 11503) combined concentration must not exceed 3.75 picocuries per liter (pCi/L) at any time.

(Source: Amended at _____ Ill. Reg. _____, effective _____)

IT IS SO ORDERED.

I, Dorothy M. Gunn, Clerk of the Illinois Pollution Control Board, certify that the Board adopted the above opinion and order on April 7, 2005, by a vote of 4-0.



Dorothy M. Gunn, Clerk
Illinois Pollution Control Board