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Rev. Thomas J. Paprocki, President
Edward Grossman, Executive Director
Marta C. Bukata, Deputy Director
Keith I. Harley
Veronique Baker
Greta Doumanian

Downtown Office
205 W. Monroe, 4th Floor
Chicago, IL 60606

Phone (312) 726-2938
Fax (312) 726-5206
TDD (773) 731-3477

PC #43

August 9, 2005

Amy Antoniolli
Hearing Officer
Illinois Pollution Control Board
100 West Randolph, Suite 11-500
Chicago, IL 60601

Hand Delivered

Re: R04-21 - In The Matter of Revisions To Radium Water Quality Standards: Proposed New 35 Ill. Adm. Code 302.307 and Amendments To 35 Ill. Adm. Code 302.207 and 302.525

Dear Ms. Antoniolli:

Please be advised that I represent Citizens Against Ruining the Environment ("CARE"), a Will County-based, not-for-profit organization. CARE is dedicated to protecting and improving the health, welfare, and safety of the people who live and work in Will County, Illinois. CARE's members live in Will County, and have been actively commenting on the permitting of Will County facilities for ten years. CARE's members have a particular interest in groundwater quality in Will County because, like thousands of Will County residents, their water originates from regional groundwater aquifers. The members of CARE are also committed to maintaining and enhancing the quality of Will County's surface waters and the quality of its land resources.

CARE strongly objects to the Board's proposal to add Section 302.207(d), which would allow a 30 pCi/L radium 226 and 228 standard for waters within one mile of outfalls from some wastewater treatment plants. This standard would apply when a POTW is treating wastewater that originates from a groundwater source with a radium concentration in excess of 3.75 pCi/L.

Comment #1 - Several public water suppliers in Will County use groundwater with radium concentrations in excess of 3.75 pCi/L. Consequently, the downstream areas within one mile of the outfalls of the associated POTWs will mark the boundaries of the 30 pCi/L water quality zones. In order to demonstrate the practical impact of the Board's proposal, CARE formally requests the Board to identify the dozens of outfall locations for these POTWs, the one-mile areas of local waterways that would be subject to the less stringent standard, the primary uses of these portions of these waterways (especially drinking water supplies), and any susceptible ecosystems (especially habitat for threatened and endangered species) within these 30 pCi/L zones. It appears the Board is proposing a rule without considering the total area that could be affected, and the human health and ecological factors within specific areas. For this reason, in order to evaluate the practical effect of this proposal, CARE formally requests the Board to identify every area of every waterway within one mile of every outfall of every Will County POTW that could fall within 302.207(d), the primary use designation of this water, and any potential ecosystem impacts created by the 30 pCi/L proposal.

Comment #2 – The Board's proposal under 302.207(d) is premature, and will be until at least 2009. As noted by the Board, this is a time of transition for public water suppliers that do not comply with the radium 226 and 228 standards. Following the promulgation of U.S. EPA's final rule reaffirming its original standard, IL EPA notified non-compliant public water suppliers that they were required to establish schedules that would achieve compliance no later than 2007. Following the implementation of control measures, it will take up to one year of monitoring to demonstrate ongoing compliance.

By the end of 2008, many of the problems anticipated by the Board's 302.207(d) proposal may be resolved. Like Lockport, some public water suppliers will change the source of their water supply to sources that do not contain radium. Others will use mixing techniques that combine sources that exceed the regulatory threshold with low or non-radium sources, with corresponding reductions in the total radium concentrations in wastewater and POTW effluent. Still others will use the technologies promoted by companies like WRT, and will remove radium from source water without reintroducing it into wastewater. The Board would be well-advised to abstain from establishing a rule like 302.207(d) until public water suppliers achieve compliance, especially because many of the techniques they may use will eliminate or substantially reduce radium in wastewater. This will allow for rulemaking that is more tailored and that is based on underlying compliance rather than non-compliance.

Comment #3 - CARE asserts that any lessening of the 302.207(c) general use water quality standard for radium 226 and 228 should only be allowed in cases where:

1. it is the direct and unavoidable consequence of achieving the SDWA radium standard;

2. it will occur despite the application of feasible wastewater treatment technologies that are available to reduce radium wastewater concentrations;

3. it is not the result of any non-compliance by the public water supplier or the POTW;

4. it will not exceed a concentration set as close to the 302.207(c) standard as possible, for as short a duration as possible;

5. it will not adversely effect human health or the environment, based on an analysis that is specific to the impacted receiving water; and,

6. it will comply with procedures and standards developed by the Illinois EPA that are substantially similar to the standards contained in 35 Illinois Administrative Code 302.102, "Allowed Mixing, Mixing Zones and ZIDs."

The approach contained in 302.207(d) would effectively allow a POTW to release effluent containing radium in any concentration and quantity so long as the radium concentration in the receiving water within one mile downstream does not exceed 30 pCi/L. Because of the reliance on the diluting power of the receiving water, 302.207(d) is establishing a "de facto" mixing zone near the outfalls of these POTWs. However, there are no procedures, restrictions, limitations or protections contained in proposed rule 302.207(d). CARE asserts this is in opposition to the well-developed regulatory approach that already exists under 35 IAC 302.102 that empowers the IL EPA to perform a case-by-case review of mixing zones based on a comprehensive application that must address well-defined criteria. This type of approach – that allows for regulatory flexibility under specific circumstances as judged on a case-by-case basis by the IL EPA – is far preferable than the categorical, "carte blanche" for POTWs contained in proposed rule 302.207(d).

In making its decisions on this matter, CARE strongly recommends the Board be guided federal decisions that have addressed the use of mixing zones. These decisions highlight the need for such an approach to be carefully tailored. For example, while acknowledging that mixing zones may be appropriate under some limited circumstances, the court in *American Wildlands v. Browner*, 94 F. Supp. 2d 1150 (D. Col. 2000) identified several characteristics of an adequate mixing zone. Key issues are the identification of criteria to limit the size of the mixing zone, in-zone quality requirements, and dilution allowances. *Id at 1162.* Allowable mixing zone characteristics should be established to ensure that (1) mixing zones do not impair the integrity of the water body as a whole; (2) there is no lethality to organisms passing through the mixing zone; and (3) there are no significant health risks, considering likely pathways of exposure. *Id.* While certain numeric criteria for a certain substance may not apply, all mixing zones are to be free from substances that (i) settle to form objectionable deposits...(iv) are acutely toxic; (v) produce undesirable or nuisance aquatic life. It is not possible to establish a wholly deterministic (a black box) procedure with which to make all mixing-zone dilution decisions. It is not advisable to make all mixing-zone dilution decisions based on a simplistic approach which overlooks the mixing characteristics and water body uses particular to a site. *Id.* Accordingly, mixing zone dilution policies should clearly set forth the considerations, guidelines, and default assumptions that will be utilized in making such case-by-case decisions. *Id. at* 1162-63. Affirmed by *American Wildlands v. Browner*, 260 F. 3d 1192 (10th Cir. 2001).

In *American Iron and Steel Institute v. EPA*, 115 F. 3d 979 (D.C. Cir. 1997), the court upheld a portion of a U.S. EPA rule that limited mixing zones in streams to 25% of the cross sectional area of the river to allow a free zone of passage for aquatic organisms. *Id* at 997. A permitting authority must use all relevant available data, including facility-specific effluent monitoring data where available and employ procedures which account for existing controls on point and non-point sources of pollution, the variability of the pollutant or pollutant parameter in the effluent, the sensitivity of the species to toxicity testing and, where appropriate, the dilution of the effluent in the receiving water when it determines whether a pollutant discharge has the reasonable potential to cause an excursion above a water quality standard. *Id.* at 999, quoting from 40 C.F.R. 122.44(d)(1)(ii).

Comment #4 - Prior to acting on any proposed rulemaking relating to radium in wastewater, the Board should require the Agency to conduct a comprehensive review of the adequacy of regulation of radium that originates in drinking water. Addressing the water quality problem in isolation – without also considering related issues like the land application of radium-containing POTW biosolids – is inadvisable. The wastewater issue would be addressed best as part of a comprehensive, multi-media review that considers whether the existing, piecemeal regulatory approach is adequate to protect human health and the environment.

The Joliet example is instructive. Joliet must comply with the radium 226 and 228 standard. In order to address the requirements that originate in the Safe Drinking Water Act, Joliet is choosing an approach that will remove radium from drinking water but will reinject it into the wastewater system. Because of this choice, Joliet must solve two additional problems. First, it must seek to lessen radium water quality standards near its outfalls because its POTW effluent will still contain elevated levels of radium. Second, Joliet is seeking approval to substantially increase the concentration of radium in biosolids it will land apply. Using the Freedom of Information Act, CARE acquired the following documents, all of which are attached and incorporated by reference into CARE's comments:

CARE Attachment One – 4/9/04 correspondence from Dennis Duffield, City of Joliet, to Jeff Hutton, Illinois EPA, requesting Joliet be allowed "...up to five applications of sludge without regard to the increase in the background radium concentration."

CARE Attachment Two – 5/10/04 correspondence from Richard Allen, Illinois Emergency Management Agency, Division of Nuclear Safety, to Allen Keller, Illinois EPA, recommending denial of Joliet's 4/9/04 request based on "public health and safety considerations" and determining Joliet may be in violation of existing standards because of the concentrations of radium in its land applied sludge.

CARE Attachment Three – Record of Biosolids Land Disposal, 2004, Joliet Westside POTW, showing 25 land applications of biosolids totaling 881 dry tons for 2004 (compared to 895 dry tons land applied in 2003)

CARE Attachment Four – Record of Biosolids Land Disposal, 2004, Joliet Eastside POTW, showing 43 land applications of biosolids totaling 2425 dry tons for 2004 (compared to 2217 dry tons land applied in 2003).

CARE Attachment Five - 2/28/05 correspondence from Dennis Duffield, City of Joliet, to Allen Keller, Illinois EPA, requesting Joliet be allowed "...to land apply wastewater treatment plant sludge to allow an increase in the background concentration of combined radium 226 and radium 228 of 1.0 pico-cuies per gram in the soil." Despite this tenfold increase over the existing standard, Joliet nonetheless asserts this will not adversely impact "future conversion of the land to residential use."

CARE Attachment Six – 5/9/05 correspondence from Richard Allen, Illinois Emergency Management Agency, Division of Nuclear Safety, to Allen Keller, Illinois EPA, raising significant questions about every aspect of the Joliet proposal.

As implied in Attachment Five, Joliet faces the issue that the Will County farmland on which its radium-containing biosolids are disposed may be converted to residential development. The concern is that homes will serve to contain radium that currently is released from agricultural disposal sites into the ambient air.

Under these circumstances, the IPCB should create a regulatory approach to water quality that has the co-benefit of discouraging the disposal of radium in effluent and biosolids. At a minimum, the IPCB should not create a regulatory approach in which it promotes approaches that will encourage radium disposal in surface waters and farm fields/next year's residential development sites. Section 302.207(d) creates a regulatory incentive for municipalities like Joliet to commit to approaches to radium that will compromise water quality, and use increasingly scarce land resources as low-level radioactive waste disposal sites. Without Section 302.207(d), Joliet and similarly situated municipalities will be forced to address the radium issue in such a way that will also eliminate or substantially minimize the impact on surface waters and land resources. For the members of CARE, all of whom live in Will County, a comprehensive approach to eliminate the threats posed by radium in drinking water, surface water and land should be the goal of these proceedings.

Thank you for your consideration of these comments.

Sincerely,

Keith Harley
Attorney at Law

JCH

CITY OF JOLIET

150 WEST JEFFERSON STREET
JOLIET, ILLINOIS 60432-4158

RECEIVED
APR 15 2004
ILLINOIS ENVIRONMENTAL PROTECTION AGENCY
BOW/WPC/PERMIT SECTION

April 9, 2004

Mr. Jeff Hutton
Division of Water Pollution Control
Bureau of Water
Illinois Environmental Protection Agency
1021 North Grand Avenue East
P.O. Box 19276
Springfield, Illinois 62794 -9276

Re: Joliet Public Water Supply
Facility Number IL1970450

Dear Mr. Hutton:

Thank you for requesting that I provide you with a proposal concerning radium in wastewater treatment plant sludge. Joliet is concerned that there is no specific plan for determining the impact of land application of wastewater treatment plant sludge containing radium and that the regulatory plan will evolve after communities have committed to a water treatment technique. This could result in the additional expenditure of public funds in the future.

I have attached an analysis of the current situation as it is understood by Joliet. The analysis includes our recommendations for sludge application. Joliet is requesting that the Division of Public Water Supplies and the Division of Water Pollution Control and Illinois Emergency Management Agency review our recommendations and provide comments.

The current criteria in the inter-agency agreement between the Illinois Environmental Protection Agency suggests that the land application of radium bearing sludge be limited to a calculated increase in the background concentration of radium in the soil after land application of less than 0.1 pico-curie per gram on a dry weight basis. This criteria is very restrictive. Joliet is recommending that this agreement be changed to allow up to five applications of sludge without regard to the increase in the background radium concentration. The risk from sludge application in Northern Illinois is primarily due to radium 226 and the generation of radon in a confined space. Radon is already a problem in some homes. The monitoring of radon is already required by many mortgage lenders and will not represent a burden to the future homeowners.

Radium bearing sludge does not represent the only potential source of radium. Joliet has measured background radium levels in soil that has not received radium bearing sludge that are higher than levels measured after multiple applications on other fields. The hazard to the public is not related to the source of the radium, but to the concentration in the soil matrix and the potential for the accumulation of radon. It should be noted that one of our samples from a field not receiving sludge indicated high combined radium 226 and radium 228, although the major contribution was from radium 228.

CARE ATTACHMENT ONE

Your assistance in determining the best approach to land application of radium bearing wastewater treatment plant sludge is requested. If you have any questions concerning Joliet's analysis and proposal, you may reach me at 815-724-4230.

Sincerely yours,

Dennis L. Duffield, Director
Department of Public Works
and Utilities
City of Joliet

Attachments
- Analysis and Recommendations
- Sampling result from Joliet Treatment Plants
- Sampling Results from Hickory Creek
- Soil sample results
- Sample calculations for Radon Production

Cc: Marcia Wilhite, Bureau Chief, Bureau of Water, IEPA
Toby Frevert, Manager, Division of Water Pollution Control, IEPA
Roger Selburg, Manager, Division of Public Water Supplies, IEPA
Al Keller, Manager, Permit Section, Division of Water Pollution Control, IEPA
Jerry Kuhn, Manager, Permit Section, Division of Public Water Supplies
John M. Mezera, City Manager, City of Joliet
Jeffrey Plyman, Corporation Counsel, City of Joliet
James E. Eggen, Utilities Administrator, City of Joliet
Harold Harty, Plant Operations Superintendent, City of Joliet
Mark Oleinik, Strand Associates, Inc.
Richard J. Christensen, Clark Dietz, Inc.

Analysis and Recommendations of the City of Joliet concerning Radium in Wastewater Treatment Plant Sludge Applied to Agricultural Land as a Soil Amendment

Treatment of Groundwater

The deep wells in Northern Illinois have combined radium 226 and 228 in concentrations greater than the maximum contaminant level of 5.0 pico-curies per liter. This requires treatment of the groundwater before delivery to consumers.

The treatment alternatives fall into the following two categories:

1. Treatment methods that remove the radium from the water, but return the radium to the sanitary sewer
2. Treatment methods that remove the radium from the water for disposal at low-level radioactive waste disposal sites outside Illinois.

One of the treatment methods that is being proposed in Illinois (some facilities are under construction) is the co-precipitation of radium with preformed hydrous manganese oxides. This method is capable of removing approximately 80% of the radium from the water. For waters with a combined radium concentration of 5-20 pico-curies per liter, 4-16 pico-curies per liter will be removed from the water provided as drinking water and discharged to the sanitary sewer as backwash from the filters employed in the HMO process.

Disposal of Radium Bearing Water Treatment Waste to Sanitary Sewers

Since the 4-16 pico-curies per liter is discharged to the sanitary sewer and combined with the water used as the public water supply, the combined radium concentration into the wastewater treatment plant is in the range of 5-20 pico-curies per liter. This is the same as the concentration in the groundwater originally.. This concentration may be reduced slightly by the infiltration into the sanitary sewers of non-radium bearing groundwater.

The wastewater arriving at the wastewater treatment plant will have a radium concentration identical to the concentration in the sanitary sewers. The range for this concentration is 5-20 pico-curies per liter. Available information indicates that the wastewater treatment plants remove 30-80% of the radium in the influent. This results in effluent concentrations of 0.83-12 pico-curies per liter. The effluent situation is being addressed by IEPA in the pending rulemaking before the Illinois Pollution Control Board (R2004-021). The concentration in sludge would is estimated to range from 20-213 pico-curies per gram dry weight.

Land Application of Radium Bearing Wastewater Treatment Plant Sludge

Land application of sludge generated from a wastewater treatment plant receiving radium has been applied to agricultural land as a soil amendment. Loadings in the range of 5 dry tons per acre are not unusual. One application of sludge can increase the background concentration of radium in the soil by 0.08-0.82 pico-curies per gram soil. If the memorandum of understanding with the Illinois Emergency Management Agency is applied, sludge applications are limited to 0.12-1.3 applications per field to remain under the requirement of increasing the background concentration by no more than 0.1 pico-curies per gram soil.

A review of the risks associated with radium on land indicates that the scenario that presents the greatest future risk is the construction of homes on land that has previously received wastewater treatment sludge containing radium. The risk does not result from the exposure of the body to the radium in the soil, but due to the resulting isotopes that result from the decay of radium. The risk is primarily from the potential development of high concentrations of radon in the homes. Since radon is a part of the decay chain for radium 226, but not for radium 228, the concentrations of radium 226 in the wastewater treatment plant sludge are of greatest concern.

Radon Risk

USEPA recommends that homeowners limit the radon in their homes to 4.0 pico-curies per liter of air in the home due to the risk of lung cancer. If the measured radon exceeds this amount, USEPA recommends that the homeowner increase the number of air changes in the home to prevent the accumulation of radon.

The radon risk scenario is developed in the ISCORS report "Assessment of Radioactivity in Sewage Sludge: Modeling to Assess Radiation Doses". Major elements in the scenario include the construction of homes with a slab on grade constructed on the topsoil that has received the sludge applicati[illegible] This is unlikely in Northern Illinois as the construction of slab on grade is not the normal co[illegible]truction method and topsoil is typically stripped from a site prior to grading to establish the str[illegible]ts and install utilities. Other elements of the scenario (converted from metric used in the report) were mixing the sludge to a depth of 6 inches into a soil with a unit weigh of 150 lbs per cubic foot and applying sludge at an application rate of 4.47 dry tons per acre.

By specifying the type of foundation and removing topsoil under the home, the risk is reduced although the magnitude of the reduction is uncertain. Radon risk may also be mitigated by the installation of additional ventilation in the home. Since the accumulation of radon will not be certain in every home, monitoring of each home will be required and the installation of ventilation only as needed.

Recommendations

As a result of the review of available information, Joliet is recommending the following actions:

1. The memorandum of understanding between the IEPA and the IEMA should be modified to control radium 226 only since this isotope represents the greatest risk.
2. The IEPA should establish monitoring standards for radium 226 at the wastewater treatment plant influent, effluent, sludge and in the soil. (Our sampling has shown a great deal of variation which will make it difficult to calculate the actual radium application rates)
3. The memorandum of understanding between the IEPA and the IEMA should be modified to allow an equivalent application of 25 pico-curies per gram dry weight sludge to agricultural land using the 4.47 dry tons per acre criteria included in the ISCORS dosage report without further review. This results in an estimated radon production of 4 pico-curies per liter air in the home under the ISCORS scenario for future homes.
4. IEPA sludge regulations should be modified to allow five applications of sludge to a field if the sludge generator and the property owner agree that the topsoil will be removed from the area under homes constructed on the property. The property owner must also be notified that radon should be monitored in any homes constructed on the site. Sludge applications to the same field are currently limited to approximately five applications because of the accumulation of phosphorus in the soil
5. The policy of IEPA should be to continue to encourage the use of wastewater treatment plant sludge as a soil amendment.

Sampling result from Joliet Treatment Plants

The concentration of radium in the influent, effluent and sludge at the Joliet Treatment Plants has been determined on two separate occasions. The samples were grab samples and the results are shown below.

A weekly composite sample was collected the week ending April 3, 2004. These samples have been submitted for analysis, however, the results will not be available until May.

The sample results are as follows:

Joliet Eastside Wastewater Treatment Plant

Date	Description	Radium 226	Radium 228	Total
Feb-04	Influent, pCi/liter	3.0	5.3	8.3
	Effluent , pCi/liter	1.2	3.9	5.1
	Primary Sludge pCi/gram dry	6.6	7.8	14.4
	Digested Sludge pCi/gram dry	8.8	9.9	18.7
	Per Cent Removal based on influent and effluent	60%	26%	39%
8-Mar-04	Influent, pCi/liter	1.9	4.3	6.2
	Effluent , pCi/liter	2.6	3.5	6.1
	Digested Sludge	8.8	8.8	17.6
	Per Cent Removal	-37%	19%	2%

Joliet Westside Wastewater Treatment Plant

Date	Description	Radium 226	Radium 228	Total
Feb-04	Influent, pCi/liter	2.9	5.1	8.0
	Effluent , pCi/liter	2.0	2.9	4.9
	Primary Sludge pCi/gram dry	17.8	28.9	46.7
	Digested Sludge, pCi/gram dry	18.3	28.9	47.2
	Per Cent Removal based on influent and effluent	31%	43%	39%
8-Mar-04	Influent, pCi/liter	3.9	6.1	10.0
	Effluent , pCi/liter	0.9	1.0	1.9
	Sludge pCi/gram dry	15.6	20.4	36.0
	Per Cent Removal	77%	84%	81%

Sampling Results from Hickory Creek

Upstream from the Joliet Eastside Plant Outfall

March 8, 2004

Location	Radium 226	Radium 228		Total
Upstream	<0.1	1.3		1.3
Downstream	0.2	1.2		1.4

Soil sample results

The control field is located west of Joliet and has not received sludge applications

Radon production has been calculated using the ISCORS conversion factors and results as follows:

	Field A		Field B		Control	
gross alpha	2.0	pCi/g	3.4	pCi/g	4.0	pCi/g
Radium 226	1.1	pCi/g	1.5	pCi/g	0.8	pCi/g
Radium 228	5.7	pCi/g	5.7	pCi/g	6.1	pCi/g
Combined 226 & 228	6.8	pCi/g	7.2	pCi/g	6.9	pCi/g

Biosolids applied to fields A and B multiple times

Control Field has not received biosolids

field measured 226 pCi/gram soil	1.1	pCi/gram soil	1.5	pCi/gram soil	0.8	pCi/gram soil
conversion from ISCORS for soil concentration to sludge concentration	0.0044		0.0044		0.0044	
sludge concentration pCi/gram	250.0	pCi/gram sludge	340.9	pCi/gram sludge	181.8	pCi/gram sludge
conversion from ISCORS for sludge concentration to radon concentration in air	0.159712		0.159712		0.159712	
radon concentration pCi/liter air	39.9	pCi/liter air	54.4	pCi/liter air	29.0	pCi/liter air
USEPA radon action level	4.0	pCi/liter air	4.0	pCi/liter air	4.0	pCi/liter air

Sample calculations for Radon Production

	West Sample A	Radium 226 East	West Sample B
Influent	3.90	3.00	2.90
Effluent	0.90	1.20	2.00
Sludge	3.00	1.80	0.90
per cent removal of	76.9%	60.0%	31.0%
Flow liters per year	12,720,079,620	24,334,065,360	12,720,079,620
Picocuries per year	38,160,238,860	43,801,317,648	11,448,071,658
Acres per year	395.20	705.90	395.20
grams soil per acre	1,186,574,400	1,186,574,400	1,186,574,400
grams soil per year	468,934,202,880	837,602,868,960	468,934,202,880
radium 226 picocuries per gram soil per application	0.08	0.05	0.02
Site life years based on 0.1 picocuries per gram soil increase	1.2	1.9	4.1
Annual Sludge production tons	988.0	2,400.0	988.0
lbs. per ton	2,000.0	2,000.0	2,000.0
lbs per year	1,976,000.0	4,800,000.0	1,976,000.0
grams per lbs	454.0	454.0	454.0
grams per year	897,104,000.0	2,179,200,000.0	897,104,000.0
picocuries per gram dry Measured from March 9, 2004 sample	42.5	20.1	12.8
radium 226 conversion factor from ISCORS	0.0044	0.0044	0.0044
radium 226 concentration in soil pCi/gram dry	0.19	0.09	0.06
Average application rate	1.37	3.39	1.37
ISCOR application rate	4.46	4.46	4.46

Multiplier calculated from application rates		0.30692432			0.760170191			0.30692432	
estimated radium 226 concentration in soil pCi/gram dry	0.06			0.07			0.02		
Site life based on 0.1 picocuries per gram soil	1.7			**1.5**			5.8		

Radon from soil

Radium 226 concentration in sludge	42.5		p/Ci gram dry	20.1		p/Ci gram dry	12.8		p/Ci gram dry
ISCORS conversion to radon in homes		0.159712371			0.159712371			0.159712371	
estimated radon concentration in homes	6.8			3.2			2.0		
Average application rate	1.37			3.39			1.37		
ISCORS application Rate	4.46			4.46			4.46		
Multiplier calculated from application rates		0.30692432			0.760170191			0.30692432	
Estimated radon concentration in homes per application	2.1		pCi/liter air	2.4		pCi/liter air	0.6		pCi/liter air
Site life based on 4.0 picocuries/liter radon in homes	1.9		years	1.6		years	6.4		years

IEMA
Illinois Emergency Management Agency
Division of Nuclear Safety

Rod R. Blagojevich, Governo
William C. Burke, Directo

RECEIVED
MAY 11 2004
ILLINOIS ENVIRONMENTAL
PROTECTION AGENCY
BOW/WPC/PERMIT SECTION

May 10, 2004

Alan Keller, P.E.
Manager, Permit Section
Division of Water Pollution
Illinois Environmental Protection Agency
1021 North Grand Avenue East
P.O. Box 19276
Springfield, IL 62794-9276

Dear Mr. Keller:

The Division of Nuclear Safety, Illinois Emergency Management Agency, has reviewed the request from the City of Joliet dated April 9, 2004, (contained in your letter dated April 21, 2004). Joliet specifically requests to land apply five applications of sewage sludge regardless of the radium concentration. The Agency recommends denial of Joliet's request based on public health and safety considerations.

The unrestricted land application of radium contaminated sewage sludge would create sites requiring land-use restrictions. The limits established in the Memorandum of Agreement between IEPA and the Division of Nuclear Safety was selected to prevent this from occurring. Viable options are available to Joliet such that the limits in the Memorandum can be complied with. The Agency's comments on the Joliet proposal are contained in Attachment 1.

Based on the information provided in Joliet's analysis, the Agency has determined that Joliet may be in violation of the Memorandum of Agreement. Specifically, Joliet is applying sludge with concentrations of radium that result in the increase of soil radium concentration greater than the allowed 0.1 pCi/g. Attachment 2 shows the calculations using Joliet information that indicates that Joliet may be exceeding the limits established in the Memorandum.

CARE ATTACHMENT TWO

Please contact me regarding any administrative action to be brought against the City of Joliet for violating the Memorandum. Any other questions may be directed to me at 782-1322.

Sincerely,

Richard Allen

Richard Allen, Manager
Bureau of Environmental Safety

Attachments

cc: Roger D. Selburg, IEPA

Attachment 1
Comments on the Joliet letter and attachment dated April 9, 2004

Fundamental Issues of Concern

In the letter from Joliet to IEPA, Joliet requests permission to allow five applications of sludge regardless of the radium concentration. As part of Joliet's supporting logic, they state, in essence, that since radon is already a problem in some homes adding more radium to the soil would not represent a burden to the future homeowners. This logic is inconsistent with basic health physics principles of limiting public exposure. To intentionally add to an existing problem or create an entirely new one is counter to protecting the public health and safety.

Joliet provides insufficient sampling data regarding the radium concentration in the sludge. Results from two grab samples were provided for each of the two sewage treatment plants. These samples demonstrate some variability. In addition, no information is provided regarding the timing of the samples in relation to the backwashing of the filters associated with the hydrous manganese oxide (HMO) water treatment process. Were the samples taken at a time that would not reflect the receipt of the high concentration filter backwash? Joliet does not provide any information regarding whether the backwash is sent to one or both sewage treatment plants. Since the sewage influent will contain periods of low radium concentration associated with normal receipt and periods of high radium concentration associated with the backwashing of the HMO filters, will there be an associated drastic variation in sludge radium concentration? Does Joliet blend the sludge to ensure a consistent and constant radium concentration?

The recommendation presented by Joliet focused only on Ra-226 and completely ignores the hazard of Ra-228. In addition, the application rate proposed by Joliet will greatly exceed the current limits presented in the Memorandum of Understanding between IEPA and IEMA. It is not clear whether the proposed 25-pCi/g-sludge concentration is for Ra-226 only or Ra-226 and Ra-228 combined. If it is combined then a single application will result in an increase in soil radium concentration of 0.124 pCi/g. If it were Ra-226 only, then the total radium soil concentration increase would be 1.78 to 3.44 times higher (based on ratios calculated from Joliet data). In addition, correcting for soil density, the proposed sludge application rate would increase indoor radon concentration 4.5 pCi/l per application. Five applications would result in an increased indoor radon concentration of 22.5 pCi/l.

In July 2002, the Will County Health Department reported the results of indoor radon measurements in 91 Will County homes. Of those 91, 69% demonstrated radon levels equal to or greater that 4.0 pCi/l, with an average radon level throughout the county of

7.3 pCi/l. Both the U.S. Environmental Protection Agency and IEMA recommend taking action to reduce indoor radon level when measurement results are 4.0 pCi/l or more. There is no justifiable basis for adding to the existing problem of elevated indoor radon concentration in Will County.

Calculation Issues

The ISCORS conversion factor for soil concentration to sludge concentration (0.0044) assumes a mixing depth of 15 cm (6 inches), a soil density of 1.52 g/cm3 (94.85 #/ft3) and an application rate of 10 metric tons per hectare (4.46 tons per acre). It is not clear why Joliet is using this factor to back calculate a hypothetical sludge application for the two fields that receive sludge and the control field. There appears to be no relevance in this procedure.

Joliet identifies an ISCORS conversion factor for sludge concentration to indoor radon concentration in air. Where did this conversion factor originate? It is not identified as such in the available ISCORS documents. What are the variables used to calculate this factor?

The calculations presented on pages 8 and 9 of the attachment only consider Ra-226 and do not include Ra-228. The Memorandum of Understanding between IEPA and IEMA (IDNS) does not single out Ra-266. Rather, it considers total radium.

The grams soil per acre was calculated incorrectly. Assuming the ISCORS values, the soil per acre is calculated as –

$$(1.52\ g/cm^3)(15\ cm)(929\ cm^2/ft^2)(43560\ ft^2/ac) = 922,653,072\ gm/ac$$

The ISCORS assumption for soil density (1.52 g/cm^3) is not appropriate for typical Illinois soil. Staff from the Illinois Department of Agriculture state that a value of 1.35 g/cm^3 is appropriate for the silt-clay-loam soil typical of northern Illinois. Using this value instead of the ISCORS assumption increases the soil radium concentration and likely the indoor radon concentration by a factor of 1.52/1.35 or 1.126.

Using the Illinois Department of Agriculture value for soil density the grams soil per acre is calculated as:

$$(1.35\ g/cm^3)(15\ cm)(929\ cm^2/ft^2)(43560\ ft^2/ac) = 819,461,610\ gm/ac$$

The average application rate was calculated incorrectly for the West Sample A and B. The correct calculation should be:

(988 tons) / (395.2 acres) = 2.5 tons/acre

Using the corrected value for soil density and considering total radium, Joliet may be violating the standards and limits contained in the Memorandum of Understanding between IEPA and IEMA (IDNS).

Summary

1. The Joliet letter does not provide sufficient basis for modifying the existing MOU.

2. Joliet's recommendation #4 would likely result in deed restrictions limiting the future use of the property receiving sewage sludge. This is an ill-conceived precedent.

3. We agree with Joliet's recommendation #2 that established monitoring standards for radium (both Ra-226 and Ra-228) in wastewater treatment influent, effluent and sludge are needed to define the variability in concentrations that will lead to a more accurate determination of acceptable application rates and residual soil concentrations.

Attachment 2
Calculation of Joliet Radium Application Rate

West Sample A

Influent – pCi/L		10.00
Effluent – pCi/L		1.9
Sludge – pCi/L		8.1
Flow – Liters per year		12,720,079,620
Acres per year		395.2

A soil density of 1.35 g/cm3 was used for these calculations based on information provided by the Illinois Department of Agriculture.

PicoCuries per year –

= Sludge activity x Flow

= (8.1 pCi/L) x (12,720,079,620 L/yr)

= 103,032,644,922 pCi/yr

Grams soil per year –

= (Acres per year) x (soil density) x (15 cm mixing depth)

= (395.2 Ac/yr) x (43.560 ft^2/Ac) x (929 cm^2/ ft^2) x (1.35 g/cm^3) x (15 cm)

= 323,851.228.272 g/yr

Radium per grams soil per application –

= PicoCuries per year / Grams soil per year

= (103,032,644,922 pCi/yr) / (323,851,228,272 g/yr)

= 0.318 pCi/g

West Sample B

Influent – pCi/L		8.00
Effluent – pCi/L		4.9
Sludge – pCi/L		3.1
Flow – Liters per year		12,720,079,620
Acres per year		395.2

A soil density of 1.35 g/cm3 was used for these calculations based on information provided by the Illinois Department of Agriculture.

PicoCuries per year –

= Sludge activity x Flow

= (3.1 pCi/L) x (12,720,079,620 L/yr)

= 39,432,246,822 pCi/yr

Grams soil per year –

= (Acres per year) x (soil density) x (15 cm mixing depth)

= (395.2 Ac/yr) x (43,560 ft^2/Ac) x (929 cm^2/ ft^2) x (1.35 g/cm^3) x (15 cm)

= 323,851,228,272 g/yr

Radium per grams soil per application –

= PicoCuries per year / Grams soil per year

= (39,432,246,822 pCi/yr) / (323,851,228,272 g/yr)

= 0.122 pCi/g

East

Influent – pCi/L		8.30
Effluent – pCi/L		5.10
Sludge – pCi/L		3.20
Flow – Liters per year		24,334,065,360
Acres per year		705.9

A soil density of 1.35 g/cm3 was used for these calculations based on information provided by the Illinois Department of Agriculture.

PicoCuries per year –

= Sludge activity x Flow

= (3.2 pCi/L) x (24,334,065,360 L/yr)

= 77,869,009,152 pCi/yr

Grams soil per year –

= (Acres per year) x (soil density) x (15 cm mixing depth)

= (705.9 Ac/yr) x (43,560 ft^2/Ac) x (929 cm^2/ ft^2) x (1.35 g/cm^3) x (15 cm)

= 578,457,950,499 g/yr

Radium per grams soil per application –

= PicoCuries per year / Grams soil per year

= (77,869,009,152 pCi/yr) / (578,457,950,499 g/yr)

= 0.135 pCi/g

CITY OF JOLIET - WESTSIDE

DATES OF BIOSOLID LAND APPLICATION

January 23, 2004
January 26, 2004
February 2, 2004
February 9, 2004
February 10, 2004
February 11, 2004
April 29, 2004
May 5, 2004
May 6, 2004
May 11, 2004
May 12, 2004
September 15, 2004
September 16, 2004
October 14, 2004
October 19, 2004
October 20, 2004
October 21, 2004
October 22, 2004
October 26, 2004
December 16, 2004
December 17, 2004
December 18, 2004
December 20, 2004
December 21, 2004
December 22, 2004

CARE ATTACHMENT THREE

Land Treatment Alternatives, Inc.
Soil and Waste Management Consultants
137 S. State St., Suite 215 • Geneseo, IL 61254
Business (309) 944-4112 • Fax (309) 944-4112

Illinois Environmental Protection Agency
Division of Water Pollution Control
Sludge Management Report

Year 2004 | Reporting Period (Circle One) | X1. January 1 - June 30
2. July 1 - December 31

NAME OF SLUDGE GENERATOR: City of Joliet - Westside WWTP

NPDES PERMIT NO.: IL0033553 IEPA# 2001-SC-2708

Indicate the Volume (cubic yards or gallons) and the Number of DRY TONS of Sludge Generated and Disposed During the Above Reporting Period:

	SEMI-ANNUAL QUANTITY (CUBIC YARDS) (Or gallons)	(DRY TONS)	ANNUAL QUANTITY* (DRY TONS ONLY)
QUANTITY OF SLUDGE GENERATED:	3,633,940 gal	267	
QUANTITY OF SLUDGE DISPOSED:			
Agricultural Land Application	3,633,940 gal	267	
Dedicated Land Reclamation			
Disturbed Land Reclamation			
Horticultural (Sod Farms, etc.)			
Landfill			
Public Distribution			
Storage Lagoon			
Other (Specify)________			

Sludge Hauler Name(s) Synagro Technologies IEPA Permit # 2001-SC-3167

Disposal Site Name(s)** ________

*If this is the July 1 through December 31 report, also indicate above the DRY TONS of sludge generated and disposed during the preceding January through December.
** For Landfill Disposal Only

Signature Harold Harty Date 1/21/05 Title Plant Ops. Supt.

Name of Contact Person Harold Harty (Please Print) Phone No. (815) 724-3675

(The report shall be signed by a person that fulfills the requirements of Section 309.103(e) of Subtitle C: Water Pollution)

This agency is authorized to require this information under Illinois Revised Statutes, 1979, Chapter 111 ½, Section 1042. Disclosure of this information is required. Failure to do so may result in a civil penalty up to $10,000.00 per day of violation or a fine up to $25,000.00 per day of violation and imprisonment up to one year. This form has been approved by the Forms Management Center.

Illinois Environmental Protection Agency
Division of Water Pollution Control
Sludge Management Report

Year 2004

Reporting Period (Circle One)

1. January 1 - June 30
X2. July 1 - December 31

NAME OF SLUDGE GENERATOR: City of Joliet - Westside WWTP

NPDES PERMIT NO.: IL0033553 IEPA# 2001-SC-2708

Indicate the Volume (cubic yards or gallons) and the Number of DRY TONS of Sludge Generated and Disposed During the Above Reporting Period

	SEMI-ANNUAL QUANTITY (CUBIC YARDS) (Or gallons)	(DRY TONS)	ANNUAL QUANTITY (DRY TONS ONLY)
QUANTITY OF SLUDGE GENERATED:	3,713,360 gal	514	* 895 DT in 2003
QUANTITY OF SLUDGE DISPOSED:			
Agricultural Land Application	3,713,360 gal	514	* 895 DT in 2003
Dedicated Land Reclamation			
Disturbed Land Reclamation			
Horticultural (Sod Farms, etc.)			
Landfill			
Public Distribution			
Storage Lagoon			
Other (Specify)			

Sludge Hauler Name(s) Synagro Technologies IEPA Permit # 2001-SC-3167

Disposal Site Name(s)**

If this is the July 1 through December 31 report, also indicate above the DRY TONS of sludge generated and disposed during the preceding January through December.
* For Landfill Disposal Only

Signature [signature] Date 1-7-05 Title Plant Ops. Supt.

Name of Contact Person Harold Harty (Please Print) Phone No. (815) 724-3675

The report shall be signed by a person that fulfills the requirements of Section 309.103(e) of Subtitle C: Water Pollution)

This agency is authorized to require this information under Illinois Revised Statutes, 1979, Chapter 111 ½, Section 1042. Disclosure of this information is required. Failure to do so may result in a civil penalty up to $10,000.00 per day of violation or fine up to $25,000.00 per day of violation and imprisonment up to one year. This form has been approved by the Forms Management Center.

CITY OF JOLIET - EASTSIDE

DATES OF BIOSOLID LAND APPLICATION

January 8, 2004
January 9, 2004
January 10, 2004
January 14, 2004
January15, 2004
January 16, 2004
January 19, 2004
January 21, 2004
March 23, 2004
April 6, 2004
April 7, 2004
April 8, 2004
April 9, 2004
April 10, 2004
April 12, 2004
April 13, 2004
April 14, 2004
April 15, 2004
April 16, 2004
April 17, 2004
April 19, 2004
April 20, 2004
August 6, 2004
August 7, 2004
August 9, 2004
August 10, 2004
August 11, 2004
August 12, 2004
August 13, 2004
October 27, 2004
November 8, 2004
November 9, 2004
November 10, 2004
November 12, 2004
November 15, 2004
November 16, 2004
November 17, 2004
November 18, 2004
November 23, 2004
December 27, 2004
December 28, 2004
December 29, 2004
December 30, 2004

CARE ATTACHMENT FOUR

Land Treatment Alternatives, Inc.
Soil and Waste Management Consultants
137 S. State St., Suite 215 • Geneseo, IL 61254
Business (309) 944-4112 • Fax (309) 944-4112

Illinois Environmental Protection Agency
Division of Water Pollution Control
Sludge Management Report

Year 2004

Reporting Period (Circle One)

X1. January 1 - June 30
2.. July 1 - December 31

NAME OF SLUDGE GENERATOR: City of Joliet - Eastside WWTP

NPDES PERMIT NO.: IL0022519 IEPA# 2001-SC-2708

Indicate the Volume (cubic yards or gallons) and the Number of DRY TONS of Sludge Generated and Disposed During the Above Reporting Period:

	SEMI-ANNUAL QUANTITY (CUBIC YARDS) (Or gallons)	(DRY TONS)	ANNUAL QUANTITY* (DRY TONS ONLY)
QUANTITY OF SLUDGE GENERATED:	8,935,250 gal	1212	
QUANTITY OF SLUDGE DISPOSED:			
Agricultural Land Application	8,935,250 gal.	1212	
Dedicated Land Reclamation			
Disturbed Land Reclamation			
Horticultural (Sod Farms, etc.)			
Landfill			
Public Distribution			
Storage Lagoon			
Other (Specify)			

Sludge Hauler Name(s) Synagro Technologies IEPA Permit # 2001-SC-3167

Disposal Site Name(s)**

*If this is the July 1 through December 31 report, also indicate above the DRY TONS of sludge generated and disposed during the preceding January through December.
** For Landfill Disposal Only

Signature [signature] Date 1/21/05 Title Plant Ops. Supt.

Name of Contact Person Harold Harty (Please Print) Phone No. (815) 724-3675

(The report shall be signed by a person that fulfills the requirements of Section 309.103(e) of Subtitle C: Water Pollution)

This agency is authorized to require this information under Illinois Revised Statutes, 1979, Chapter 111 ½, Section 1042. Disclosure of this information is required. Failure to do so may result in a civil penalty up to $10,000.00 per day of violation or a fine up to $25,000.00 per day of violation and imprisonment up to one year. This form has been approved by the Forms Management Center.

Illinois Environmental Protection Agency
Division of Water Pollution Control
Sludge Management Report

Year 2004

Reporting Period (Circle One)

1. January 1 - June 30
X 2. July 1 - December 31

NAME OF SLUDGE GENERATOR: City of Joliet - Eastside WWTP

NPDES PERMIT NO.: IL0022519 IEPA# 2001-SC-2708

Indicate the Volume (cubic yards or gallons) and the Number of DRY TONS of Sludge Generated and Disposed During the Above Reporting Period:

	SEMI-ANNUAL QUANTITY (CUBIC YARDS) (Or gallons)	(DRY TONS)	ANNUAL QUANTITY* (DRY TONS ONLY)
QUANTITY OF SLUDGE GENERATED:	15,503,300 gal	1213	*2,217 DT in 2003
QUANTITY OF SLUDGE DISPOSED.			
Agricultural Land Application	15,503,300 gal.	1213	*2,217 DT in 200[illegible]
Dedicated Land Reclamation			
Disturbed Land Reclamation			
Horticultural (Sod Farms, etc.)			
Landfill			
Public Distribution			
Storage Lagoon			
Other (Specify)			

Sludge Hauler Name(s) Synagro Technologies IEPA Permit # 2001-SC-3167

Disposal Site Name(s)**

*If this is the July 1 through December 31 report, also indicate above the DRY TONS of sludge generated and disposed during the preceding January through December.
**For Landfill Disposal Only

Signature [signature] Date 1-7-05 Title Plant Ops. Supt.

Name of Contact Person Harold Harty (Please Print) Phone No. (815) 724-3675

(The report shall be signed by a person that fulfills the requirements of Section 309.103(e) of Subtitle C: Water Pollution)

This agency is authorized to require this information under Illinois Revised Statutes, 1979, Chapter 111 ½, Section 1042. Disclosure of this information is required. Failure to do so may result in a civil penalty up to $10,000.00 per day of violation or a fine up to $25,000.00 per day of violation and imprisonment up to one year. This form has been approved by the Forms Management Center.

DEPARTMENT OF PUBLIC WORKS CITY OF JOLIET
AND UTILITIES
815/724-4230
815/723-7770 FAX
150 WEST JEFFERSON STREET
JOLIET, ILLINOIS 60432-4156

RECEIVED
MAR 0 1 2005
ILLINOIS ENVIRONMENTAL
PROTECTION AGENCY
BOW/WPC/PERMIT SECTION

February 28, 2005

Reply to: 921 E. Washington ST
Joliet, IL 60433

RECEIVED
MAR 0 1 2005
ILLINOIS ENVIRONMENTAL
PROTECTION AGENCY
BOW/WPC/PERMIT SECTION

Mr. Allen Keller, P.E., Manager
Division of Water Pollution Control, Permit Section
Illinois Environmental Protection Agency
1021 North Grand Avenue East
P.O. Box 19276
Springfield, Illinois 62794-9276

Re: Radium in Biosolids
Joliet Public Water Supply Facility Number IL1970450
Joliet Eastside Wastewater Treatment Plant NPDES IL0022519
Joliet Westside Wastewater Treatment Plant NPDES IL0033553
Joliet Aux Sable Creek Basin Wastewater Treatment Plant
NPDES IL0076414 (under construction)

Dear Mr. Keller:

The City of Joliet is pleased to submit a request for approval of the continued land application of biosolids containing radium based on the 1984 Memorandum of Agreement between the Illinois Environmental Protection Agency and the Illinois Department of Nuclear Safety (now Illinois Emergency Management Agency, Division of Nuclear Safety) concerning the disposal of radium containing water and wastewater treatment plant sludge.

Paragraph 7 of the agreement is the basis for Joliet's request. Paragraph 7 provides for alternative methods where it is economically infeasible to comply with other paragraphs of the agreement and the radon exhalation rate is less than 5.0 picocuries per square meter per second.

To support our request, Joliet employed a team of professionals to review our operations and develop information for your review. Dose modeling was performed and is provided with this letter.

CARE ATTACHMENT FIVE

The dose models were prepared using the radium concentrations for the Joliet Eastside and Joliet Westside Wastewater Treatment Plants. The models were based on the application of sludge eight separate times over 20 years and nine separate times over 22 years. The models were prepared by RSSI, Inc. a consulting health physics firm, and used the program RESRAD 6.22. This is the same model that was used by the Interagency Steering Committee on Radiation Standards (ISCORS) in their review of biosolids.

The program was run by RSSI, Inc, a consulting health physics firm, at the direction of the City of Joliet. The inputs to the model are in the written report and output material. The future land use was based on single family homes with 3 units to the acre who do not have a dairy cow or grow their own vegetables. Water was to be supplied by the City of Joliet after installation of the radium removal equipment. The applied radium concentrations were based on Joliet experience. One model with 8 applications over 20 years and another model for 9 applications over 22 years were used. All models conclude that the dose to residents is less than 10 milli-rems per year. Modeling results are provided as Attachment 1.

A cost comparison of land application of biosolids and disposal in a landfill was also prepared by Clark Dietz, Inc. This report is also provided for your review. This report details the increased costs that Joliet will incur if land application of biosolids containing radium was no longer allowed. This supports our position that it is not economically feasible and that an alternative method of disposal is required. This information is provided as Attachment 2.

A cost benefit comparison of the land application program based on the anticipated increase in radiation dose and the cost of placing biosolids in a landfill is also provided. It also supports the need for the approval of an alternative to the methods provided in the MOA. This is information is provided as Attachment 3.

As a result of the information developed from these analyses, Joliet is requesting that IEPA-DWPC determine that land application of biosolids containing radium continues to be acceptable method of disposal for Joliet. This determination is necessary so that Joliet can proceed with the selection of a method of radium removal for the Joliet Public Water Supply without concerns of future land application restrictions. Future restrictions could require the installation of a different water treatment method and the associated additional costs.

The recommendation of the City of Joliet is that Joliet be authorized to land apply wastewater treatment plant sludge to allow an increase in the background concentration of combined radium 226 and radium 228 of 1.0 pico-curies per gram in the soil. This will allow multiple application of biosolids to the same field without adversely impacting future conversion of the land to residential use. This also will limit the annual increase in radiation dose to a future resident to less than 10 milli-rems per year. IDNS can advise you on the safety of allowing 10 milli-rems per year, however, I am advised that 10 milli-rems does not cause any concern to our consulting health physicist. Attachment 4 provides the calculations that support the 1.0 picocuries per gram.

The increase in radium in the soil should continue to be a calculated number submitted to the IEPA on the basis of the radium concentrations in the biosolids expressed in picocuries per gram dry and the application rate in dry tons per acre.

I am available for a joint meeting of IEPA and IEMA after both agencies have had time to review this information. Consultants employed by Joliet will also be available to meet concerning this submittal

If you have any further questions regarding this matter, please feel free to contact me at 815/724-4230.

Sincerely,

Dennis L. Duffield
Director of Public Works & Utilities

DLD

Attachments:

1. Report of RSSI concerning Dose Modeling without RESRAD Printouts
2. Evaluation of Radium Removal impacts to Sludge-Joliet Eastside and Westside Wastewater Treatment Plant
3. Cost Benefit Analysis Prepared by City of Joliet
4. Calculation of Recommended Increase in Background Radium Levels

cc: John M. Mezera, City Manager
Jeffrey Plyman, Corporation Counsel
James E. Eggen, P.E., Utilities Administrator
Harold Harty, Plant Operations Superintendent
Roy M. Harsch, Gardner, Carton and Douglas
Richard Christensen, P.E., Clark Dietz, Inc
Daniel Fiedler, Land Treatment Alternatives
Mark Oleinik, P.E., Strand Associates, Inc.
Eli Port, P.E., CHP, RSSI
Roger Selburg, P.E., Manager, PWS, BOW, IEPA
Toby Frevert, P.E., Manager, WPC, BOW, IEPA
Marcia Wilhite, Manager, Bureau of Water, IEPA
Jeff Hutton, Permit Section, DWPC, BOW with RESRAD Printouts

Attachment 1

REPORT OF RESRAD DOSE MODELING
FOR
WASTE WATER TREATMENT PLANT SLUDGE
APPLIED TO LAND CURRENTLY USED FOR AGRICULTURE

PERFORMED FOR

DEPARTMENT OF PUBLIC WORKS AND UTILITIES
CITY OF JOLIET, ILLINOIS

BY

6312 W. OAKTON STREET
MORTON GROVE, ILLINOIS

October 25, 2004

H:\HOME\400001 Health Physics\Joliet\Resrad\REPORT OF RESRAD DOSE MODELING 10 25 2004 .doc

INTRODUCTION

Radium (Ra) is a naturally occurring radioactive element. It is present in rock and soil and may be found in groundwater. The more common isotopes of radium are Ra-226 and Ra-228. Ra-226 is the most important in terms of radiological health effects because of its decay kinetics and metabolism. Ra-226 and Ra-228, collectively referred to as radium, both decay by emitting alpha particles to two series of naturally occurring radionuclides.

Surface water usuallyhas low radium concentrations, but groundwater concentrations can be significant. Water drawn from deep bedrock aquifers may contain concentrations of radium that exceed regulatory standards. In Northern Illinois, high radium concentrations result from the presence of radium in the granite bedrock that surrounds the aquifers from which water supplies are drawn.

Radium in drinking water may pose a radiological health hazard. About one-fifth of ingested radium is taken up by the body and the balance is excreted in feces. Some of the absorbed radium is subsequently excreted in urine. In the body, radium, a group IIA alkali earth element, behaves like other elements in the group, such as calcium, and is deposited primarily in bone cortex.

The internally deposited radium emits alpha particles that damage tissues adjacent to the decaying atoms. Radium is not known to cause adverse health effects at levels typically found in drinking water, diet, or the environment. However, studies of humans find that body burdens in excess of 10 µCi result in an increased incidence of malignant disease.

The U.S. Environmental Protection Agency (USEPA) has established a maximum contaminant level (MCL) of 5 picocuries per liter (pCi/l)for radium in public water supplies. The MCL for radium has been set well below levels for which health effects have been observed and is assumed by the USEPA to be protective of public health. Public water supply systems whose radium concentration exceed 5 pCi/l are not known to be inherently unsafe, but are required to notify the public. These systems must also evaluate ways to reduce the radium concentrations in their water.

The radium concentration in the City of Joliet (Joliet) water supply is between 6 pCi/l and 10 pCi/l, exceeding the current

MCL. Methods are available to Joliet's water supply system to remove radium from the water. The total amount of radium remains unchanged and radium removed from the water remains in some other form and must be disposed of. Depending upon the method, treatment may result in the radium being concentrated in drinking water treatment waste or wastewater (sewage treatment) sludge.

Joliet currently returns the radium initially in the water supply to sewage treatment sludge. The sludge is made available for agricultural application to exploit its nutrient content. The application of the sludge to land raises the radium concentration of the soil. This report describes modeling of public dose resulting from these agricultural applications.

METHODOLOGY

RESRAD Model software

The RESidual RADioactivity (RESRAD) Model, developed by Argonne National Laboratory, assesses the dose or risk associated with residual radioactive material. RESRAD computes potential annual doses or lifetime risks resulting from exposure to radioactive material in soil, and concentrations of radionuclides in air, surface water, and ground water resulting from the activity in soil. RESRAD supports cost-benefit analyses that can help in decision-making.

The significant exposure pathways available in RESRAD modeling[1] are direct external dose from the contaminated soil, and internal dose from inhalation of airborne radionuclides including radon progeny, and from ingestion of fruits and vegetables grown in the contaminated soil and irrigated with contaminated water, from meat and ingestion of milk from live stock fed with contaminated fodder and water, from drinking water drawn from a contaminated well or pond, from ingestion fish from a contaminated pond, and from ingestion of contaminated soil.

This model of dose from sludge applications uses three pathways: external exposure, inhalation, and radon. The model does not consider plant food, meat, milk, aquatic foods, soil ingestion, and drinking water because the planed use of land is resident with no option of growing livestock or significant plant food. Municipal water supply will be used for drinking, bathing and irrigation purposes.

External radiation produces dose from radionuclides outside the body. Gamma and beta radiations from radionuclides distributed throughout the contaminated zone are the dominant external radiation sources and are the only external radiation pathways considered in calculating soil guidelines.

The RESRAD model accepts multiple variables to describe the environment. These are radionuclides and concentration, radionuclide transport factors, time, area and thickness of the contaminated zone, cover, contaminated zone and saturated zone hydrological data, occupancy, inhalation, and external gamma data, uncontaminated unsaturated zone parameters, external

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[1] User's manual for RASRAD version 6: Environmental assessment division, July 2001

radiation area factors, the ingestion pathway, dietary and nondietary data, plant factors, radon data, and storage time before use. Variables are listed below in the INPUTS section. The following inputs were provided by the Joliet or are default values.

INPUTS

Radionuclides: Ra-226 and Ra-228
Calculation time: present through 25 years
The dimension of the field: 590,000 square meters
Sludge depth (Contaminated zone): 0.2 meters
The length of the side parallel to the aquifer flow: 488 meters
The contaminated zone soil: silty clay and silty clay loam
Density of contaminated zone: 1.25 grams per cubic centimeter
Contaminated zone erosion rate: 0 meters per year
Contaminated zone total porosity: 0.45
Contaminated zone field capacity: 1
Contaminate zone hydraulic conductivity: 4,310 meters per year
Contaminated zone b parameter: 9.075
Evapotranspiration coefficient: **0.5**
Wind speed: 4.5 meters per second
Precipitation: 0.8765 meters per year
Irrigation: 0 meters per year
Runoff coefficient: 0.4
Watershed area for near by stream or pond: 2,589,988 square meters
Accuracy for water/soil computations: **0.01**
Density of saturated zone: 1.25 grams per cubic centimeter
Saturated zone total porosity: 0.45
Saturated zone effective porosity: **0.2**
Saturated zone field capacity: 1
Saturated zone hydraulic conductivity: 4,310 meters per year
Saturated zone hydraulic gradient: **0.02**
Saturated zone b parameter: 9.075
Water table drop rate: **0.001 meters per year**
Well pump intake depth: 10 meters below water table
Model for water transport parameters: nondispersion
Well pump rate: 0 cubic meters per year
Density of unsaturated zone: 1.25 grams per cubic centimeter
Unsaturated zone total porosity: 0.45
Unsaturated zone effective porosity: **0.2**
Unsaturated zone field capacity: **0.2**
Unsaturated zone hydraulic conductivity: 4,310 meters per year
Unsaturated zone b parameter: 9.075
Inhalation rate: 8400 cubic meters per year
Mass loading for inhalation rate: 0.0001 grams per cubic meter

Exposure duration: 70 years
Indoor dust filtration factor: **0.4**
External gamma shielding factor: **0.7**
Indoor time fraction: **0.5**
Outdoor time fraction: 0.3
Shape of the contaminated zone: non-circular
Cover total porosity: 0
Cover volumetric water content: 0
Cover radon diffusion coefficient: 0
Building foundation thickness: 0.1016 meters
Building foundation density: 2.403 gram per cubic centimeter
Building foundation total porosity: **0.1**
Building foundation volumetric water content: **0.03**
Building foundation radon diffusion coefficient: **0.0000003 square meters per second**
Contaminated radon diffusion coefficient: **0.000002 square meters per second**
Radon vertical dimension mixing: **2 meters**
Building air exchange rate: 0.3 liters per hour
Building room height: **2.5 meters**
Building indoor area factor: 0.08
Foundation depth below ground surface: **-1**
Radon (Rn)-222 emanation coefficient: 0.35
Rn-220 emanation coefficient: **0.15**
Default values are bolded.
Most fields in the program: 30-60 acres
The area of the largest field: 150 acres (450 houses can be built on the 150 acres)
House dimension: 27.5 feet by 40 feet
Ingestion pathway: the new homes will be served by a public water supply providing water that complies with the Safe Drinking Water Act.

Joliet has an Eastside Waste Water Treatment Plant (WWTP) and a Westside WWTP The annual radon dose and annual total dose resulting from two application patterns using sludge from the Eastside WWTP and two application patterns using sludge from the Westside WWTP follow.

Radium Concentrations in Sludge

Plant	Ra-226 (pCi/g)	Ra-228 (pCi/g)
Eastside	8.8 pCi/g	9.9 pCi/g
Westside	18.3 pCi/g	28.9 pCi/g

The modeled doses result from applications of sludge containing the stated concentrations at a rate of 3.5 tons (3.2 x 10^6 grams per acre) per acre and mixing in soil with a density of 1.25 g/cm^3 to a depth of 8 in (0.2 meters).
8 acre inches = 8.1 x 10^8 cm^3
At a density of 1.25 g/cm^3, 8 acre inches = 1 x 10^9 grams of soil per acre
The radium in applied sludge is distributed in this 1 x 10^9 grams of soil per acre.
For example, the Eastside Ra-226 concentration is 8.8 pCi/g and the application rate is 3.2 x 10^6 g/acre, resulting in 2.8 x 10^7 pCi distributed in 1 x 10^9 grams of soil. The concentration in the 20 cm thick layer is 2.8 x 10^{-2} pCi/g.

Resulting Radium Concentrations in Soil
from a Single Application

Plant	Ra-226 (pCi/g)	Ra-228 (pCi/g)
Eastside	0.028 pCi/g	0.031 pCi/g
Westside	0.058 pCi/g	0.091 pCi/g

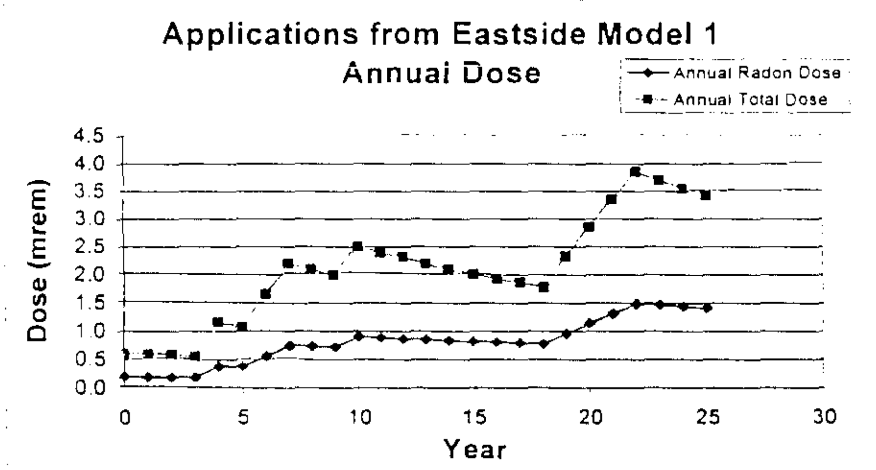
Application Years

Eastside Sludge		Westside Sludge	
Model 1	Model 2	Model 1	Model 2
1	1	1	1
4	4	4	4
7	6	6	6
9	7	7	9
17	10	10	17
18	19	19	18
19	20	20	19
20	21	21	20
	22	22	

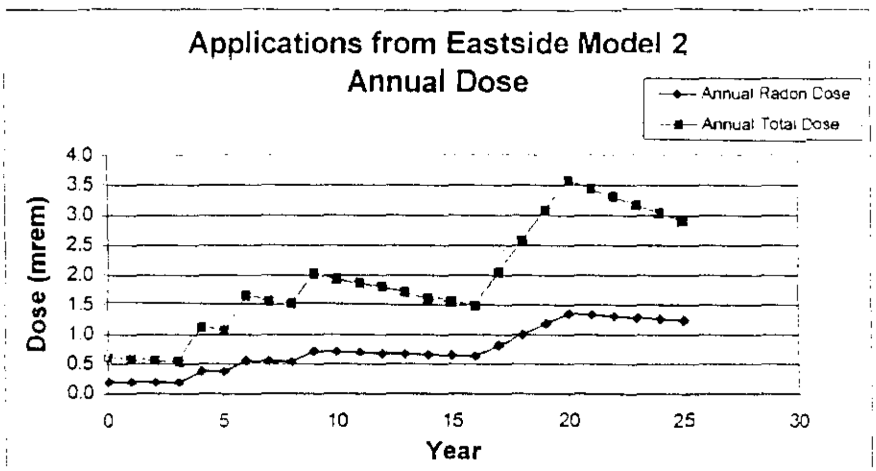
RESULTS

The maximum annual dose from the total of all applications in any application pattern is less than 9 mrem per year. Eastside and Westside annual and cumulative doses follow in tabular and graphic form. Eastside and Westside RESRAD modeling data are in Appendix A.

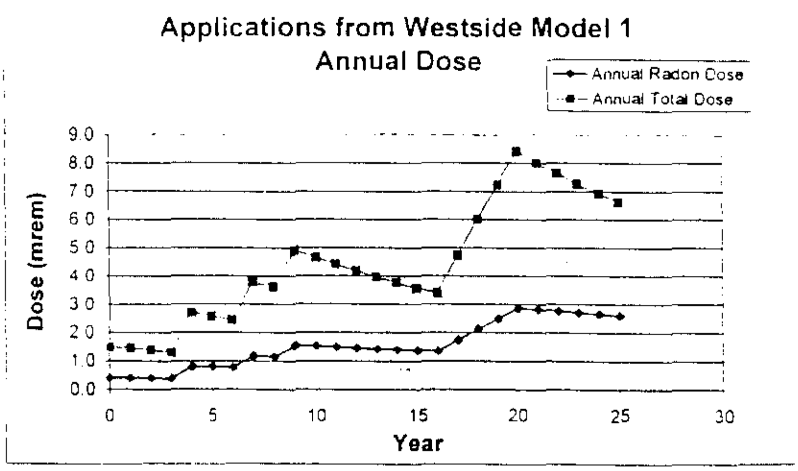
Eastside Model 1				
Year	Annual Dose	Cumulative Doses	Maximum 7 Year Cumulative Doses	Annual Radon Dose
0	0.61	0.61		0.2
1	**0.58**	**1.19**		**0.2**
2	0.56	1.75		0.2
3	0.54	2.29		0.2
4	**1.12**	**3.41**		**0.4**
5	1.06	4.47		0.4
6	1.64	6.11		0.6
7	**2.16**	**8.27**		**0.7**
8	2.07	10.35		0.7
9	**1.98**	**12.33**		**0.7**
10	2.50	14.83		0.9
11	2.38	17.21		0.9
12	2.28	19.49		0.9
13	2.18	21.67		0.9
14	2.07	23.75		0.8
15	1.99	25.74		0.8
16	1.91	27.65		0.8
17	**1.84**	**29.48**		**0.8**
18	**1.76**	**31.25**		**0.8**
19	**2.31**	**33.55**	**2.31**	**1.0**
20	**2.84**	**36.39**	**5.15**	**1.1**
21	3.35	39.74	8.49	1.3
22	3.83	43.56	12.32	1.5
23	3.68	47.25	16.00	1.5
24	3.55	50.79	19.55	1.4
25	3.40	54.19	22.95	1.4



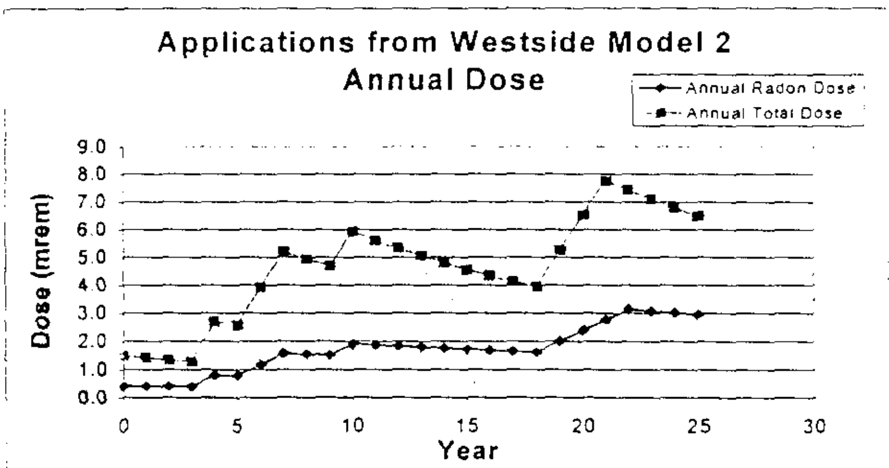
Eastside Model 2				
Year	Annual Dose	Cumulative Doses	Maximum 7 Year Cumulative Doses	Annual Radon Dose
0	0.61	0.61		0.2
1	**0.58**	**1.19**		**0.2**
2	0.56	1.75		0.2
3	0.54	2.29		0.2
4	**1.12**	**3.41**		**0.4**
5	1.06	4.47		0.4
6	**1.64**	**6.11**		**0.6**
7	**1.55**	**7.66**		**0.6**
8	1.49	9.15		0.5
9	2.03	11.18		0.7
10	**1.94**	**13.12**		**0.7**
11	1.85	14.97		0.7
12	1.77	16.75		0.7
13	1.69	18.44		0.7
14	1.61	20.05		0.7
15	1.55	21.60		0.6
16	1.48	23.08		0.6
17	2.05	25.13		0.8
18	2.56	27.69		1.0
19	**3.08**	**30.77**	**3.08**	**1.2**
20	**3.58**	**34.35**	**6.66**	**1.4**
21	**3.44**	**37.79**	**10.10**	**1.3**
22	**3.30**	**41.09**	**13.40**	**1.3**
23	3.15	44.25	16.55	1.3
24	3.04	47.28	19.59	1.3
25	2.91	50.19	22.50	1.2



Westside Model 1				
Year	Annual Dose	Cumulative Doses	Maximum 7 Year Cumulative Doses	Annual Radon Dose
0	1.48	1.48		0.42
1	**1.42**	**2.90**		**0.41**
2	1.35	4.25		0.40
3	1.28	5.54		0.39
4	**2.69**	**8.23**		**0.80**
5	2.56	10.79		0.78
6	**2.44**	**13.23**		**0.77**
7	**3.78**	**17.01**		**1.17**
8	3.59	20.60		1.15
9	4.90	25.50		1.54
10	**4.65**	**30.15**		**1.51**
11	4.41	34.56		1.48
12	4.18	38.75		1.45
13	3.97	42.72		1.42
14	3.76	46.48		1.39
15	3.57	50.05		1.37
16	3.40	53.45		1.34
17	4.74	58.19		1.73
18	6.01	64.20		2.11
19	**7.23**	**71.43**	**7.23**	**2.49**
20	**8.39**	**79.82**	**15.62**	**2.86**
21	**8.02**	**87.84**	**23.64**	**2.81**
22	**7.65**	**95.49**	**31.29**	**2.75**
23	7.27	102.76	38.56	2.70
24	6.94	109.70	45.50	2.65
25	6.63	116.33	52.13	2.60



Westside Model 2				
Year	Annual Dose	Cumulative Doses	Maximum 7 Year Cumulative Doses	Annual Radon Dose
0	1.48	1.48		0.42
1	**1.42**	**2.90**		**0.41**
2	1.35	4.25		0.40
3	1.28	5.54		0.39
4	**2.69**	**8.23**		**0.80**
5	2.56	10.79		0.78
6	**3.92**	**14.71**		**1.19**
7	5.20	19.91		1.58
8	4.95	24.85		1.55
9	**4.70**	**29.55**		**1.52**
10	5.93	35.48		1.90
11	5.62	41.10		1.86
12	5.34	46.44		1.83
13	5.06	51.50		1.79
14	4.79	56.29		1.75
15	4.55	60.85		1.72
16	4.34	65.18		1.69
17	**4.14**	**69.32**		**1.65**
18	**3.95**	**73.26**		**1.62**
19	**5.26**	**78.53**	**5.26**	**2.01**
20	**6.53**	**85.05**	**11.79**	**2.39**
21	7.75	92.80	19.54	2.76
22	7.42	100.22	26.95	3.13
23	7.09	107.31	34.05	3.07
24	6.78	114.09	40.83	3.01
25	6.49	120.58	47.32	2.96



CONCLUSION

The Position Statement of the Health Physics Society, Radiation Risk in Perspective, states, "In accordance with current knowledge of radiation health risks, the Health Physics Society recommends against quantitative estimation of health risks below an individual dose of 5 rem in one year or a lifetime dose of 10 rem above that received from natural sources." Below these doses, risk estimates should not be used; expressions of risk should only be qualitative emphasizing the inability to detect any increased health detriment (i.e. zero health effects are the most likely outcome).

The above notwithstanding, attempts have been made to quantify risk from low dose radiation. USEPA has used the most conservative available value, 5×10^{-4} per 1000 mrem from ICRP 60. For a maximum 25 year cumulative dose of 120.58 mrem in Westside Model 2, the calculated increment in risk is 6×10^{-5}.

The housing density over the 405 acres, to which sludge is being applied, will be a maximum of 3 houses per acre with a Joliet average of 3.5 individuals per house. Therefore, 4253 individuals will be affected by these applications. If sludge with concentrations of Ra-226 and Ra-228 from the Westside plant is applied using Model 2, the collective dose will be 513 person-rem.

The average residential property turnover rate is 1/7 per year. For a maximum 7 year cumulative dose of 47 mrem in Westside Model 2, the calculated increment in risk is 2.4×10^{-5}.

Joliet

Attachment 2

Evaluation of Radium Removal Impacts to Sludge Handling at the Eastside and Westside Wastewater Treatment Facilities

Prepared for:

City of Joliet

Clark Dietz, Inc.
1817 South Neil Street, Suite 100
Champaign, IL 61820

August 2004

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1 INRODUCTION

1.1 Project Background and Objective

The City of Joliet currently owns and operates two wastewater treatment facilities which treat the City's wastewater. The Eastside WWTP, located on the east side of the River, has the capacity to treat an average daily flow of 18 MGD, while the Westside WWTP has the capacity to treat an average daily flow of 14 MGD. In addition, a third wastewater treatment plant, located on the far western edge of the City in Kendall County, is currently under construction, which has the capacity to treat 3.2 MGD.

The Eastside and Westside treatment facilities consist of the secondary treatment activated sludge process with primary settling upstream of the aeration tanks. The clarified effluent is sent directly to the receiving streams. The waste biosolids from the activated sludge process, as well as the primary sludge, is sent to the anaerobic digesters for stabilization. After sludge stabilization, the stabilized sludge is stored in holding tanks to be land applied on local farmers' fields.

As part of the City's continued population growth, the City is currently in the process of providing upgraded and expanded water treatment facilities. Regulations require the City to remove radium from the water supply. Due to the type of radium removal equipment, concentrated discharges of filter backwash from the co-precipitation of radium with hydrous manganese oxides will be discharged to the sewer system, causing radium to accumulate in the biosolids. The radium accumulation in the biosolids will be similar to the radium accumulation occurring at the present time. The waste sludge to be land applied may exceed the allowed amounts radium and may require that the waste sludge is disposed of in a landfill rather than continuing with the current practice of land application.

The purpose of this report is to review the costs, as well as advantages and disadvantages, of changing from the practice of land application of biosolids to disposal of the biosolids in a landfill.

2 EXISTING SLUDGE HANDLING AND DISPOSAL METHODS

2.1 Westside Wastewater Treatment Plant

The Westside Wastewater Treatment Plant was designed for an average daily flow of 14 MGD and a peak flow of 28 MGD. The plant consists of an influent pump station which pumps the flow to an influent channel where it flows by gravity through a Parshall flume to the grit removal tanks. The wastewater then flows to the primary clarifiers for primary treatment and then on to the aeration tanks for removal of CBOD and ammonia from the wastewater. After secondary clarification, the treated wastewater is discharged to the Des Plaines River.

The primary sludge from the primary clarifiers, and the waste sludge from the secondary clarifiers, are both sent to anaerobic digesters for sludge digestion. The digested sludge is then transferred to sludge storage tanks where it is held in storage until it can be land applied to local farm fields. There are no thickening process units prior to the sludge storage tanks. It is estimated that the sludge storage tank decant system will allow the operator to thicken the sludge to the 6 to 8 percent range while in storage.

Based on the records from the City of Joliet Land Application Program for 2003, the amount of biosolids produced by the Westside WWTP and land applied was 895.3 dry tons. This amounted to a liquid volume of sludge of 8.69 million gallons.

2.2 Eastside Wastewater Treatment Plant

The Eastside Wastewater Treatment Plant was designed for an average daily flow of 18.2 MGD and a peak flow of 45 MGD. The plant consists of an influent pump station which pumps the flow to an influent channel where it flows by gravity to the grit removal tanks. The wastewater then flows to the primary clarifiers for primary treatment and then on to the aeration tanks for removal of CBOD and ammonia from the wastewater. After secondary clarification, the treated wastewater is discharged to the Des Plaines River.

The primary sludge from the primary clarifiers, and the waste sludge from the secondary clarifiers, are both sent to anaerobic digesters for sludge digestion. The digested sludge is then transferred to sludge storage tanks where it is held in storage until it can be land applied to local farm fields. A gravity belt thickener thickens the waste activated sludge and the digested sludge.

Based on the records from the City of Joliet Land Application Program for 2003, the amount of biosolids produced by the Westside WWTP and land applied was 2217.3 dry tons. This amounted to a liquid volume of sludge of 17.03 million gallons.

Eastside?

2.3 Land Application of Sludge

Both the Eastside and Westside wastewater treatments use land application as the ultimate disposal option for the wastewater sludge generated by the treatment process. The sludge is stored onsite in large sludge storage tanks and is taken to local farm fields by contract sludge haulers.

The City currently uses about 23 different land application sites with a total area of approximately 1287 acres. All of these sites are located in Will County, Illinois. The biosolids are applied during approximately six months out of the year. A total of 25.7 million gallons of biosolids were applied in 2003.

The local farmers agree to take the biosolids in order to provide the nitrogen required for the crops. There is a substantial difference between the biosolids generated by the Eastside plant and the biosolids generated by the Westside plant. The Eastside biosolids are lower in nitrogen and therefore require more volume per acre (approximately 32,300 gal/acre). The Westside biosolids are able to meet the crop nitrogen requirements with approximately 21,400 gals/acre. The plant personnel attempt to obtain 6 to 8% solids in the sludge storage tanks in order to reduce transportation costs and allow for more nutrient value per gallon of biosolids.

The site application life for the farm fields is based on total phosphorus applied and is generally limited to five years. The application of sludge to a field may not occur over five consecutive years, but may be applied over 10 or more years. Application to a specific field during a year depends on the crops planted, harvest time, rainfall, and other factors. The sludge is applied to the farm field using chisel plows that inject the sludge 6" to 8" under the surface.

The sludge from both plants consistently meets Class B requirements for sludge disposal by land application. The anaerobic digestion process provides enough detention time and a high enough temperature to control pathogenic microorganisms. The majority of the biosolids are injected below the soil surface to allow nutrients to be readily available to the crop roots.

2.4 Current Costs for Land Application

The City bids out for the hauling services to haul the biosolids to the farm fields for land application. The cost for hauling and disposal at the farm fields has historically ranged from 2 to 2.4 cents per gallon according to City records. This results in an approximate annual cost of $617,000 based on the 2003 volumes of sludge removed from the wastewater treatment plants. The City does not charge the landowners for the biosolids.

3 IMPACT OF WATER TREATMENT RESIDUALS

3.1 Radium Removal Requirements

The Safe Drinking Water act requires the removal of radium from drinking water supplies down to the level of 5 picocuries per liter. The City of Joliet's water supply contains naturally occurring radium at a level above the required 5 picocuries per liter limit. The City is in the process of evaluating water treatment technology to be installed at the new water treatment facilities for the removal of radium from the water supply.

3.2 Proposed Water Treatment Technology

The radium removal technology being considered at present is hydrous manganese oxide technology. The backwash from the regeneration cycle will contain concentrated forms of radium which can be discharged to the City's wastewater collection system, and eventually, to the treatment facilities downstream. While the concentration of radium in the backwash stream will be higher than the naturally occurring radium levels, the mass loading of radium to the wastewater treatment plants is not expected to change due to the mechanisms by which radium is absorbed.

3.3 Current Radium Levels in Existing Sludge

The proposed water treatment technology is not expected to increase the amount of radium in the sludge. Tests on the sludge and the farmers' fields have indicated radium levels that have not exceeded background levels of radium.

Since the mass loading of radium is not expected to change, the quantity of radium in the waste sludge from the plant is not expected to change from the current levels. Therefore, the amount of radium currently being applied with the biosolids to farm fields will not be increased due to the installation of new water treatment technology.

4 ANALYSIS OF LANDFILL OF ALTERNATIVE

4.1 Design Objective and Approach

In evaluating the range of feasible alternatives for the ultimate disposal of sludge, if land application is not available due to radium issues, the options that are available to the City are limited. Since there is a limiting constituent in the sludge (radium), options such as composting and eventual use as soil amendment will have the same limitations as land application. Therefore, the only option available for ultimate disposal is disposing of the sludge in a landfill.

In order to decrease the amount of solids to the landfill, additional processes such as incineration can be considered. Due to the high capital cost, significant increase in operation and maintenance costs, and the air pollution control considerations, the option of incineration will not be considered at this time. Instead, landfill disposal preceded by dewatering of the sludge will be evaluated.

Landfill disposal will require additional dewatering of the sludge in order produce a cake like product without any free water. Belt filter press dewatering facilities will be required to accomplish the required dewatering.

Belt filter presses can typically achieve between 18 to 25 percent cake solids. In order to be conservative in the amount of sludge dewatered and disposed of in the landfill, the cake solids will be assumed to be 16% in the dewatered sludge. This will produce a somewhat higher volume of dried sludge for landfill disposal. The estimated sludge production from the wastewater treatment plants, based on design capacity flow rates, is as follows:

Eastside Plant

Daily Production at 6% Solids (wet)	40,000	gpd
Annual Production at 6% solids (wet)	14,600,000	gal
Annual Production at 16% solids (wet)	5,475,000	gal
Annual Solids Production	47,487,960	lbs

Westside Plant

Daily Production at 6% Solids (wet)	34,000	gpd
Annual Production at 6% solids (wet)	12,410,000	gal
Annual Production at 16% solids (wet)	4,653,750	gal
Annual Solids Production	40,364,766	lbs

Therefore, the total solids requiring landfill disposal is approximately 43,927 tons. This amount of material will require hauling from the plant and disposal at the landfill.

4.2 Capital Costs for New Sludge Dewatering Facilities

New sludge dewatering facilities will consist of the following components at each of the wastewater treatment plants:

New building: A new building will be required to house the dewatering equipment.

Dewatering equipment: The dewatering equipment will consist of belt filter presses, sludge feed pumps, sludge conditioning equipment, polymer mixing and feeding facilities, conveyor belts, sludge hoppers and truck loading areas.

Dried sludge storage: In order to account for scheduling of trucks to haul sludge to the landfill, some type of dried sludge storage facilities will be needed. This will most likely consist of a large pole barn type building.

Odor control facilities: The sludge dewatering building and the sludge storage building will be the source of significant odors. Therefore, extensive odor control facilities will be required to remove the required air changes per hour and treat the air for odors from these two buildings.

Site piping: Significant piping modifications will be required in order to route digested sludge from the digesters to a new dewatering building.

Electrical: The new dewatering facilities and odor control equipment will require that new electrical be routed from the existing MCC's to the new buildings.

The capital costs for new sludge dewatering and odor control facilities are estimated as follows:

Eastside Plant

New Building	$750,000
Dewatering Equipment	$500,000
Odor Control	$750,000
Dried Sludge Storage	$450,000
Electrical	$200,000
Site Piping	$250,000
Site Restoration	$50,000
Miscellaneous	$50,000
Construction Cost Sub-Total	$3,000,000

Contingency	$600.000
Non-Construction Cost	$450.000
Project Total	$4,050.000

Westside Plant

New Building	$750.000
Dewatering Equipment	$500.000
Odor Control	$550.000
Dried Sludge Storage	$350.000
Electrical	$200.000
Site Piping	$250.000
Site Restoration	$50.000
Miscellaneous	$50.000
Construction Cost Sub-Total	$2,700.000
Contingency	$540.000
Non-Construction Cost	$405.000
Project Total	$3,645.000

4.3 Annual O & M Costs for New Sludge Dewatering Facilities

In addition to the capital costs discussed above, there will be ongoing annual costs to operate and maintain the facilities, as well as the hauling and disposal costs for the dried sludge. The annual O & M costs, for both the Eastside and Westside plants, are estimated as follows:

Operation of presses (Power, staff, polymer)		$400.000
Odor control facilities		$350.000
Hauling costs at $7.00 per ton (44,000 tons)		$308.000
Disposal costs at $30.00 per ton		$1,320.000
	Total	$2,378.000

Therefore, the estimated annual cost for operating new sludge dewatering facilities and for hauling and disposing the dried sludge at a landfill is approximately $2,400.000 per year. This is a significant increase in operating costs for the City of Joliet. This annual amount has a present worth value over 20 years at the current rate of inflation is approximately $37 million dollars.

4.4 Other Costs

In addition to the capital and O & M costs listed above, there are a number of other costs due to switching to landfill disposal, some of which are not as easily quantified. These costs include the following:

Use of available landfill space: The amount of sludge to be disposed of in a landfill is approximately 44,000 tons per year. By using this available landfill space for sludge disposal it reduces the capacity available for normal domestic waste disposal. Normal domestic solid waste generation is estimated to be approximately 4.4 lbs per person per day. At this rate, and considering each household to consist of 3.5 persons, disposal of waste sludge at a landfill will use the equivalent capacity of over 15,000 households each year.

It is getting more and more difficult each year to site and permit landfills. Therefore, this disposal alternative does have a significant impact on the available landfill capacity.

Nutrient value of sludge: The sludge which is currently land applied provides a substantial nutrient benefit to the local farmers who participate in the program. The nutrient components of the existing biosolids consist of nitrogen, phosphorus, potassium, copper, zinc and manganese. The fertilizer value of the applied biosolids has been estimated at $30.28 per acre in the first year of the program and at $44.65 per acre in the fourth year of the program. On the average, the fertilizer value is $37.47 per acre. Based on a total acreage in the program of 1287 acres, the current benefit to the local farmers is a cumulative annual savings of approximately $48,000.

If the City is required to switch to landfill disposal, the local farmers will have this added cost due to the required purchase of fertilizer for their fields.

Abandonment of existing facilities: The existing sludge storage facilities would no longer be required if the biosolids were disposed of in a landfill. These facilities consist of large sludge storage tanks as well as mixing and transfer pumping systems. There are very few equipment items from these systems that can be used in the new dewatering facilities. Therefore, these facilities will be abandoned and the capital investment will be returning no value as the facilities sit in a mothballed state.

The construction cost of the existing sludge storage infrastructure at the Eastside Wastewater Treatment Plant was $2,964,330. The construction cost of the existing sludge storage infrastructure at the Westside Wastewater Treatment Plant was $4,075,000. Therefore, the total cost of existing infrastructure that would be abandoned by going to landfill disposal is approximately $7,000,000.

5 RECOMMENDATION

Based on the costs required to switch to landfill disposal of the sludge, the landfill disposal option of the sludge is not cost effective. The costs are summarized as follows:

Parameter	Proposed Landfill	Existing Land Application
Planning Period, years	20	20
Inflation Rate, %	2.5	2.5
Capital Cost	$7,695,000	$0
Installation Cost	[redacted]	[redacted]
Present Value Capital Cost	[redacted]	[redacted]
Operating Costs per Year	$2,378,000	$617,000
Present Value Operating Cost	[redacted]	[redacted]
Total Life Cycle Cost - Present Value	[redacted]	[redacted]

As can be seen from the above table, the present value life cycle cost is over $44 million dollars, versus under $10 million dollars for the existing land application practice. This does not account for the cost of abandoning facilities, the nutrient value of the sludge, or the landfill space taken up by landfill sludge disposal.

Therefore, since landfill disposal of sludge is not required for environmental reasons, it is recommended that the current practice of land application of the sludge on local farmers' fields be continued as it is the most cost effective option for ultimate sludge disposal.

Calculation of Benefit to Cost Ratio

The benefit to the public is that costs are saved by continued land application of biosolids(wastewater treatment plant sludge)

The savings associated with land applications were calculated by Clark Dietz, Inc in the report entitled

"Evaluation of Radium Removal Impacts on Sludge Handling at the Eastside and Westside Wastewater Treatment Plants"

The report provides 20 year costs and must be adjusted to 25 years Adjustments were made to the operating costs only

	Joliet Eastside	Joliet Westside	Total
Capital	$ 4,050,000 00	$ 3,645 000 00	$ 7,695 000 00
20 year operating increase	$ 15 647 933 55	$ 11 804,581 45	$ 27,452 515 00
20 year total	$ 19,697,933 55	$ 15,449,581 45	$ 35,147,515.00
25 year total	$ 22,543,836 32	$ 17,596,490 56	$40,140 326 88

The costs to the public are the cost associated with additional radiation exposure The Nuclear Regulatory Commission published costs in 1995 of $2,000 per person rem This cost inflates to $2,500 per person rem in 2004 using the consumer price index

Using the radiation dose for 25 years from the RSSI Study entitled" REPORT OF RESRAD MODELING FOR WASTEWATER TREATMENT PLANT SLUDGE APPLIED TO LAND CURRENTLY USED FOR AGRICULTURE
The 25 year doses are as follows"

	Joliet Eastside		Joliet Westside		Total	
	50 19000	mrem	120.58	mrem	170 77	mrem
convert to rem	0 00100	rem/mrem	0 00100	rem/mrem	0 00100	rem/mrem
	0 05019	rem	0 12058	rem	0 17077	rem
Acres receiving biosolids	705 00		405 00		1,110 00	
homes per acre	3 00		3 00		3 00	
homes	2,115 00		1,215 00		3,330 00	
People per home	3 50		3 50		3 50	
People	7,403		4,253		11,655	
	371 53	person rem	512 77	person rem	884 30	person-rem
	$ 2 500 00	$/person-rem	$ 2,500 00	$/person-rem	$ 2,500 00	$/person-rem
	$ 928 828 69	Cost	$ 1,281,916 13	Cost	$ 2,210 744 81	Cost

	Joliet Eastside	Joliet Westside	Joliet Total
Benefits	$ 22,543 836 32	$ 17,596,490 56	$40,140,326 88
Costs	$ 928 828 69	$ 1,281,916 13	$ 2,210,744 81
Ratio	**24.27**	**13.73**	**18.16**
	Joliet Eastside	**Joliet Westside**	**Joliet Total**

Attachment 4

Calculation of Recommended Increase in Background Radium Concentrations

Prepared by City of Joliet, Department of Public Works and Utilities

Concentrations in Sludge

	Radium 226	Radium 228	Combined Radium 226 and 228
Eastside	8.8 picocuries per gram, dry	9.9 picocuries per gram, dry	18.70 picocuries per gram, dry
Westside	18.3 picocuries per gram, dry	28.9 picocuries per gram, dry	47.20 picocuries per gram, dry

Concentration in Soil after application at 3.5 dry tons per acre

	Radium 226	Radium 228	Combined Radium 226 and 228
Eastside	0.028 picocuries per gram, dry	0.031 picocuries per gram, dry	0.059 picocuries per gram, dry
Westside	0.058 picocuries per gram, dry	0.091 picocuries per gram, dry	0.15 picocuries per gram, dry

Attachment 4

Calculation of Recommended Increase in Background Radium Concentrations

Prepared by City of Joliet, Department of Public Works and Utilities

From the RESRAD Modeling, one application of sludge from the Joliet Westside Wastewater Treatment Plant at 3.5 dry tons per acre results in a dose of 1.48 milli-rems per year for the first year

If 10 milli-rems per year is accepted as the dose limit, how many applications may be made?

	10.00	milli-rems total
	1.48	milli-rems per application
	6.76	applications
	6.76	applications
	0.15	pico-curie per gram increase in background per application
	1.01	pico-curie per gram increase in background
use	**1.00**	**pico-curies per gram**

This is somewhat conservative due to the normal decline in dose over time.

IEMA
Illinois Emergency Management Agency
Division of Nuclear Safety

Rod R. Blagojevich, Governor
William C. Burke, Director

May 9, 2005

Mr. Alan Keller, P.E.
Manager, Permit Section
Division of Water Pollution Control
Illinois Environmental Protection Agency
1021 North Grand Avenue East
P.O. Box 19276
Springfield, IL 62794-9276

Dear Mr. Keller:

The Illinois Emergency Management Agency, Bureau of Environmental Safety, (Agency) has reviewed the request from the City of Joliet dated February 28, 2005, (contained in your letter dated March 3, 2005). Joliet specifically requests to land apply sewage sludge containing radium such that the radium concentration in the soil receiving the sludge would be increased 1 pCi/g.

The Agency has questions regarding Joliet's application that must be addressed before a decision can be rendered. The questions have been separated by the application document and identified by page and paragraph.

Joliet transmittal letter:

Pg 2, 6th paragraph – Joliet requests authorization to increase radium soil concentration by 1 pCi/g. This is ten times the current limit established in the Memorandum of Agreement between IEMA-DNS and IEPA. Joliet makes no commitment as to the specific number of applications, the application rate, or the application schedule. They provide various scenarios as examples but do not make any guarantees they will adhere to these examples. Calculations can demonstrate that different application scenarios could result in a situation that will result in doses to the public that exceeds those of the examples. Joliet needs to provide clarification and or commitment on how the sludge is applied and to what degree the sludge is blended into the soil mass. Alternatively, your office may decide to dictate these values, but in any case we suggest that these values need to be conditions of the permit.

CARE ATTACHMENT SIX

Attachment 4 – Calculation of Recommended Increase in Background Radium Concentrations.

Was Joliet planning on taking decay of Ra-228 into consideration in calculating when soil concentrations are increased 1 pCi/g? If no, then the number of applications would be limited to the same number as calculated by using a dose limit.

Any questions or concerns related to this correspondence should be directed to Gary McCandless at the address above or at (217) 782-1329.

Sincerely,

Richard Allen

Richard Allen, Chief
Bureau of Environmental Safety

RA:tlk

cc: Roger Selburg, IEPA