

BEFORE THE ILLINOIS POLLUTION CONTROL BOARD

IN THE MATTER OF:)
)
WATER QUALITY STANDARDS AND)
EFFLUENT LIMITATIONS FOR THE) R08-9
CHICAGO AREA WATERWAY SYSTEM) (Rulemaking - Water)
AND THE LOWER DES PLAINES RIVER:)
PROPOSED AMENDMENTS TO 35 ILL.)
Adm. Code Parts 301, 302, 303 and 304)

**PRE-FILED TESTIMONY OF THOMAS GRANATO
RECREATIONAL USES AND STANDARDS**

My name is Thomas Granato, and I am the Assistant Director of Research and Development managing the Environmental Monitoring and Research Division at the Metropolitan Water Reclamation District of Greater Chicago. I have been employed by the District for over 20 years and have held progressively responsible positions, including head of the Biosolids Utilization and Soil Science Section, and Coordinator of Technical Services. I have been Assistant Director of R&D for the past three and one half years. The EM&R Division houses the District's Wastewater Treatment Process Research Section, the Biosolids Utilization and Soil Science Section, the Analytical Microbiology and Biomonitoring Section, the Aquatic Ecology and Water Quality Section, and the Radiochemistry Section, which collectively house approximately 70 environmental scientists and engineers, soil scientists, biologists, microbiologists, chemists, radiation chemists, biostatisticians and other technical personnel. Over this time period I have been directly involved in the planning, development, management and administration of the many research studies that the District has undertaken to support the Chicago Area Waterways Use Attainability Analysis.

I hold a Bachelor of Science degree in Agricultural Science and a Master of Science degree in Soil Chemistry from the University of Illinois at Urbana-Champaign and a Doctor of Philosophy degree in Environmental Soil Science from North Carolina State University. I am a

member of the Water Environment Federation, the American Chemical Society, the Soil Science Society of America and the American Society of Agronomy. I have been a managing editor of Water Environment Research for the past two years. I have published over 50 research articles and reports pertaining to biosolids management, risk assessment, water quality, and other areas of environmental science.

This testimony summarizes and concludes the District's testimony on recreational use issues for the Chicago Area Waterways System (CAWS). The District believes that the Illinois Environmental Protection Agency relied on incorrect assumptions and incomplete information to reach faulty conclusions regarding recreational use designations and associated standards for the CAWS. Instead of pursuing this rulemaking now, IEPA should wait for necessary studies being conducted by the District to be completed. These studies will provide essential information to make scientifically supported decisions regarding appropriate water quality standards for the CAWS. However, if the rulemaking does move forward at this time before the studies are complete, the District urges significant revisions to assure that the recreational use designations and criteria for the CAWS are technically and legally supportable.

The District participated in and supported the UAA Study by providing technical information on the potential recreational use classification for the CAWS. IEPA and the District agreed that a thorough understanding of the CAWS is required before scientifically sound recommendations concerning the recreational use potential and associated protective standards can be established given the unique man-made and altered waterways of the CAWS.

IEPA requested that the District undertake and support a structured scientific assessment approach designed to evaluate the need and, if necessary, provide the basis for generating numeric water quality standards for the proposed recreational use designations. To assist IEPA

in making this determination, and at the agency's request, the District initiated a multi-phase research program, and has invested substantial funds (over \$10 million) on expert studies that can produce meaningful recommendations for a systematic technical and scientific assessment of recreational health risks to protect the identified uses of the CAWS. The key focus in this comprehensive research program is the assessment of the risks to human health for the identified recreational uses relative to the current practice of not disinfecting the effluents that discharge to the CAWS, as well as a structured scientific assessment to generate data and information upon which science-based water quality criteria can be derived.

However, instead of waiting for the conclusion of this scientific assessment, which is well underway, IEPA is proposing to revise the recreational designated uses for the CAWS and to impose technology-based effluent standards for treated wastewater. The District disagrees with the decision by IEPA not to wait for the results from the structured scientific assessment approach, which it supported and asked the District to undertake. However, if this rulemaking moves forward before completion of the scientific assessment, the District makes the following recommendations concerning specification of recreational uses and standards.

Recreational Uses

In the proposed rulemaking, most waterways in the CAWS have been designated for Incidental Contact Recreation. Incidental Contact Recreation includes fishing, commercial boating, small craft recreational boating, and any limited contact associated with shoreline activity such as wading. However, the CAWS presents many safety issues that may render contact recreational activities such as swimming, wading and hand-powered boating hazardous to individuals. The man-made waterways do not have a substantial shallow area along the banks; the depth drops off very rapidly; the banks are lined with high vertical sheet piling or large limestone rocks; periodic draw downs of water levels cause unexpected, rapid increases in

stream velocity; and there is frequent barge and large power boat traffic. These safety factors are persuasive grounds for restricting primary and incidental contact recreational activities such as swimming, wading and hand-powered boating in the CAWS.

Non-Contact Recreation is defined in Section 301.323 of the IEPA's regulatory proposal as "any recreational activity in which human contact with the water is unlikely, such as pass through commercial or recreational navigation, and where physical conditions or hydrologic modifications make human contact unlikely or dangerous." The physical limitations and hydrological modifications of the CAWS make this category more appropriate for the CAWS than Incidental Contact Recreation.

Based on the physical hazards they present, the District proposes that the following waterways be designated for Non-Contact Recreation, contrary to the proposed standards: the Chicago Sanitary and Ship Canal from the South Branch of the Chicago River to the junction with the Calumet-Sag Channel, the entire Calumet-Sag Channel, the Chicago River, and the South Fork of the South Branch of the Chicago River (Bubbly Creek).

Recreational Standards

The District is confident that the weight of scientific evidence against the proposed 400 fecal coliform cfu/100 mL effluent standard is clear and overwhelming. To provide confidence in any decision making regarding disinfection requirements, multiple lines of scientific evidence must be considered collectively. On the basis of the District's systematic technical and scientific assessment of the CAWS, as summarized in the testimony presented by those before me, these lines of evidence include the following:

1. The microbial risk assessment report concluded that low pathogen levels in the District's plant effluents and in the CAWS downstream of the plants mean there is a minimal risk for gastrointestinal illness associated with recreational use of the CAWS. Furthermore, the

presence of pathogens is mainly due to secondary loading of the waterway under wet weather conditions from CSOs and other discharges. The microbial risk assessment report also concludes that disinfection of effluent from the water reclamation plants will have minimal effects on overall recreational illness rates.

2. The District's epidemiological study will not be completed until 2010, and undertaking this rulemaking prior to completion of the study is premature. The District's epidemiology study is necessary to develop science-based criteria for incidental contact activities.

3. Disinfection to reduce fecal coliform from wastewater effluent discharges is not justified when much higher concentrations of fecal coliform are regularly introduced into the CAWS by tributary flows and during wet weather. A District report concluded that disinfection during wet weather would not improve the microbiological water quality in the CAWS downstream of the District's reclamation plants in terms of maintaining less than 400 fecal coliform cfu/100 mL.¹ Results from the UAA Study also indicated that fecal coliform densities upstream of the reclamation plants and in major tributaries to the CAWS were well above the proposed 400 fecal coliform cfu/100 mL effluent standard, indicating that the proposed effluent standard could not be attained in the CAWS even if the reclamation plants met the proposed effluent standard. Previous testimony regarding the risk assessment study indicated that fecal coliform were not well correlated with presence of pathogens.

4. Over the past 23 years, wastewater discharges have received secondary treatment but have not been disinfected, and there have been no documented public health outbreaks resulting from recreational use of the CAWS. As Dr. Blatchley presented in his testimony, this

¹ District Report, 2007-79.

is not surprising considering the experience of many other developed countries. In most countries of western Europe, wastewater disinfection is practiced only at facilities where effluent discharge is to a public swimming area, or where other opportunities for direct human contact are likely (e.g., shellfish breeding grounds). Despite the fact that effluent disinfection is uncommon in Europe, the incidence of diseases associated with waterborne pathogens among the residents of these countries does not appear to be substantially different than in the U.S.

5. The proposed effluent standard is normally applied to treated wastewater effluents discharged to receiving waters that may be used for drinking water supply, swimming, or shell fishing. However, IEPA has concluded that primary contact recreation is not an attainable use in the CAWS, and that the CAWS is not a drinking water or shell fishing source. Therefore, the proposed disinfection requirements should not be applied to CAWS dischargers.

6. USEPA's monitoring methods detect traditional fecal indicators that are not always associated with health risks.² Although the presence of these indicator organisms can initiate management actions, sound science does not justify such actions for the CAWS. The report of the Experts Scientific Workshop on Critical Research Needs for the Development of New or Revised Recreational Water Quality Criteria recommended that monitoring tools for bacteria should be reflective of health risks.³ The current rulemaking addresses fecal coliform bacteria, which have been determined by USEPA to be poor predictors of the presence or concentration of pathogens in water. It is essential that the microbial standards for water be

² Colford et al., 2007. *Water Quality Indicators and the Risk of Illness at Beaches With Nonpoint Sources of Fecal Contamination*. *Epidemiology*. 18(1):27-35.

³ EPA, 2007. Report of the Experts Scientific Workshop on Critical Research Needs for the Development of New or Revised Recreational Water Quality Criteria. EPA 823-R-07-006.
<http://www.epa.gov/waterscience/criteria/recreation/>.

reasonably and adequately protective of human health in light of the substantial capital expenditure that may be required to bring the CAWS into regulatory compliance.

7. There is evidence that no disinfection technology can offer a 100 percent guarantee of safe recreational water. Studies have found that although bacterial indicators are significantly reduced by disinfection, there is no clear indication that pathogens are also significantly reduced, particularly viruses.⁴ The infrastructure expenditure necessary to achieve a particular effluent fecal coliform level is not an efficient or productive use of limited public resources.

8. The District's Stickney, Calumet, and North Side reclamation plants provide treated wastewater of exceptional quality. The District is addressing the current and future needs of the plants for handling wet weather flow. The District has also instituted an effective research program to determine the health risks and to study potential public health issues for the CAWS. The risk assessment study found that the risks associated with incidental contact recreational practices on the CAWS are below the most conservative risk threshold that USEPA applies to criteria for primary contact recreation. IEPA acknowledges that the results of the CAWS epidemiological study, which is well underway, will provide the necessary scientific basis for protective bacterial water quality standards for the CAWS.

9. The costs associated with effluent disinfection are extraordinary, particularly considering the limited benefit. For example, installation and operation of UV disinfection technology, which currently represents the most likely choice for implementation at the District's North Side, Calumet and Stickney plants, is estimated at a total present worth cost of \$919.6 million. Chlorination/dechlorination would result in similar costs to the District. Based upon the

⁴ Blatchley et al., "Effects of Wastewater Disinfection on Waterborne Bacteria and Viruses," 2007.

District's limitations and restrictions on generating revenues to fund programs, funding such an expenditure would require legislative action, a voter referendum, or significantly reducing funding of existing District programs.

10. Finally, effluent disinfection will result in substantial environmental impacts in the form of energy usage, air emissions from power generation and transportation of raw and waste materials, and land usage. These environmental impacts must be weighed when considering the appropriateness of disinfection requirements.

Conclusion

As established by the preceding testimony by the District's witnesses, IEPA's tentative conclusions in the Statement of Reasons are not supported by sound science, and are often arbitrary, speculative, or not rationally related to the information necessary to establish appropriate recreational uses and supporting criteria. The District, partly at IEPA's request, has undertaken an expeditious and systematic program of study to generate the scientific information necessary to understand the public health uncertainties in the CAWS. Given the enormous capital costs that will be required to meet the proposed effluent standards and the apparent low risk that currently exists for recreational users of the CAWS, it would be most prudent to base the final rulemaking on the completed program of study. For these reasons, the District strongly recommends that the IPCB consider delaying the establishment of new recreational uses and the technology-based effluent disinfection requirement. If the rulemaking proceeds, we recommend that those parts of the CAWS as previously stated (including the Chicago Sanitary and Ship Canal from the South Branch of the Chicago River to the junction with the Calumet-Sag Channel, the entire Calumet-Sag Channel, the Chicago River, and the South Fork of the South Branch of the Chicago River (Bubbly Creek).) be designated for Non-Contact Recreation, and that the requirement to disinfect be removed as unsupported.

Respectfully submitted,

A handwritten signature in cursive script that reads "Tom Granato". The signature is written in black ink and is positioned above the typed name.

By: Thomas Granato

Thomas C. Granato
14822 Oak Creek Ct.
Orland Park, IL 60467
708-588-4116/708-403-9984
thomas.granato@mwrddgc.dst.il.us

EDUCATION

Ph. D. North Carolina State University 1987. Environmental Soil Science
M.S. University of Illinois 1984. Soil Chemistry
B.S. University of Illinois 1981. Agricultural Science

EXPERIENCE

Assistant Director of Research and Development, Metropolitan Water Reclamation District of Greater Chicago, Research and Development Department, March 2005 to present

- Head of the Environmental Monitoring and Research (EM&R) Division, direct research activities of six sections including Wastewater Treatment Process Research Section, Biosolids Utilization and Soil Science Section, Aquatic Ecology and Water Quality Section, Analytical Microbiology and Biomonitoring Section, Radiochemistry Section, and Statistical Support Section.
- Responsible for preparation and administration of EM&R Division budget for 70 employees and supporting facilities.
- Responsible for assignment, tracking, review and approval of all assignments received by EM&R Division.
- Responsible for focusing staff on relevant research to improve District operations, reduce operating costs and ensure regulatory compliance.
- Provide back-up administration and supervision to the R&D Department in the absence of the Director and represent R&D Department at executive level meetings.
- Managing District research program supporting Illinois EPA Chicago Area Waterways Use Attainability Analysis study and nutrient standard develop (projects include quantitative microbial risk assessment, epidemiological study of secondary contact recreation on waterways, habitat evaluation and restoration study, studies of non-point sources of bacterial indicators to waterways, studies to develop design criteria for effluent disinfection, full scale P removal effects on water quality in receiving stream, effectiveness of permeable pavement and development of sustainable streetscapes to reduce stormwater entry to combined sewers)
- Chair Illinois Water Environment Association Biosolids Committee
- Managing Editor, Water Environment Research (January 2007 to present)

Coordinator of Research, Metropolitan Water Reclamation District of Greater Chicago, Research and Development Department, May 2004 to March 2005

- Coordinate assignments and review work for four sections in the Environmental Monitoring and Research Division including 25 employees (Stickney & Fulton Co.)
- Coordinate preparation and administration of EM&R Division budget for seven sections and 70+ employees
- Review 80+ monitoring reports for U. S. EPA, IEPA, and IL Emergency Management Agency regulations and permits
- Manage R&D Department activities related to researching and supporting biosolids processing and use
- Serving on MWRDDGC Management and Leadership Development Program Steering Committee
- Completed Intergovernmental Executive Development Program (Fall 2004- Sponsored by City of Chicago Department of Personnel and City Colleges of Chicago)

Soil Scientist III, Metropolitan Water Reclamation District of Greater Chicago, Research and Development Department, Jul. 1998-May 2004

- Manage Land Reclamation & Soil Science Section Including 17 Employees (Stickney & Fulton Co.)
- Manage U. S. EPA 40CFR Part 503 and IEPA permit compliance monitoring programs – Provide tech support on regulatory compliance for biosolids processing and use
- Design and implement research on land application of biosolids, fate of trace elements and nutrients, suitability of plant species for growth in biosolids
- R&D Department representative for biosolids marketing meetings and projects
- Serve on two project review committees for Water Environment Research Foundation
- MWRDGC Trainer - Supervisory Skills and Management Practices Program
- Serve on Advisory Board, Environmental Science Studies Program, Environmental Institute, Loyola Univ.

Soil Scientist II, Metropolitan Water Reclamation District of Greater Chicago, Research and Development Department, Jul. 1988-Jun. 1998.

- Managed Stickney Soils Laboratory (6 employees)
- Research Project Manager, projects included: NuEarth vegetable garden study, PCBs and priority pollutant uptake by corn and vegetables, study of background trace element and radionuclide concentration in Illinois soils, characterization of trace elements in street dusts and urban soils, determining phytotoxic threshold Zn concentration in grass and vegetable leaves, determining tolerance of grasses, native plants to salinity and NH₃-N; suitability for growth in biosolids, determining nature of biosolids salinity.
- Research Programs Featured in Water Quality International Jan/Feb 1998 Issue
- Served on Biosolids Marketing Committee
- Served on Committee Utilized By U.S. EPA to Revise Proposed Part 503 Regulation Prior to Promulgation
- Prepared Comments, Position Papers on all Aspects of U.S. EPA Part 503 Rulemaking
- Served On Two Project Review Committees For Water Environment Research Foundation

Post-Doctoral Research Associate, University of Illinois, Department of Agronomy, Nov. 1987-Jun. 1988

- Managed project team studying reclamation of explosives contaminated soils at Joliet Army Ammunition Plant and acquired U.S. Army Toxic & Hazardous Materials Agency certification for HPLC analysis of explosives residues.

AWARDS, COMMENDATIONS, INVITED PAPERS

- Invited to Speak at Water Environment Association of Ontario Biosolids Conference, Toronto, Canada, Oct 2007
- Invited to Speak at American Society of Agronomy Special Symposium, Indianapolis, IN, Nov. 2006
- Invited to Chair Session at WEF Biosolids Specialty Conference, Nashville, TN April 2005
- Invited to Speak at American Society of Agronomy Special Symposium, Seattle, WA Nov. 2004
- Invited to Present Seminar to Dept. Natural Resources & Environmental Sci., U. IL., Urbana, April 2004
- Invited to Speak at Central States Water Environment Association Education Seminar, Madison, WI, April 2004
- Invited to Speak before Illinois Soil Classifiers Association, Naperville, IL, February 2004
- Received Assoc. Metropolitan Sewerage Agencies Research and Technology Award, June 2001
- Invited onto Program Committee USEPA Region 5 Innovative Biosolids Use Annual Symposia, Sept. 2000, 2001
- Invited to Speak before Illinois Dunesland Preservation Society, October 2000
- Invited to Present Seminar to Dept. Soil & Environmental Sci., U. California, Riverside, March 1999
- Served on Program Committee for 4th International Conference on Biogeochemistry of Trace Elements, June 1997
- Commendation For 5 Years Service, Symposium Judge, Chicago Public Schools Science Fairs, March 1997

- Invited to Present Paper on Final Part 503 Regulations to Lake Michigan Water Analysts, January 1993
- Editor's Citation For Excellence in Manuscript Review Journal of Environmental Quality 1992
- 1st Annual Best Paper Award Presented by Illinois Water Environment Association, March 1990
- Invited to Present Paper on Proposed Part 503 Regulations to Lake Michigan Water Analysts, January 1990
- Outstanding Graduate Teaching Assistant N.C. State Agricultural Institute 1985

REPORTS, PUBLICATIONS, PRESENTATIONS

- Co-authored two book chapters
- Authored/Co-Authored 31 R&D Department research reports or comprehensive regulatory comment documents
- Authored/Co-Authored 23 research articles published in scientific journals or conference proceedings
- Presented over 50 technical papers at local, regional, national, and international conferences and meetings

PROFESSIONAL SOCIETY MEMBERSHIPS

- Water Environment Association/Illinois Water Environment
- Association Soil Science Society of America/American Society of Agronomy
- American Chemical Society

REPORTS, PUBLICATIONS, ABSTRACTS, PRESENTATIONS

MWRDGC REPORTS:

- Dennison, S. G., G. K. Rijal, and T. C. Granato. 2007. Fecal Coliform Densities in the Chicago Waterway System During Dry and Wet Weather 2004-2006. Report 07-79, Research and Development Department, Metropolitan Water Reclamation District of Greater Chicago.
- Zmuda, J. T., R. A. Gore, Z. Abedin, and T. C. Granato. 2006. The Effect of Secondary Sewage Treatment on the Total Numbers and Percentages of Antibiotic Resistant Fecal Coliforms in Raw Sewage Entering the Seven Water Reclamation Plants of the Metropolitan Water Reclamation District of Greater Chicago. Report 06-32, Research and Development Department, Metropolitan Water Reclamation District of Greater Chicago.
- Hundal, L., S., A. C. Cox, P. Lindo, G. Tian, T. C. Granato, and B. Sawyer. 2005. Use of Biosolids for Establishing Vegetation at the USX Steel Mill Slag Brownfield In Chicago: A Research and Demonstration Project. Report 05-06, Research and Development Department, Metropolitan Water Reclamation District of Greater Chicago.
- Granato, T. C., O. Dennison, and G. Knafl. 2004. Determination of Phytotoxic Zinc Thresholds in Leaves of Grasses and Food and Fiber Crops. Report 04-23, Research and Development Department, Metropolitan Water Reclamation District of Greater Chicago.
- Khalique, A., A. Cox, T. C. Granato, and R. I. Pietz. 2004. Radioactivity in Biosolids-Amended Soil and Uptake by Corn. Report 04-22, Research and Development Department, Metropolitan Water Reclamation District of Greater Chicago.
- Lindo, P., A. Cox, and T. C. Granato. 2004. Biosolids Chemical Characteristics. Report 04-21, Research and Development Department, Metropolitan Water Reclamation District of Greater Chicago.
- Cox, A., T. C. Granato, C. Carlson, and R. I. Pietz. 2004. Reclamation of the St. David, Illinois, Coal Refuse Pile with Biosolids and Other Amendments: Effects on Chemical Composition of Coal Refuse, Forage and Surface Runoff Water. Report 04-13, Research and Development Department, Metropolitan Water Reclamation District of Greater Chicago.
- Pietz, R. I., Z. Abedin, T. C. Granato, and C. Carlson. 2004. Corn Yields and Nutrient Composition During Long-Term Biosolids Applications to Calcareous Strip-Mine Soil. Report 04-12, Research and Development Department, Metropolitan Water Reclamation District of Greater Chicago.
- Granato, T. C., A. Cox, O. Dennison, and R. I. Pietz. 2004. An Investigation of Salinity in Biosolids Generated by the Metropolitan Water Reclamation District of Greater Chicago. Report 04-3, Research and Development Department, Metropolitan Water Reclamation District of Greater Chicago.
- Granato, T. C., Z. Abedin, O. Dennison, S. Zumpano, R. I. Pietz, P. Tata, and C. Lue-Hing. 2003. Trace Element Concentrations in Street Dust and Surface Soils in the Drainage Basins of the Stickney and Calumet Water Reclamation Plants. Report 03-21, Research and Development Department, Metropolitan Water Reclamation District of Greater Chicago.
- Cox, A., G. Tian, and T. C. Granato. 2003. A Survey of Characteristics of Topsoils Marketed in the Chicago Metropolitan Area. Report 03-19, Research and Development Department, Metropolitan Water Reclamation District of Greater Chicago.
- Granato, T. C., R. I. Pietz, C. R. Carlson, P. Tata, C. Lue-Hing, and G. Knafl. 2001. Mineralization of Organic Carbon Does Not Produce a "Time Bomb Effect" in Biosolids-Amended Soil. Report 01-15, Research and Development Department, Metropolitan Water Reclamation District of Greater Chicago.

- Nelson, S. N., T. C. Granato, C. R. Carlson, R. I. Pietz, and P. Tata. 2001. Elevated Nitrate-N Concentrations in Groundwater at Field 10, Fulton County, Illinois. Report 01-9, Research and Development Department, Metropolitan Water Reclamation District of Greater Chicago.
- Granato, T.C., R.I. Pietz, C.R. Carlson, G. Knafl, and C. Lue-Hing. 1999. Effect of Time After Cessation of Biosolids Applications on Uptake of Cadmium, Copper, Nickel and Zinc into Corn Leaves and Grain. Report 99-23, Research and Development Department, Metropolitan Water Reclamation District of Greater Chicago.
- Granato, T.C., R.I. Pietz, O. Dennison, P. Tata, D.R. Zenz, and C. Lue-Hing. 1998. An Evaluation of the Suitability of Grass Species and Varieties for Germination and Growth in Biosolids. Report 98-26, Research and Development Department, Metropolitan Water Reclamation District of Greater Chicago.
- Pietz, R.I., R. Johnson, R. Sustich, T.C. Granato, P. Tata and C. Lue-Hing. 1998. A 1996 Sewage Sludge Survey of the Association of Metropolitan Sewerage Agencies Members. Report 98-4, Research and Development Department, Metropolitan Water Reclamation District of Greater Chicago.
- Lue-Hing, C., P. Tata, T. Granato, R. Sustich, R. Johnson, R. I. Pietz. 1998. Sewage Sludge Survey. Association of Metropolitan Sewerage Agencies, Washington, D.C.
- Pietz, R. I., T. C. Granato, J. Gschwind, J.G. Anderson, D.R. Zenz, R. Hill and C. Lue-Hing. 1996. Petition to the Illinois Pollution Control Board for an Adjusted Standard to Use Air-Dried Sludge as a Substitute for Soil in the Final Protective Layer of Nonhazardous Waste Landfills, (AS 95-4). Report 96-9, Research and Development Department, Metropolitan Water Reclamation District of Greater Chicago.
- Pietz, R. I., T. C. Granato, J. G. Anderson, D. R. Zenz, R. Hill, and C. Lue-Hing. 1996. Beneficial Use of Municipal Sludge as a Final Protective Vegetative Cover on Nonhazardous Waste Landfills. Report 96-12, Research and Development Department, Metropolitan Water Reclamation District of Greater Chicago.
- Granato, T. C., R. I. Pietz, J. Gschwind, and C. Lue-Hing. 1995. Mercury in Soils and Crops from Fields Receiving High Cumulative Sewage Sludge Applications: Validation of USEPA's Risk Assessment for Human Ingestion. Report 95-12, Research and Development Department, Metropolitan Water Reclamation District of Greater Chicago.
- Pietz, R. I., T. C. Granato, C. R. Carlson, Jr., J. Gschwind, D. R. Zenz, and C. Lue-Hing. 1994. Reclamation of the St. David, Illinois Coal Refuse Pile with Sewage Sludge and Other Amendments. Report 94-12, Research and Development Department, Metropolitan Water Reclamation District of Greater Chicago, 1994.
- Pietz, R. I., T. C. Granato, C. R. Carlson, R. Ellis, and P. Tata. 1994. Sampling and Analyses of Sediments from the Acid Mine Lake, Fulton County. Research Report, Research and Development Department, Metropolitan Water Reclamation District of Greater Chicago.
- Granato, T. C., B. Sawyer, G. Elenbogen, D. R. Zenz, K. C. Rao, and C. Lue-Hing. 1993. Effect of Sludge Type, Total Soil Metal Concentration, and the Concentration of Metal in Chemical Fractions of Sludge Amended Soil on the Accumulation of Cd, Cr, Cu, Ni, and Zn in Spinach Leaf. Report 93-11, Research and Development Department, Metropolitan Water Reclamation District of Greater Chicago.
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- Webber, M. D., R. I. Pietz, T. C. Granato, R. L. Hong-You., B.A. MacGillivray, M. L. Svoboda, and G. A. O'Connor. 1991. Organic Priority Pollutants in Soil and Vegetation from the St. David Coal Refuse Pile Reclamation Site. Report prepared for the Metropolitan Water Reclamation District of Greater Chicago, Environment Canada, Wastewater Technology Centre, Burlington, Ontario, Canada.

- Granato, T. C., G. R. Richardson, R. I. Pietz, and C. Lue-Hing. 1991. Prediction of Phytotoxicity and Uptake of Metals by Models in Proposed USEPA 40 CFR Part 503 Sludge Regulations: Comparison with Field Data for Corn and Wheat. Report 91-11, Research and Development Department, Metropolitan Water Reclamation District of Greater Chicago.
- Lue-Hing, C., D. R. Zenz, T. C. Granato, and G. R. Richardson. 1991. Impact of the Proposed USEPA 40 CFR Part 503 Regulations on Sewage Sludge Management by the Metropolitan Water Reclamation District of Greater Chicago. Report 91-6, Research and Development Department, Metropolitan Water Reclamation District of Greater Chicago.
- Lue-Hing, C., T. Granato, D. R. Zenz, J. Gschwind, G. R. Richardson. 1991. Impact of the Proposed USEPA Part 503 Sludge Management Technical Regulations on POTWs. Report 91-33, Research and Development Department, Metropolitan Water Reclamation District of Greater Chicago.
- Lue-Hing, C., D. R. Zenz, T. C. Granato, J. Gschwind, R. I. Pietz, K. C. Rao, and J. B. Murray. 1991. Use of Case-By-Case Permitting for Dedicated Beneficial Use Sites Under 40 CFR Part 503: A Proposal of the Metropolitan Water Reclamation District of Greater Chicago, Research and Development Department, Metropolitan Water Reclamation District of Greater Chicago.
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- Lue-Hing, C., D. R. Zenz, T. C. Granato, R. I. Pietz, D. Taylor, D. Landis, R. Oberst, R. Case, and T. Garrett. 1991. Comments of the Association of Metropolitan Sewerage Agencies on the Notice of Availability of Information and Data from the National Sewage Sludge Survey and Request for Comments (Federal Register, November 9, 1990 pp. 47210-47283), Association of Metropolitan Sewerage Agencies, Washington, DC.
- Lue-Hing, C., D. R. Zenz, T. C. Granato, J. Gschwind, and J. Murray. 1990. Utilization of Municipal Sludge as Daily and Final Cover at Municipal Solid Waste Landfills, Response to USEPA Proposed Part 503 Sludge Regulations (Standards for the Disposal of Sewage Sludge, Federal Register, February 6, 1989, pp. 5746-5902), Research and Development Department, Metropolitan Water Reclamation District of Greater Chicago.
- Lue-Hing, C., D. R. Zenz, T. C. Granato, and R. I. Pietz. 1989. Comments of the Association of Metropolitan Sewerage Agencies on the Proposed Standards for the Disposal of Sewage Sludge (Federal Register, February 6, 1989, pp. 5746-5902), Association of Metropolitan Sewerage Agencies, Washington, DC.
- Lue-Hing, C., D. R. Zenz, T. C. Granato, R. I. Pietz, K. C. Rao, and J. Gschwind. 1989. Comments of the Metropolitan Water Reclamation District of Greater Chicago on the Proposed Standards for the Disposal of Sewage Sludge (Federal Register, February 6, 1989, pp. 5746-5902). Research and Development Department, Metropolitan Water Reclamation District of Greater Chicago.

PUBLICATIONS:

- Hundal, L. S., A. C. Cox, T. C. Granato, and Z. Abedin. 2008. Levels of dioxin in soils and corn tissues after 30 years of biosolids application. Journal of Environmental Quality: 37: 1497-1500.
- Oskouie, A. K., D. T. Lordi, T. C. Granato, and L. Kollias. 2008. Plant-specific correlations to predict the total VOC emissions from wastewater treatment plants. Atmospheric Environment 42: 4530-4539.
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