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Project Summary

Combined Sewer Overflow Abatement Program, Rochester, N.Y.—Volume I. Abatement Analysis

Frank J. Drehwing, Cornelius B. Murphy, Jr., David J. Carleo, and Thomas A. Jordan

CSO locations within the Rochester, New York, Pure Waters District served as the basis for network modeling studies. The USEPA Stormwater Management Model—Version II, Simplified Stormwater Model, and receiving water models were used to evaluate various CSO pollution abatement alternatives.

Nonstructural, minimal structural, and structurally intensive alternatives were defined and evaluated by these models. The nonstructural approach applied Best Management Practices (BMP). Structural alternatives involved evaluation of conventional storage and treatment options. Cost benefit analyses of all structurally intensive alternatives were conducted using optimum treatment process train configurations developed from pilot plant evaluations, as reported in Volume II.*

Preliminary analysis of BMP and minimal structural alternatives indicated that by addressing the major sources of pollution and by eliminating throttling constraints within the existing sewerage system, a substantial decrease in the total annual load of contaminants to the receiving waters from rainfall-induced CSO can be achieved for relatively small capital expenditures. These measures can be initiated within a short period of time, thereby immediately reducing pollution to the receiving waters, while long term design and construction of more structurally intensive alternatives are undertaken.

This Project Summary was developed by EPA's Municipal Environmental Research Laboratory, Cincinnati, OH, to announce key findings of the research project that is fully documented in a separate report of the same title (see Project Report ordering information at back).

*Combined Sewer Overflow Abatement Program, Rochester, N Y Volume II Pilot Plant Evaluations F J. Drehwing, C B. Murphy, Jr., S R. Garver, D F Geisser, and D Bhargava EPA-600/2-79-031b, NTIS Order No PB 80-159 262 (also available from the Storm and Combined Sewer Branch, MERL, USEPA, Edison, NJ 08837)

Introduction

In response to the transient water quality problems induced by periodic overflows from the Rochester Pure Waters District's combined sewer system, a project was undertaken to develop an abatement and management program necessary to achieve a cost effective solution to the CSO induced impairment of the Genesee River, Irondequoit Bay, and Lake Ontario.

Other aims of the project were to demonstrate the usefulness of mathematical models (the Simplified Stormwater Model (SSM) developed by Metcalf & Eddy, Inc., and the USEPA Stormwater Management Model—Version II (SWMM)) simulating both the urban rainfall/runoff process and the subsequent stormwater flows within a large combined sewer system; present the merits of implementing the BMP program to abate CSO; and evaluate source and collection system management options.

The developed management program (including the methodology of approach, urban stormwater mathematical modeling, and abatement alternative analysis that involved both structural and BMP measures) lead to the formulation of a master plan for CSO pollution abatement within the Rochester Pure Waters District.

Problem Definition

All programs adopted by Monroe County for the Rochester Pure Waters District are directed at meeting state and federal water quality standards established for the Rochester, NY, area. These programs specifically address the problem of receiving water quality degradation due to urban storm runoff and subsequent CSO. The study area including the major receiving water bodies, intercepting sewer network, and significant overflow relief points are shown in Figure 1.

Present CSO directly contravenes established water quality standards for the Genesee River, imposes heavy nutrient and chemical loadings on Irondequoit Bay, and causes bacterial contamination of the public bathing beaches along the Rochester Embayment of Lake Ontario. The latter has resulted in periodic beach closing days during the summer months.

Aside from such direct impacts as objectionable floating material and high bacteria loadings, the settling of oxygen demanding materials discharged during overflow events contribute to contravening stream standards in the lower reaches of the Genesee River under dry-weather conditions.

Previous studies of the District's combined sewer system cited major deficiencies in the existing sewer system and identified the effects of CSO on the area receiving waters.

Project Elements

The project was divided into three basic elements: a CSO monitoring and assessment program, a CSO mathematical modeling program, and a pilot plant demonstration program. The monitoring and modeling programs are described in detail in Volume I (summarized here) and the pilot plant studies, in Volume II.

As part of the overflow monitoring program, an intensive CSO flow recording and sampling system was implemented to define the frequency, volume, and pollutant characteristics associated with the District's CSO discharges. A drainage basin field investigation was conducted to define those basin parameters that affect the urban stormwater runoff process.

These two programs provided the necessary data sets, including representative CSO hydrographs and pollutographs, drainage basin characteristics, and sewer system inventory, to facilitate model calibration and verification. Included in the modeling effort was the refinement and verification of the previously developed Genesee River Water Quality Model.

The pilot plant program involved designing and constructing a pump station and pilot treatment facilities to evaluate the effectiveness of eight unit processes: high-rate flocculation/sedimentation, swirl degritting, swirl primary separation, high-rate dual-media filtration, granular activated carbon adsorption, high-rate disinfection using chlorine, high-rate disinfection using chlorine dioxide, and microscreening. These results were used to develop process models and associated cost effectiveness relationships.

Conclusions

1. A rigorous defining of the existing system of CSO and stormwater facilities is fundamental for developing an abatement program. This definition includes identifying major drainage basins, major trunk and intercepting sewers, and CSO and stormwater relief points.

2. Installing and properly maintaining overflow monitoring instrumentation are essential for both receiving water problem definition and any subsequent sewer network and water quality model calibration and verification.

3. Collecting accurate rainfall data and subsequent statistical analyses, including defining the design storm, are essential in evaluating the response of the existing system as well as the effectiveness of various abatement alternatives.

4. Developing a methodology of approach and defining applicable abatement alternatives early in the program will ensure that the purpose of the study is not lost and all data collection activities are conducted according to the required analyses.

5. SSM is capable of providing a preliminary screening of potential abatement alternatives involving a balance between storage and treatment.

6. SWMM can project the urban storm runoff and quantities within acceptable confidence limits but is presently limited in its ability to simulate overflow quality.

7. Overflow quality can be better simulated by applying statistical techniques using actual monitored overflow data.

8. The ability to abate CSO pollution may require implementing structurally-intensive facilities. In Rochester, one structural alternative involves grit removal, in conjunction with the optimized operation of the F. E. Van Lare Treatment Facility.

9. In many situations, significantly reducing the total annual load of contaminants discharged to receiving waters because of CSO can be reduced through minimal structural improvements to the existing sewer system. In Rochester, minimal structural abatement alternatives include removing three throttling constraints, modifying or adjusting overflow weirs and regulators, and using inflatable dams for increased in-system storage.

10. Implementing nonstructural abatement alternatives (BMP) can reduce the annual load of pollutants discharged by CSO and stormwater. Implementing inflow

restriction regulations (e.g., use of porous pavement) in select areas and more intensive street cleaning and sewer maintenance can alleviate a portion of CSO induced water quality degradation.

11. Based on projections using a simplified mathematical stormwater model, the nonstructural and minimal structural abatement alternatives are expected to reduce significantly the existing volume of CSO and the average annual BOD_5 and TSS loadings to the Genesee River.

Recommendations

It is recommended that:

1. Network models, such as SWMM, be relied on, mostly, for determining runoff and overflow volumes for selected storm events and less for estimating the quality of the runoff. Use statistical analyses of actual field monitored data to estimate surface runoff quality.

2. Initial screening, planning, and designing of storage and treatment abatement alternatives be made with a simplified continuous simulation model to avoid the prohibitive computer costs associated with many detailed hydraulic models. Use only a model that will satisfy the objectives of a study at the least possible cost.

3. Hydraulic analysis and design of sewer systems be conducted with a detailed network model such as SWMM.

4. Rainfall characterization be based, primarily, on the use of historical precipitation data, although the design storm approach may have to be applied in certain situations. More research should be conducted on the concept of design storms to establish design rainfall hyetographs that could be applied with mathematical network runoff models.

5. Models not be used to predict runoff/overflow quantities or qualities without proper field calibration and verification. A relatively detailed field monitoring program is essential in providing the background data for proper model calibration and verification.

6. More statistical analyses be conducted to better establish the correlation between runoff quality and parameters such as rainfall and land use characteristics.

7. Detailed hydraulic analyses be conducted to better define interceptor throttling constraints, regulator/weir modifications, and control structure locations. SWMM is capable of providing the required analyses.

8. BMP be considered when conducting any CSO abatement program. In many instances implementing BMP, possibly in conjunction with minimal-structural alternatives, can alleviate many problems associated with frequent CSO discharges. Failure to investigate their effects could severely limit establishing cost effective abatement solutions.

9. A program be initiated to investigate the effectiveness of increased street sweeping on reducing the pollutant loadings to the sewer system. Include provisions for correlating the effects of increased street sweeping operations, types of equipment used, street parking use and restrictions, and program costs for reducing surface pollutants available for washoff during storm events.

10. A master plan for CSO pollution abatement be developed and implemented that follows a sequence of phasing of required system improvements according to their projected cost effectiveness.

11. Scheduled reviews be included in any CSO abatement program to periodically evaluate the effectiveness and cost/benefits associated with alternative implementation. This periodic review will ensure that previously defined objectives are being met and, if not, changes to the program can be made to better solve the initial problems.

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Frank J. Drehwing, Cornelius B. Murphy, Jr., David J. Carleo, and Thomas A. Jordan are with O'Brien & Gere Engineers, Inc., Syracuse, NY 13201.
***Richard Field, Anthony Tafuri,** and **Lawrence Moriarty** (retired) are the EPA Project Officers (see below).*
*The EPA Grant Officer is **Ralph G. Christensen** (see below).*
The complete report, entitled "Combined Sewer Overflow Abatement Program, Rochester, N.Y.: Volume I. Abatement Analysis," (Order No. PB 81-219 602; Cost: $15.50, subject to change) will be available only from:

National Technical Information Service
5285 Port Royal Road
Springfield, VA 22161
Telephone: 703-487-4650

The EPA Project Officers can be contacted at:

Storm and Combined Sewer Section
Municipal Environmental Research Laboratory-Cincinnati
U.S. Environmental Protection Agency
Edison, NJ 08827

The EPA Grant Officer can be contacted at:

Great Lakes National Program Office
USEPA, Region V
Chicago, IL 60604