



Project Summary

Model Protocol for the Comprehensive Evaluation of Publicly Owned Treatment Works Performance and Operation

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The document described by this Project Summary presents a systematic approach to conducting a comprehensive performance evaluation of municipal wastewater treatment plants. The objective of the evaluation is to identify and rank the causes of poor plant performance.

Five major problem areas are addressed. They are design, performance monitoring, operation, maintenance, and administration. By following this protocol, an evaluation team will be able to identify deficiencies in each of the five categories, weight them with respect to adverse impact on plant performance, and rank them in order of severity of impact. The document also addresses the preparatory steps to be completed before the actual plant visit and includes a section covering the preparation of the evaluation report, which is written upon completion of the on-site investigation. All required data sheets and work sheets are included in the appendices of the manual.

The evaluation protocol has been prepared as a user-oriented field document that provides specific guidance for conducting comprehensive plant evaluations and identifying problems and solutions to improve plant performance.

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).

Introduction

Several studies and reports have documented that a large percentage of the country's municipal wastewater treatment plants do not meet design expectations and are not in compliance with their National Pollution Discharge Elimination System (NPDES) permit standards. U.S. Environmental Protection Agency (EPA) studies of poorly performing plants have identified deficiencies in the areas of design, operation, maintenance, and administration that adversely affect plant performance. It was found that at any one facility, poor performance was not the result of one single factor, but was always the result of a combination of inhibitory factors. The studies also documented that identifying the adverse factors and ranking their negative impact on plant performance increases the potential for improving the performance of treatment systems simply and inexpensively. Improvements



can be made through upgrading operation and maintenance programs, improving attention to management procedures and administrative requirements, and by making low-cost correction of design deficiencies.

Because these findings are applicable to publicly owned treatment works (POTWs) on a nationwide basis, a need exists for establishing a treatment plant performance survey protocol. A protocol would provide consistency in conducting comprehensive plant evaluations to identify performance problems and establish cause and effect relationships. By addressing all performance-limiting factors, this approach will result in the formulation of solutions to the problems so that plant performance may be improved.

During the conduction of the research program cited above, a specific procedure was developed and followed as a protocol for the comprehensive evaluation of biological wastewater treatment plant performance and operation. The evaluation procedure is presented as a model protocol in the Project Report described by this Project Summary.

The objective of the comprehensive evaluation is to identify and rank the causes of poor plant performance. Plant performance is related to the consistency with which the effluent water quality meets the provisions of the NPDES permit. Five major problem areas are addressed in the comprehensive evaluation: design, performance monitoring, operation, maintenance, and administration. By following this protocol, an evaluation team will be able to identify deficiencies in each of the five categories, weight them with respect to adverse impact on plant performance, and rank them in order of severity of impact. The evaluation is accomplished by an on-site investigation that, depending on the size and complexity of the plant, typically requires 3 to 5 days to complete.

In the evaluation methodology, detailed guidance and a systematic approach are provided for all phases of the evaluation from initial contact with responsible municipal and plant personnel through presentation of findings and report preparation. The effectiveness of the presentation of the findings is important because the findings will provide the basis for developing a composite correction program (CCP) to improve plant performance. Formulation of the CCP is not covered in this model protocol.

The protocol has been formatted as a user-oriented, desk and field document. All data forms, checklists, and data evaluation summary forms that are needed to conduct the comprehensive plant evaluation, identify problems, and submit the report are included in the document. It is intended for use by EPA, state, or contract investigators who visit wastewater treatment facilities and submit reports.

Discussion

The following discussion provides a brief description of the contents of the model protocol report.

Section 1 is a short introduction to the report. Section 2 covers those tasks that should be performed before the actual plant visit to minimize time in the field and to maximize the quality of information obtained. Preliminary activities discussed include notification of POTW personnel and municipal officials; estimation of time, labor, materials, and money required to conduct the evaluation; and formulation of the field sampling and analytical program.

Tables included in this section provide guidance in the following areas: recommended number of investigators for an evaluation team, suggested sampling and analysis program, recommended sampling points, cost of the wastewater analyses, and estimation of cost for a comprehensive evaluation. Also discussed in Section 2 is Appendix A, which is a guide for designing the sampling and analysis program portion of the evaluation.

Section 3 identifies three potential sources of monitoring data by which the performance of a treatment plant may be evaluated. One source is the data contained in the plant operating reports. Another source is the sampling and analysis information maintained by the state regulatory agency. The results of analyses performed on samples collected during the on-site investigation constitute the third source.

There are three appendices that supplement this section. Recommendations for volume of sample required and for sample preservation are given in Appendix B. Appendix C supplies a list of the state water pollution control agencies. Appendix D deals with the computation of operational parameters and performance indicators.

The fourth section of the protocol report focuses on design analysis. The objectives of this portion of the compre-

hensive evaluation are to discern all facets of the design that may limit the ability of the plant to meet its permit conditions, determine the limitations of operations imposed by the design, and identify design deficiencies that may be easily and inexpensively corrected. The major portion of the design evaluation phase is devoted to the analysis of individual unit process designs. Thorough evaluation of unit process design provides the information necessary to establish the existence and degree of the following conditions that have potential to limit plant performance:

- Poor process design
- Construction or installation that does not conform to documented specifications
- Inadequate process flexibility
- Poor process selection
- Incompatibility of the unit process with the constituent removal requirements.

Guidelines for collection and manipulation of data are presented for 17 different unit processes such as primary sedimentation, disinfection, and sludge dewatering. Appendix E furnishes summary forms that may be utilized to record and organize pertinent design information.

Section 5 addresses the evaluation of operational capabilities and limitations. Operational factors are frequently given inadequate attention during plant evaluations. It should be noted that their consideration is critical to a comprehensive evaluation. For a successful investigation of the operational area, the protocol recommends that the evaluation team be prepared to devote at least 50 percent of its on-site survey time to this effort. Operational factors affecting plant performance range from qualitative factors such as the personal characteristics of operators, for example, process knowledge or general aptitude, to more quantitative physical constraints placed on the staff, such as deficiencies in laboratory equipment or a lack of reference materials. In the evaluation protocol, plant operational practices are divided into four major categories: operating personnel, plant monitoring, process control, and operations references.

Several forms are provided to assist in the appraisal of operational factors. One is a guide for evaluating the process control testing performed at a plant. Furthermore, a format for recording

information obtained on laboratory testing capability and performance is supplied in Appendix G. Appendix F furnishes a checklist to summarize the evaluation of major factors affecting plant operations and the assessment of operational capabilities.

The examination of plant maintenance programs is treated in Section 6. Maintenance duties typically range from simple, routine, preventive maintenance functions, such as lubrication, to major corrective maintenance functions, such as on-site repair of equipment. Concerns discussed include process units and equipment out of service, units in operation but in need of repair, preventive maintenance procedures, spare parts and equipment availability, chemical supply inventories, housekeeping practices, emergency provisions, and availability of maintenance references. A checklist to be completed by the evaluation team to document the quality or regularity of various aspects of plant maintenance is provided in Appendix H.

Section 7 deals with the investigation of the administrative aspects of a treatment facility. Four key areas of plant administration are discussed: plant staffing, budgeting, staff training, and use of consultant services. Appendix I supplies a form to be used in summarizing plant budget data. Information on administrative practices and characteristics may be compiled on another form, identified in Appendix J.

The ultimate objective of the treatment plant evaluation procedure outlined in the report is to identify and rank all factors that adversely impact the plant's performance. Although attempts to quantify professional judgments and subjective evaluations generally involve some imprecision and uncertainties, such quantification and ranking of factors must be accomplished if a rational and comprehensive correction program is to be formulated. To present the results of the on-site evaluation and to organize and streamline the weighting and ranking processes, a plant evaluation summary form is employed. The summary form and numerical weighting procedure used to complete it are discussed in Section 8, and a sample plant evaluation summary form may be found in Appendix K.

The plant evaluation summary form consists of three parts. The first part records general plant identification information. The second part is a weighting table in which all factors evaluated

are rated numerically from zero (0) to three (3), in order to reflect the degree of adverse impact each factor has on plant performance. An explanation of what should be considered in assigning a weight to a factor is provided for 70 different factors that have potential to limit plant performance. Finally, the third section of the plant evaluation summary is a ranking table in which the specific factors that were weighted in the weighting table portion of the summary form are now ranked in relative decreasing order of severity of adverse impact on plant performance and reliability. The ranking table then becomes the basis for designing a comprehensive program to correct problems and improve plant performance.

The last section of the protocol report, Section 9, discusses the preparation of the plant evaluation report, which is written upon completion of an on-site investigation. Cause and effect relationships are addressed. Performance problems (effects) identified during the survey are cross-referenced with the potentially performance-limiting factors (causes) that were ranked highly in the plant evaluation summary (discussed in Section 8). In attributing specific problems to specific causes, caution is emphasized, since, as noted earlier, performance problems result from a combination of factors. Suggested report content, organization, and format to permit a clear, concise, and effective presentation of findings are described.

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The complete report, entitled "Model Protocol for the Comprehensive Evaluation of Publicly Owned Treatment Works Performance and Operation," (Order No. PB 82-180 480; Cost: \$12.00, subject to change) will be available only from:

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Springfield, VA 22161
Telephone: 703-487-4650*

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