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PILOT STUDY REQUIREMENTS FOR PROPOSED TREATMENT

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Program Applicability
Supercedes Policy, SOP or Guidance #
Approved by: David Y. Terry

Policy, SOP or Guideline #90-04

PURPOSE

This policy has been adopted to provide guidance on Departmental criteria for piloting of treatment for removal of primary and secondary constituents from public drinking water supply sources. This policy establishes consistent procedures for approving proposals, scopes of work, report submittals, and pilot studies for treatment.

The Department reserves the right to modify any section of this policy as circumstances justify.

POLICY

1) General:

The first step required for all water treatment projects is the completion of an engineering study, as outlined in the Department's Guidelines and Policies for Public Water Systems. The pilot studies required as part of the Engineer's Report shall include a Pilot Test Proposal leading to subsequent reports called "Pilot Test Reports".

The Pilot Test Proposal submitted to the Department will contain anticipated time frames, raw and finished water parameters to be analyzed and specific analysis methods and testing intervals, as well as and proposed methods of water treatment to be piloted. An outline of the information to be included in the Proposal is contained in this policy.

The Final Pilot Test Report will summarize the piloting events, results, water quality analyses, recommended method of treatment and cost effectiveness. Both the Final Pilot Test Report and the Pilot Test Proposal submittals require Department concurrence and written approval.

2) Purpose of Pilot Testing:

Pilot testing is performed :

a) To ensure that the proposed treatment process will continuously produce water that meets State and Federal drinking water standards. Additionally, the treatment should address secondary standard quality concerns such as taste and odor or other consumer complaints so as to provide a drinking water widely accepted by the public.

b) To determine the specific operational and performance characteristics of the selected processes throughout the anticipated range of raw water quality, hydraulic loading rates, chemical feeds, and operating conditions.

b) To ensure that the proposed treatment process will continuously produce water that meets State and Federal drinking water standards.

c) To enable full scale design to be implemented with the approved pilot scale model.

d) To assist the water supplier in estimating overall capital and operation costs.

e) To compare the benefits of the most cost effective process with benefits of other processes.

f) Piloting is intended to test the treatment processes identified in the Pilot Test Proposal. The Department will determine whether any changes in actual construction from the treatment process(es) piloted will require additional piloting.

PILOTING FOR FILTRATION

1) Pilot Test Proposal

A Pilot Test Proposal should include the following:

a) Raw Water Quality Data:

For sources which must treat for secondary standards but which have no violations of primary standards, testing prior to piloting may be waived at the discretion of the Department. Recommended water quality testing for treatment other than filtration is stated elsewhere in this policy.

For surface water supplies requiring filtration the following is recommended, in addition to other treatment requirements stated elsewhere in this policy:

Optimally (except as noted above), up to 1 year of raw water quality testing of the source water should have been conducted prior to submittal of the Pilot Test Proposal. This additional raw water testing should be done when, in the opinion of the Department, there is inadequate existing data to identify problems with the raw water. At the Department's option this testing may be done concurrently with the pilot testing.

This will assist the Department in determining the periods when, and for what duration, pilot tests should be conducted. The raw water quality data will identify potential problems which should be more closely evaluated during the pilot test.

Raw water data obtained may allow the Department to waive pilot testing under certain circumstances.

A list of the water quality parameters for which raw water should be tested and the frequency for such testing appears in Attachment #1 to this policy. If the Department determines that inadequate raw water quality data exists, the Department may require pilot testing during all four seasons (winter, spring, summer, and autumn).

b) The Pilot Test Proposal should include an evaluation of the available raw water quality data and any water quality concerns. It should also include an outline of the various treatment processes available to provide appropriate treatment to ensure potability of such water.

c) It should identify the selected processes and/or proprietary package plants to be pilot tested. The Department recommends that at least 2 processes/plants be pilot tested, so that the testing can continue even if the initial first choice is eliminated due to unforeseen problems.

d) If treatment processes to be piloted have been used in the past in Massachusetts, discussion should be provided of the historical success of the treatment process in Massachusetts. Water quality parameters and operating conditions, as well as a history of the water quality results of treatment under specific seasonal changes, should be provided.

There should also be a description of any operational problems and treatment system limitations encountered during the test.

For drinking water treatment systems not previously used in the Commonwealth of Massachusetts, the Division of Water Supply's Policy for New Technology, DWS Policy 89-01 should be reviewed and a separate submittal should be provided prior to requesting piloting approval.

e) The Pilot Test Proposal should indicate any proposed method of corrosion control to be included in the pilot test.

f) The pilot test should measure how the primary and secondary disinfectants will meet the CT requirements of the Surface Water Treatment Rule (310 CMR 22.20A).

g) Schematics and design data sheets of the actual processes/plants involved in the pilot testing should be presented in the Pilot Test Proposal. The design data sheets should include but not be limited to the physical dimensions of each unit in the process/plant, the expected flow rates through each unit, the detention time in each unit, the G value of the mixing equipment, and the range of hydraulic loading rates through each unit.

h) It should indicate specific considerations which would affect the pilot testing and actual treatment (for example, whether multiple withdrawal points at various depths should be used to avoid water quality problems during overturn events).

i) The Pilot Test Proposal should include a discussion of why any other appropriate processes/plants which were not selected for pilot testing were eliminated from consideration.

j) It should give, based on the raw water data, the proposed time periods the piloting will occur. This should include extreme cold water temperature conditions (normally January or February). Pilot tests should also be conducted during any problem periods identified by the raw water data or during specific periods of consumer complaints. The Department reserves the right to require pilot testing during extreme warm water conditions (normally August) in addition to extreme cold water conditions particularly if no other pilot period is recommended. If inadequate preliminary raw water data is available, pilot testing will be required for at least 2 weeks each during winter, spring, summer and fall seasons, with concurrent raw water sampling and analysis.

k) The Pilot Test Proposal should give a proposed duration of each pilot test period. The minimum

duration for each period should be 10 operating days. The duration of each pilot test period should be that length of time needed for the following:

i) to obtain optimum chemical dosages and hydraulic loading rates,

ii) A minimum of 3 filter runs conducted at design hydraulic loading rates and 2 filter runs conducted at peak loading rates during any pilot test period for any treatment sequence-filter media combination that could be the final selected option. The filter run times to terminal headloss or breakthrough for the design and peak hydraulic loading rates are to be determined during the pilot testing.

iii) duration of any other cyclic operations other than filter runs discussed in ii) above,

iv) estimated operation costs of each process/plant evaluated.

The number of filter runs can be as important as the duration of the pilot testing. For example, multiple filters can be constructed and operated simultaneously. These filters could be of different media to evaluate the best media at set loading rates, they may be the same media being operated at various hydraulic loading rates to determine the optimum design and peak loading rates, or may have other variables related to prior chemical addition.

l) The proposed scale of the pilot plant should be stated in the Pilot Test Proposal. The recommended minimum flow into the pilot plant is 10 gallons per minute, which can be split into various filters at lower flow rates. The minimum filter-surface area of each filter evaluated shall be equivalent to a 6 inch diameter (approximately 0.2 square feet). The actual size of the pilot units shall be of sufficient dimension to allow for direct extrapolation of the resulting data for the following design parameters:

i) design and peak hydraulic loading rates of all components of the treatment/filtration plant,

ii) chemical dosages, contact times, detention times, and G values of mixing units,

iii) process unit dimensions to include optimum filter bed depths and clarifier overflow rates as well as type of filter media,

iv) filter run times, backwash rates, and backwash volumes as a percentage of filter production,

v) filter media characteristics, including Effective Size (E.S.) and Uniformity Coefficient (U.C.) of the grain sizes,

vi) residual volumes and disposal methods.

m) The Pilot Test Proposal should state proposed analyses of the quality and quantity of the reject/backwash portion of flow will be required in the Pilot Test as related to residuals, supernatant and/or backwash water disposal options necessary in the final treatment plant.

2) Pilot Test - Water Quality

a) The water quality data obtained during the pilot tests must be analyzed by State certified laboratories. Water quality parameters to be measured during each pilot filter run shall include:

i) temperature and dissolved oxygen and depth profiles of temperature and dissolved oxygen of raw water,

ii) turbidity of raw and finish water

iii) color (raw and finish)

iv) alkalinity (raw and finish)

v) pH (raw and finish)

vi) odor (raw and finish)

vii) aluminum (raw and finish)

viii) Total Trihalomethane formation under SDS (Simulated Distribution System) conditions. SDS conditions include the expected chlorine feed rate to be used in the full scale treatment plant to meet minimum CT values and to maintain disinfectant residuals in the distribution system.

ix) Total Haloacetic Acids (HAA5) (finish water)

x) Total Organic Carbon (raw and finish water)

xi) Total and Fecal Coliform (raw and finish)

x) iron and manganese (raw and finish)

xi) particle analysis (raw and finish water) Analysis results must include a log removal determination within the 2 - 5 micron, and 5 - 15 micron ranges. This sample should augment in-line particle counter results.

b) The following water quality parameters are to be analyzed from the raw and finish water at least once during each pilot period, with additional analysis to be determined on a case by case basis:

i) Volatile Organic Compounds

ii) Sanitary Chemical Group (sodium, calcium, magnesium, potassium, hardness, sulfate, nitrate, nitrite, ammonia)

iii) Inorganic Chemicals (arsenic, barium, cadmium, chromium, lead, mercury, selenium, copper, fluoride,selenium)

c) Residuals

i) To evaluate water treatment facility residuals thickening, settling basin design or any other mechanical means of handling, bench testing can be performed.

ii) Bench testing for anticipated residuals volumes can be performed during piloting or prior to design of residuals handling facilities at the water treatment facility site.

iii) Chemicals utilized for bench testing must be identical to those used and approved by the Department during the piloting phase. In addition, one additional coagulant type, coagulant aid and polymer testing combination should be performed. Additional evaluations on settled residuals with polymers to increase thickening capabilities should be included in this additional testing.

iv) Filter backwash water must be quantified, and typical suspended solids concentrations should

be determined to allow for correct sizing of holding or thickening basins.

v) Polymers can be utilized to assist in sedimentation basin settling velocities and to provide additional thickening after treatment through the regular process.

vi) Proposals to perform bench testing for proposed or existing water treatment facilities can be submitted in conjunction with piloting proposals or in a separate format similar to that required by this policy.

vii) Written documentation of settling rate observations with chemical usages, should be provided. Chemical dosages for piloted ranges and special chemical usages should be used during this bench testing.

3) Waiver From Full Scale Pilot Testing:

In the four (4) cases listed below a waiver from some or all of the pilot test requirements may be appropriate. The applicant should verify with the Department whether they are eligible for a waiver from pilot test requirements before proceeding with the design of treatment. However, if a waiver is granted and the constructed plant fails to operate properly, the Department reserves the right to require subsequent pilot testing, modifications to the constructed treatment/filtration plant, or construction of an entirely different treatment/filtration plant; the cost of which is to be borne entirely by the water supplier. The four cases where pilot testing may be waived are:

a) where the same source water has previously been pilot tested for the same purpose and the Department would again approve the conclusions of the pilot report, and

b) Based on results of the Raw water quality analysis discussed in Section 3 of this policy, if slow sand filtration is appropriate, slow sand filters for water systems serving less than 3,300 people per day.

c) the Department may also reduce or waive the required pilot testing for minor modifications to existing filtration plants.

d) Pilot Testing for Filtration of Groundwater Under the Influence of Surface Water:

For groundwater determined to be under the influence of surface water, extensive pilot plant testing may not be generally necessary nor warranted. For these situations, 5 to 10 days of operation of a pilot plant with at least three complete filter runs is recommended. Also, there is a lesser need to concurrently pilot two different technologies for these sources. Where the pilot plant test consists of a single 5 to 10 day test, a Final Comprehensive Report would be submitted within 30 working days following the completion of the pilot plant study.

5) Reporting Procedures:

Results of the ongoing pilot testing shall be submitted in progress reports within one month of completing the pilot test period. A final report containing the following shall be submitted within 2 months of completing all the pilot testing:

a) Description of raw and finish water quality and pilot testing performed,

b) Tabular and graphical summaries and interpretations of the data, including but not limited to percentage removal of water quality parameters of concern, turbidity vs time for each filter run, and headloss vs time for each filter run,

c) a complete set of all the raw water data obtained or used in the pilot tests.

d) Recommended process or proprietary package plant for the full scale treatment/filtration plant.

e) Estimated chemical usage, capital and O&M costs.

f) Estimated size and design flow of the full scale treatment/ filtration plant and how that design flow compares to the existing and projected overall water system demands as identified in prior master plans.

g) Description of recommended disposal options for residual, supernate and/or backwash water and the necessary permits or approvals for implementing chosen disposal option (ex: groundwater discharge permit, sewer connection permit, etc.).

PILOTING FOR TREATMENT OTHER THAN FILTRATION

I Volatile Organic Compounds

1) Pilot Proposal Submittal

Proposals can be for temporary, emergency or permanent treatment facilities. The following is required to be submitted with the engineering proposal and based upon this submittal, piloting of these sources may be waived:

a) A general description of the primary and secondary standard contaminants. This should include anticipated maximum levels of contaminants, based upon presented curves.

b) Aeration units should conform to Division of Water Supply Policy No.88-01 Trichloroethylene (TCE) Air Stripper Policy. This includes:

i) Maximum concentrations of contaminants and proposed design flow rates.

ii) Column heights, packing material quality and quantity and manufacturer.

iii) Estimated air emissions

iv) Calculations for air to water ratios.

v) Plans for the temporary and final disposal of sludge from treatment system.

vi) Isotherms from manufacturing for the proposed removal of contaminants.

2) Pilot Test

a) For those groundwater with primary maximum contaminant level violations, such as volatile organic compounds (VOC), modified piloting procedures may be acceptable for VOC treatment technologies. Additional piloting may be required if the source has other secondary standard violations, such as iron and manganese.

b) Limited piloting may be accepted provided that a Zone II delineation has been conducted or is in the process of being conducted. The Department may require continual pre-pumping at five days, ten days or longer time periods with continued analyses prior to accepting a proposed treatment design for

volatile organic contaminants removal.

c) Samples for VOC contaminants will be taken weekly during the pumping period to determine quality fluctuations.

3) Pilot Report

A piloting report will be submitted at the end of the Department approved pumping time cycle, requiring installation of temporary or permanent treatment components.

II. Iron and Manganese Piloting

1) A pilot proposal must be submitted for Department review and approval. The proposal must contain:

a) History of the source

b) Evaluation of the raw water quality data and a discussion of appropriate treatment that would treat such water.

c) Plans and schematics of actual process involved in pilot testing.

d) Proposed time periods the piloting will occur.

e) Optimum chemical dosages

2) Pilot Test

a) For an existing source, with extensive water quality data, as determined by the Department's Regional staff, a minimum of five days of piloting, performed consecutively shall be required. It shall be up to the Regional engineering staff and the public water supplier or consultant engineer, acting as their approved representative, to determine the final piloting time requirement, beyond that stated above.

b) For a new source, the public water supplier shall be responsible for proposing to the Department's Regional staff, a pumping plan, to stress the aquifer and determine and/or extrapolate potential iron and manganese levels. The pumping plan shall consist of no less than thirty days of continuous pumping, prior to the start of piloting. The pumping plan shall consist of no less than thirty days of continuous pumping, prior to the start of piloting. The pumping plan shall be approved by the Department, prior to submittal of a request for piloting approval.

c) Piloting proposals should refer to the General section of this policy for determining the level of submittal, for piloting, to be submitted to the Department's Regional engineering staff.

d) The public water supplier and/or legal representative shall meet and determine the best time to pilot that groundwater source. The Department recommends a time period when the groundwater levels are low.

e) Piloting may be extended and/or more than one technology may be required to be piloted dependent on water quality.

f) For iron and manganese treatment, only one type of piloted treatment may be required by the Department. Any other water quality problems may require piloting of at least two different treatment methods.

g) Some treatment processes may require piloting requirements other than listed above.

3) Water Quality Analysis

a) The Department will determine the number and types of required water quality analyses, but shall be no less than the parameters listed in Appendix #2.

b) Residual generation analyses will be performed during piloting.

4) Report Requirements

The public water supplier will be required to submit piloting information in a report format.

a) Description of raw and finished water quality and pilot testing performed,

b) Tabular and graphical summaries and interpretations of the data, including but not limited to removal of iron,

c) a complete set of all the raw and finished water data obtained or used in the pilot tests.

DEMONSTRATION STUDY FOR CORROSION CONTROL AND THE SEQUESTERING OF IRON AND MANGANESE

1) The pilot demonstration must, as a minimum, include the following:

a) the start-up date, the proposed duration of the demonstration pilot (a minimum of one year will be required), expected chemical addition dosages and target residuals within the distribution system.

b) a list of all proposed chemicals used in the treatment system, and their chemical constituents. In addition, a statement of National Sanitation Foundation (NSF) approval for each chemical, if applicable, must be included.

c) a proposed monitoring program in the distribution system designed to show the effectiveness of the chemical addition and to identify any other water quality impacts throughout the distribution system. The Department requires that the following monitoring be included as a minimum in the monitoring program:

i) pH, alkalinity, temperature, conductivity, poly-phosphate residuals (if appropriate), ortho-phosphate residuals (if appropriate), silicate residuals (if appropriate), iron, manganese, calcium, magnesium and turbidity measured at least once per month at five locations throughout the distribution system, and from each source (required source samples will be limited to pH, alkalinity, temperature, conductivity, iron, manganese,

calcium, magnesium, and turbidity). The location of the five monitoring sites must also be submitted to the Department for approval.

Disinfection Byproducts, including Trihalomethanes, and chlorine residuals measured quarterly from those systems using surface water sources.

ii) lead and copper measured at least once per month from five of the previously

approved lead and copper sample sites (those five with the highest measured lead levels). The sampling protocol must conform to the protocol used during the lead and copper program (first draw samples etc.).

All monthly water quality results must be submitted to this office on a monthly basis during the pilot.

iii) two full rounds of lead and copper samples, monitored in accordance with the Lead and Copper Rule during two consecutive six month monitoring periods.

All lead and copper samples must be submitted to this office for review by the tenth day following the six month monitoring period.

iv) the Department will require that a pilot report be submitted to the Department following the completion of the pilot program.

2) Iron and manganese sequestering must also have a demonstration study conducted to demonstrate the effectiveness of the sequestering and to identify water quality impacts throughout the distribution system.

3) The Department strongly recommends that any chemical addition within the distribution system be gradually increased to the target level. A rapid increase will tend to soften and break up existing tuberculation, and may lead to increases in iron and manganese levels.

4) All liquid chemical metering systems must include a calibration chamber, a pulsation dampener, a backpressure valve, and a pressure relief valve with atmospheric discharge. Installation plans, and specifications for the chemical metering systems must be submitted, with the pilot proposal, to the Department for approval.

Approved: 9-05-90
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Amended: 4-07-95

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David Y. Terry, Director
Division of Water Supply

ATTACHMENT #1

WATER QUALITY TEST PARAMERTERS AND FREQUENCIES

FREQUENCY

	Parameter	Daily	Weekly	Monthly	Quarterly
1.	Algae, Plankton millfoil, etc (Visual Observation)			5/1-9/30	
2.	Alkalinity				x
3.	Aluminum				x
4.	Calcium				x
5.	Total Coliform Fecal Coliform			x	
6.	Color			x	
7.	Cooper				x
8.	Heavy Metals				x
9.	Iron		x		
10.	Manganese		x		
11.	Nitrates Nitrites, TKN			x	
12.	PH		x		
13.	Sodium				x
14.	Suspended Solids			x	
15.	Total Dissolved Solids			x	
16.	Sulfates				x
17.	Temperature	x			
18.	Turbidity	x			
19.	THM*				x
20.	HAA5*				x
21.	Total Organic Carbon (TOC)				x

*THM and HAA5 samples are to be taken from disinfected water at the estimated point within the distribution system where the water has been in the distribution system the longest period of time. All other samples are taken from raw water. (HAA5 is the sum of 5 haloacetic acids: Mono -, di -, and trichloroacetic acid, and mono-and dibromoacetic acid).

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Appendix #2

For Iron and Manganese Piloting

Raw and Finished Water

Required	Department May Require On Case by Case Basis
Turbidity	VOC
Iron and Manganese	Sodium
pH	Nitrates
Color*	Calcium
Alkalinity	Magnesium
Coliform(Total)	Potassium
Carbon Dioxide	Hardness
	Sulfates
	Inorganics

* Color test should differentiate between apparent and true color. The true color analysis would indicate whether a public water supply would need conventional treatment.