Guidance for documenting public health priority points by sampling individually owned wells.

Version 3.0

North Carolina Department of Environment and Natural Resources

Division of Water Infrastructure

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1.0 Overview

The Division of Water Infrastructure (DWI) provides financial assistance for drinking water projects. DWI prioritizes projects (in part) based on public health, and provides **Project Benefit** priority points to projects that address contamination of individually owned wells. This guidance documents the procedures DWI uses to assign **Project Benefit** priority points for individually owned well contamination.

The sampling program must meet the following three requirements to obtain the priority points:

- provide adequate sample coverage;
- show that the prevalence of contamination exceeds the values listed in Table 1; and
- report the results.

Table 1 – Minimum prevalence of contamination required to be considered for priority points.

CONTAMINANT	MINIMUM CONTAMINATION PREVALANCE REQUIRED[1]
Total Coliform	At least 60.0 % of wells positive.
Fecal Coliform	At least 10.0 % of wells positive.
Total Nitrate (reported as nitrogen)	At least 15.0% of wells exceed MCL of 10 mg/L **as nitrogen**.
Total Nitrite (reported as nitrogen)	At least 15.0% of wells exceed MCL of 1 mg/L **as nitrogen**.
Total Nitrate + Nitrite (reported as nitrogen)	At least 15.0% of wells exceed MCL of 10 mg/L **as nitrogen**.

[1] For coliform, nitrate, and nitrite, the required minimum level of contamination is twice the worst-case countywide average contamination rate. The required minimum level of contamination for other pollutants was established in a DEH review committee meeting on 10 May 2002.

CONTAMINANT	MINIMUM CONTAMINATION PREVALANCE REQUIRED[1]
Other exceedances of the MCL.	At least 25.0% of wells exceed the MCL.

The remainder of this guidance is split into two parts:

- §2 describes the requirements for conducting the sampling program, and
- §3 describes the requirements for reporting the results.

2.0 Conducting the Sampling Program

Applications do not earn priority points based on individual well tests unless the tests are performed as part of a coordinated sampling program[2]. The sections below describe the required elements of a coordinated sampling program.

2.1 Outline of process

This section outlines the process flow of a successful sampling program.

1. The applicant identifies an area that it believes has excessive contamination of individually owned wells.
2. The applicant scopes a project to extend waterlines and replace contaminated wells.
3. The applicant surveys the route of the proposed project to determine what wells the project will replace.
4. The applicant submits to DWI the addresses of the wells the project will replace.
5. DWI determines which wells to sample.
   a) DWI uses Table 2 of this policy to determine how many wells to sample.
   b) DWI uses a random number generating scheme to determine which wells to sample.
   c) DWI informs the applicant which wells to sample.
6. As an alternative to steps 4 and 5, the applicant may choose to sample all wells or to assume that any unsampled wells are "clean."
7. The applicant samples the wells designated by DWI (or samples all wells).

[2] For expensive analytes (e.g., pesticides) DWI will allow the reuse of existing data to the extent it corresponds to the sampling sites PWS assigns.

8. The applicant reports the results of the sampling program in the format of the attached sampling report.

2.2 Identify wells the project will replace

Unless the applicant chooses to sample all wells, the applicant will survey the path of the lines and determine the wells that the project will replace. The applicant will assign a general-purpose identifier (e.g., property address) to each well. The applicant will also number each well sequentially (the "unique identifier" discussed below).

To ensure random selection, the applicant will provide DWI with a Microsoft Excel spreadsheet listing the wells, including the general-purpose identifier and the unique identifier.[3] The applicant will inform DWI for what contaminants the samples will be analyzed.

2.3 Selection of sample locations

DWI will use Table 2 to determine the minimum required number of samples to ensure with 90% confidence that the sample results are statistically meaningful.

DWI will use one of several random number generating methods to determine which wells to sample (e.g., http://www.randomizer.org/index.html). Appendix 2 outlines these random number generating schemes.

DWI will give the applicant the list of wells to be sampled.

The applicant should note that (as a rule-of-thumb) one needs to sample nearly all wells up to fifty. **Therefore, (especially for projects involving less than fifty wells) the applicant may wish to forgo the steps above and simply test all wells to be affected, assuming any untested wells are "clean**."

If the applicant chooses to sample all wells affected, then the number of positive samples required is calculated by multiplying the appropriate percentage from Table 1 by the number of wells affected.

[3] The general-purpose identifier and the unique identifier are described in §3.0.

Table 2 –Minimum Required Sample Size and Upper Confidence Levels

TOTAL NUMBER OF WELLS (POPULATION SIZE)	MINIMUM REQUIRED SAMPLE SIZE	TOTAL COLIFORM UPPER CONFIDENCE INTERVAL	NITRATE / NITRITE UPPER CONFIDENCE INTERVAL	FECAL COLIFORM UPPER CONFIDENCE INTERVAL
0-10	Sample all	60%	15%	10%
11-15	10	7	2	2
16-20	15	10	3	2
21-25	20	13	4	3
26-30	25	16	5	3
31-35	30	19	5	4
36-40	35	22	6	4
41-45	40	25	7	5
46-50	45	28	8	5
51-55	50	31	8	6
56-60	50	32	9	6
61-70	50	33	10	7
71-80	50	33	10	7
81-90	50	34	10	7
91-100	50	34	10	7
101-110	50	34	11	8
111-120	50	34	11	8
121-130	50	34	11	8
131-140	50	35	11	8
141-150	50	35	11	8
151-160	50	35	11	8
161-170	50	35	11	8
171-180	50	35	11	8
181-190	50	35	11	8
191-200	50	35	11	8
201-300	55	38	12	9
301-400	60	42	13	9
401-500	65	45	14	10
501-600	70	48	15	11
601-700	75	52	16	12
701+	75	52	16	12

2.4 Treatment of samples and analysis

The applicant must document the method, date and time of sampling, and the identity and qualifications of the sampler.

The applicant must document the method, date and time of analysis, and the qualifications of the analyst. An appropriately certified[4] drinking water laboratory (preferably the county health department) must conduct the analysis using the method specified for that analyte in T15A NCAC .1500 *et seq*. The laboratory must report the analysis results to the applicant on the PWS form approved for compliance with the NC Drinking Water Act.

The applicant must document sample custody including holding times and temperatures, from the time of sample acquisition to the time of sample receipt by the laboratory.

2.5 QA/QC

No samples will be considered valid if the application deadline is more than 18 months after the date of sample acquisition. No samples will be considered valid if the holding times specified in the method are exceeded or if the sample acquisition and analysis fails to follow the method.

3.0 Reporting Results

The results of a coordinated sampling program must be reported in a manner that addresses each of the concerns discussed in section 2. The report must include each of the following elements:

1) How was the number of samples chosen?

2) How were the sample locations chosen?

3) How were samples acquired?

4) How was sample chain of custody maintained?

[4] The certification must be issued by the State of North Carolina for compliance with the NC Drinking Water Act and must be for the analyte in question.

5) How were the samples analyzed?

6) **Do not report results for a property for which public water service is currently available.** If public water service is already available to a property, the property is ineligible for consideration as a public health risk, because the project is not needed to address any risk at that property.

   If a property is sampled and it is later determined that public water service is currently available, the report must discuss and present the statistics discounting any results for the property.

7) **Do not report results for a property that the project will not serve.** A project is ineligible to "get credit" for a problem that the project will not correct.

   If a property is sampled and it is later determined that the project will not provide water service, the report must discuss and present the statistics discounting any results for the property.

8) Include the laboratory sheets for every sample. The laboratory sheet must include a unique sample identifier that can be linked to the table and map discussed below.

9) Include a color-coded map of the project area showing the following:

   a) the location of all known individually owned wells,

   b) the locations of all samples taken,

   c) the results indicated by color[5],

   d) the proposed project layout (e.g., the proposed new waterlines), and

   e) the existing waterlines.

10) Include the following statements:

   a) "W*e have notified the owner of each well showing contamination*." Attach copies of notifications as an appendix.

[5] An example color-coding scheme is green for uncontaminated (clean), yellow for total coliform, red for fecal coliform, and brown for a spoiled sample. A spoiled sample is one with no reliable results. Examples of spoiled samples are samples lost, or samples that exceeded allowable holding times.

b) *"Owners of XXX of the XXX wells along the route have provided statements that they propose to sign up for the service. This constitutes XXX% of the wells that can be served. There are XX connections per mile of waterline throughout the project*." Note that, consistent with USDA Rural Development, DWI prefers to fund projects meeting 80% commitment at a minimum of 17 connections per mile. In certain cases, commitment proportion can be traded against connections per mile.

c) If the applicant sampled all affected wells, include the following statements:

i) "*The results of all samples taken are reported in this report*."

ii) "*This project will be able to provide water service to each property for which results are reported.*"

If the project will not provide water service to any property for which results are reported, please discuss and report the statistics discounting any positive results for the property in question.

iii) "*There is currently no public water service available to any of the properties for which results are reported*" (i.e., the property cannot now be served without extensions of the main).

If water service is available to any properties for which results are reported, please discuss and report the statistics discounting any positive results for the property.

11) Address cost effectiveness.

a) Compare the cost of the project to the cost of **every technically feasible alternative**.

b) Calculate the cost per connection of each technically feasible alternative, <u>including point of use systems</u>. Compare this cost of connection to the assessed value of each property.

c) Discuss any (non-technical) limitations that may make an identified technically feasible alternative infeasible (e.g., local politics).

d) Consider those owners who propose to sign up and discuss the cost per proposed connection.

12) Include a table of results cross-indexing results, identifier, address, date of sample acquisition, date of sample analysis, whether the well-owner has signed a statements proposing to connect, and report the following:

a) number of wells in the project area,

b) whether the well-owner has signed a statements proposing to connect,

c) number of samples taken (total and as a percent of wells),

d) number of samples spoiled,

e) number and proportion of samples positive for each analyte:

i) as a percent of all samples taken, and

ii) as a percent of valid samples taken (unspoiled samples from wells that currently cannot be served, and that will be served as a result of the project).

An example report is included as Appendix 1.

Appendix 1 – Statistical Notes for Well Water Contamination

Tables 1 - 3

Prepared as *Statistical Notes for Well Water Contamination* {"Statistical Notes (for J.Miles 1-30-2001).doc"}, internal correspondence prepared by Harry Herrick of the State Center for Health Statistics, part of DPH, for Jessica Miles).

1. The statistical objectives for this project were twofold: (1) implement random sampling in all communities, except for the very smallest communities (<11 proposed hook-ups); and, (2) reduce variation in the standard errors of samples from very small and very large communities, so that the "chances" of a small or large community meeting the contaminant criteria are more nearly the same as those communities in the mid-range of the population.

2. The standard error of the sample proportion was calculated as the square root of (p q/n), where p is the proportion under investigation and q is equal to 1– p. So that, for example, the standard error for a sample size of 10 with a mean of 60% (e.g., total coliform) is: sqrt(.6(1-.6)/10)[6], which resolves to .154 or 15.49%.

3. The standard errors for Tables I-III were also adjusted by the square root of the factor, (N – n)/(N – 1), which is known as the finite population correction factor, or fpc. The standard error is multiplied by the fpc to obtain the adjusted standard error. The value of N (population size) for Tables I-III was derived from the median value of the corresponding population interval.

    - For example, the fpc for a sample of 10 wells drawn from a well population interval of 11-15 is: sqrt (13 – 10)/(13 - 1), which yields 0.5. Returning to our previous example (#2), the standard error of .154 was then multiplied by 0.5, yielding an adjusted standard error of .077 or 7.7%, reducing the standard error by 50%.

    - Thus it can be seen that the fpc serves to reduce the size of the standard error, when the sampling fraction represents a large percentage of the population, or when n is close to N. As the sampling fraction becomes small relative to the population, the fpc has less effect. For example, for a sample of 50 wells (for fecal coliform, requiring 10% positive) taken from a population interval of 201-300 wells, the standard error of .042, when multiplied by the corresponding fpc of 0.89, reduces to .037 – lowering the error by about 11%.

4. The adjusted standard errors were used in the calculations of the 95 and 90 percent confidence intervals for Tables I-III. To calculate the 95% confidence interval, the adjusted standard error was multiplied by 1.96 (two standard deviations of p), and

[6] sqrt(x) means square root of x. The square root character (√) does not display correctly on some computer systems.

the resultant value was added to and subtracted from the proportion under investigation. To obtain the 90% confidence interval, the adjusted standard error was multiplied by 1.64.

5. Rounding Rule: using the 100th decimal place, _.55 was rounded down to the next whole number; _.56 was rounded up to the next whole number.

6. Example: Imagine that in a population of N=27, *n*=26 samples are taken for total coliform (requiring *p*=60% of samples to be positive to earn priority points).

   The unadjusted standard error is sqrt{p(1-p)/n} = 0.09608.

   The fpc is sqrt{(N-*n)*/(N-1)} = 0.1961.

   The adjusted standard error is the fpc times the unadjusted standard error = .01884 as a proportion of the samples.

   Multiply the number of samples (*n*) by the adjusted standard error and obtain 0.4899 (the adjustment to the number of samples required to be positive) {closing parenthesis missing in original}.

   Multiply the number of samples (*n*=26) by the percent required to be positive (*P*=0.60) is 15.6. Adding 1.64 times the adjusted standard error yields

   15.6+(1.64 * 0.4899) = 16.403 - the 90% upper confidence limit.

   To be 90% confident that the sample results are the result more than 60% of the population having total coliform, **more than** 16.4 samples of the 27 need to be positive. This is rounded down to 16 or more samples need be positive.

A spreadsheet performing these calculations is available:
WellSamplingStatisticalTests_v1.0.xls.

Appendix 2 – Random Number Generating Methods

Prepared as *Guidelines for Sampling Community Wells* {"Sampling Protocol (for J.Miles 1-30-2001).doc"}, internal correspondence prepared by Harry Herrick of the State Center for Health Statistics, part of DPH, for Jessica Miles).

I. Preparing the list of community wells (sample frame):

1. Community applicants will need to provide the Public Water Supply Section with a list of all wells affected by the proposed water improvement project. Each well on the list will require some form of identification, such as the home owner's name or street address, to designate the physical location of the well.

    - NOTE: A label or number, obtained from the list of wells in the community, should be attached to each sample member sent to the lab for analysis. The report from the lab should also show the results of the analyses by the labels that are associated with any given community sample. (If a lab report contains a label that *does not* correspond to a member of the sample list, then those results should be discarded.)

2. The list of wells can be ordered in any fashion. (For persons' names, alphabetical listings are usually recommended.)

3. Staff from the Public Water Supply Section will then need to attach a number or 'label' to the list of wells, beginning with 00, 01, 02, etc., and proceed with consecutive numbers until all wells on the list are numbered. Two digit labels, i.e. 00-99, are adequate for sample frames containing between 11 and 100 wells. Three digit labels, 000, 001, etc., are needed for sample frames containing between 101 and 1000 wells. Always use as few digits as possible in labels.

    - IMPORTANT NOTE: If using automatic random number generators, such as the one described below [B], the list may be numbered from 1 to the total number of wells on the list. The use of the leading '0' digit is needed only for using random numbers tables.

II. Selecting the sample (Method A & B):

A. Using a random numbers table:

1. This procedure requires access to a table of random numbers, which can usually be found in most introductory statistics textbooks.

2. A random numbers table contains columns of numbers usually in blocks of five numbers. In some tables, the first column designates the line or row number. DO NOT use the line number as part of the selection process of random numbers.

3. Enter the table at any line number and systematically read through the table, selecting consecutive two-digit or thee-digit numbers (depending on the population size) until you have reached your desired sample size.

   Example: Randomly select 4 wells from a total of 50 wells
   a. We enter a random number table at line number 131. The first three blocks of random digits read: 05007 16632 05194
   b. Our sample consists of wells having the labels: 05, 00, 32, and 19.
   c. We ignore 71 and 66 because they are greater than 50.
   d. Because 05 is already in the sample, we ignore repeated groups of digits.

B. Using an automatic random number generator located on the Web:

1. Go to: http://www.randomizer.org/index.html *Research Randomizer* is a free web-based service for students and researchers 'who want an easy way to perform random sampling.' The service is sponsored by the Social Psychology Network and maintained by Geoffrey C. Urbaniak and Scott Plous.

2. Click on the **Randomizer** button on the home page.

3. Fill out the Randomizer form accordingly:

   a. "How many sets of numbers do you want to generate?" [enter 1]
   b. "How many numbers per set?" [enter the desired sample size, e.g., 50]
   c. "Number range (e.g., 1-50):" "From:" [enter 1] "To:" [enter total number of wells, e.g., 128]
   d. "Do you wish each number in a set to remain unique?" [enter Yes]
   e. "Do you wish to sort your outputted numbers?" [enter Yes]
   f. "How do you wish to view your outputted numbers" [check 'Place markers off]
   g. Click on the **Randomize Now!** button and record numbers.
   h. Select the sample of wells with the corresponding numbers from your list of total wells.

Appendix 3 - Example Report

Example Report Justifying Health Priority Points for a Water Main Extension.

Version 3.0

Signed and dated by "Responsible Official" who submits the application, or signed, sealed and dated by the P.E.

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1.0 Purpose and Overview

This report determines whether Project Benefit priority points are justified for the proposed project: extending a six-inch water main three miles along US Route 19.

1.1 The proposed project

The proposed project is to extend a six-inch transmission/distribution line three miles North from Clairsville to interconnect with Bethel. The purposes of the project are a) to provide water service to 35 homes currently served by individually owned wells, and b) to provide the interconnection between Clairsville and Bethel (and continuing to Mineral Beach).

The project proposed to earn 15 points under line item 2.E. "project addresses acute contamination of a water supply source."

However, the results indicate that the total coliform contamination does not reach the level qualifying for such priority points (60%). Based on the sampling program 42.9% (15/35) of all the samples taken in the area are contaminated with total coliform.

Further, the fecal coliform contamination does not reach the level qualifying for maximum priority points (10%). Based on the sampling program, 8.6% (3/35) of all the samples taken in the area are contaminated with fecal coliform.

Instead, the project earns no **Project Benefits** points.

1.2 Positive statements

This report is signed, sealed, and dated by Bartholomew C. Jones, PE **(alternatively, the report may be signed and dated by the responsible official)**. Mr. Jones makes the following representations in this report.

1) The first house north of the existing six-inch line (10,000 US Rt. 19) could currently obtain water service. This house is currently served by an individually owned well. Based on the sampling conducted, this well is not contaminated. The owner has not connected to public water because the well is not contaminated and the connection fee (for the 300-foot service line) would be approximately $8,000). Results are reported both including and discounting this property.
2) This project will make water service available to each property for which results are reported with one exception. 15,000 US RT. 19 (sample #11) is 150 feet above the road at the top of the highest elevation in the line and cannot be served by available pressure. It is not economically feasible to modify the design to serve this one wellsite. Service will not be available to 15,000 US Rt. 19 (which has a contaminated well). Results are reported both including and discounting this sample.
3) "We have notified the owner of each well showing contamination." Note that this includes 15,000 US Rt. 19. Copies of these notifications are attached as Appendix 4.
4) "Owners of 30 of the 35 wellsites along the route have provided statements that they propose to sign up for the service. This constitutes 89% of the wellsites that can be served. Discarding sample 11 (15,000 US Rt. 19 – which cannot be served because of hydraulics) and sample 1 (10,000 US Rt. 19, which can currently be served), this is 29 of 33 or 88% of the wellsites that can be served.
5) There are 35 potential connections in the 3.0-mile project, or 11.7 potential connections per mile of waterline[1]. Considering only those 30 connections whose owners have proposed to connect, there are 10

[3] 35 connections in 3.0 miles.

connections per mile. This is below the DWI's preference to fund only projects meeting 80% commitment and at least 17 connections per mile.

1.3 Cost Effectiveness

The cost effectiveness of the project and of the technically feasible alternatives is discussed at greater length in the engineering report (ER), and is only outlined here. In summary the ER discusses the following five alternatives:

Table 1 – Alternatives Comparison

Alternative	Advantage	Disadvantage	Cost	Cost / wellsite (33)
Proposed Waterline Extension	• meets health need • gets all wellsites on a regulated public system. • provides interconnection between Bethel & Clairsville. • Is expected to form backbone of a Bethel-to-Clairsville-to-Mineral Beach Regional System	Most costly	$800K	$24,242 ($12,121 remaining after contribution of Bethel & Clairsville)
Do Nothing Alternative	cheapest alternative	fails to address public health need	0	0
Rehabilitate existing wells	inexpensive	not expected to succeed – previous superchlorinations on three wells were recontaminated within six month	N/A	$2,000
Drill new wells	still inexpensive	leads to unregulated individually owned wells that can again be contaminated		$10,000
New community system	less expensive than waterline extension	although technically feasible, the system would be too small and spread-out to be viable	$500K	$15,151

2.0 Sampling

Sampling was performed in accordance with the *Guidance for documenting public health priority points by sampling individually owned wells.*

2.1 Selection of sample locations

There are 35 wellsites along the proposed project.

Location #1 (10,000 US Route 19) is currently serviceable.

Location #11 (15,000 US Route. 19) cannot be served by the proposed waterlines (for hydraulic reasons).

Therefore, there are effectively, 33 sample locations.

Based on Tables 2 and 4 of the *Guidance for documenting public health priority points by sampling individually owned wells,* for 33 sample locations, a minimum of 30 samples are required.

For simplicity, and because of the low cost of bacteriological analysis, all 35 wells were sampled, including #1 and #11

Based on the Table 1 of the *Guidance for documenting public health priority points by sampling individually owned wells*, when sampling all the affected wellsite, to earn Project Benefit priority points:

- 60% or more of the wellsites must be contaminated with total coliform, or
- 10% or more of the wellsites must be contaminated with total coliform.

2.3 Treatment of samples and analysis

Samples were taken by Kurt Smith, a technician with the XX County Public Health Department. Mr. Smith is a qualified water treatment plant operator and is familiar with Method XX sampling.

Samples were acquired in accordance with Method XXX. Samples were stored (from acquisition until delivery to the laboratory) in an unsealed cooler in the bed of a pickup truck, shaded by a cap. At no time were the samples locked in the cab with the windows up. Samples were stored at ambient temperatures (but out of direct sunlight).

Samples were logged in at the XX County Public Health Department Laboratory and analyzed by Method 31XX for total coliform. The XX County Public Health Department laboratory is certified by EPA for Method 31XX analysis

Samples found to have total coliform contamination were subsequently analyzed by Method 31ZZZ for fecal coliform. The XX County Public Health Department laboratory is certified by EPA for Method 31ZZZ analysis All samples were analyzed on the same day as acquired (results the next day).

All laboratory results sheets are included in Appendix 1.

2.4 Age of samples

Samples were acquired on 10, 11, and 12 July 2016. The samples are approximately one month old as of the date of this report. None of the samples will be eighteen months or older on the application deadline (30 September 2003).

3.0 Results

The results of a coordinated sampling program are reported in Table 1 below. Valid samples were obtained from all 35 wellsites. Please note the following:

- The "Location" field indicates the address on US Route 19.
- The "Sample Date" and "Analysis Date" fields indicate the day in July on which the sample was acquired and analyzed.
- One of the samples (sample # 8a, the original sample for 13,500 US Route 19) fell to the floor and broke as samples were being logged in. This spoiled the sample before analysis. The spoiled sample was not analyzed and is not included in the data analysis. A second sample (#8b) was taken at the same location the next day.
- 15,000 US Route 19 will not receive service (for hydraulic reasons). Sampling was performed only for the sake of completeness. Statistical results are reported excluding this property.
- 10,000 US Route 19 is currently serviceable. Statistical results are reported excluding this property.

<u>Based on 35 "affected" wellsites (including 10,000 and 15,000 US Route 19):</u>

- **Fifteen** of the wells were positive for total coliform (21 needed for maximum priority points).
  - The sampling fails to establish that the total coliform contamination rate exceeds 60%.
- **Two** of the wells were positive for fecal coliform (four needed for maximum priority points).
  - The fecal coliform contamination rate in the sample population approaches 6%.
  - The sampling fails to establish that the fecal coliform contamination rate exceeds 10%.

Based on 33 "affected" wellsites (excluding 10,000 and 15,000 US Route 19):

- **Fifteen** of the wells were positive for total coliform (20 needed for maximum priority points).
  - The sampling fails to establish that the total coliform contamination rate exceeds 60%.
- **Two** of the wells were positive for fecal coliform (three needed for maximum priority points).
  - The fecal coliform contamination rate in the sample population approaches 6%.
  - The sampling fails to establish that the fecal coliform contamination rate exceeds 10%.

Example

Table 2 – All Results Tabulated

Lab ID	Location	Fecal?	Total?	Currently Serviceable?	Future Service?	Sample Date	Analysis Date	Proposes to Connect?	Notes
1	10,000	☐	☐	☒	☒	10	10	no	Currently serviceable
2	10,500	☐	☐	☐	☒	10	10	yes	
3	11,000	☐	☒	☐	☒	10	10	yes	
4	11,500	☐	☐	☐	☒	10	10	yes	
5	12,000	☐	☒	☐	☒	10	10	yes	
6	12,500	☐	☐	☐	☒	10	10	no	
7	13,000	☒	☒	☐	☒	10	10	yes	
8a	13,500	N/A	N/A	☐	☒	10	10	yes	Spoiled by dropping
8b	13,500	☐	☒	☐	☒	11	12	yes	Replaced sample #8a
9	14,000	☐	☐	☐	☒	11	11	yes	
10	14,500	☐	☐	☐	☒	11	11	yes	
11	15,000	☐	☐	☐	☐	11	11	no	will not be serviced; sampled only for sake of completeness
12	15,500	☐	☐	☐	☒	11	11	yes	
13	16,000	☐	☐	☐	☒	11	11	no	
14	16,500	☐	☐	☐	☒	11	11	yes	
15	17,000	☐	☒	☐	☒	11	11	yes	
16	17,500	☐	☐	☐	☒	11	11	yes	
17	18,000	☐	☒	☐	☒	11	11	yes	
18	18,500	☐	☐	☐	☒	11	11	yes	
19	19,000	☐	☐	☐	☒	12	12	no	
20	19,250	☐	☒	☐	☒	12	12	yes	
21	19,400	☐	☒	☐	☒	12	12	yes	
22	19,500	☐	☐	☐	☒	12	12	yes	
23	20,000	☐	☒	☐	☒	12	12	yes	
24	20,500	☐	☐	☐	☒	12	12	yes	
25	21,000	☐	☐	☐	☒	12	12	yes	
26	21,500	☐	☒	☐	☒	12	12	yes	
27	22,000	☐	☐	☐	☒	12	12	yes	
27	22,500	☐	☐	☐	☒	12	12	yes	
29	23,000	☐	☒	☐	☒	12	12	yes	
30	23,500	☐	☒	☐	☒	12	12	yes	
31	24,000	☐	☒	☐	☒	12	12	yes	
32	24,500	☒	☒	☐	☒	12	12	yes	
33	25,000	☐	☐	☐	☒	12	12	yes	
34	25,000	☐	☐	☐	☒	12	12	yes	
35	25,000	☐	☒	☐	☒	12	12	yes	
Sums		**2**	**15**	**1**	**35**			**30/35 "yes"**	

Appendix 1 - Color-coded map of the area

This map shows the locations of all samples taken, the results (color-coded as green for clean (uncontaminated), yellow for total coliform, red for fecal coliform, and brown for the spoiled sample) and includes the proposed project layout.

Appendix 2 - All field data sheets

Appendix 3 - All laboratory data sheets

Appendix 4 - Copies of notification of positive results to each owner

Appendix 4 – Revision History

Changes to version 3.0 from version 2.0, based on final proofread:

I. Revised for Division of Water Infrastructure.

Changes to version 2.0 from version 1.9, based on final proofread:

II. Page 3 – placed period at end of second paragraph.

III. Page 8 – removed extra whitespace.

IV. Page 13 – note missing closing parenthesis in quoted matter.

V. Page 20 – inserted optional hyphen. Added caption to table outlining alternatives analysis.

VI. Page 21 –inserted comma in a dollar amount, changed referenced version of the *Policy*, and changed an example date to a future date.

VII. Page 25 – made typographic changes in version 1.9 history discussing changes to §2.1 and §2.2 (formerly items III and IV).

Changes to version 1.9 from version 1.8, based on John McFadyen's second review, completed 10 July 2002:

VIII. "Private well" is changed to "individually owned well" throughout the document.

IX. In §1.0, first paragraph: reject suggested wording change "almost." The cited regulations are identical.

X. In §2.1, first outline item: "determines that too many wells in an area are contaminated" is replaced with "identifies an area with excessive contamination of individually owned wells."

XI. §2.2, second paragraph is rewritten as requested to clarify that the table must be submitted as a Microsoft Excel spreadsheet. A footnote reference to the definition of "general-purpose identifier" and "unique identifier" is added.

XII. §2.3, first paragraph is rewritten as requested.

XIII. In §2.3, fourth paragraph, the reference to "rule of thumb" is removed.

XIV. In §2.3, the fifth paragraph is retained. It is important to point out the implications of sampling all wells (conducting a census).

XV. In §2.4, third paragraph:

a) first sentence, a typographical error is corrected.

b) second sentence, the footnote is modified to further define what "appropriately certified" means.

c) the following sentence is added: " The laboratory shall report the analysis results to the applicant on the PWS form approved for compliance with the NC Drinking Water Act."

XVI. In §3.0, outline item #8, the request to specify that the unique identifier be three alphanumeric digits is rejected. There is no need to specify the number of digits. The applicant is free to follow the example report, where, for example the five-digit address is used as the unique identifier.

XVII. Appendix 3, Example Report: "private well" is changed to "individually owned well" throughout the example report.

Changes to version 1.8 from version 1.6, based on John McFadyen's review completed 7 June 2002:

XVIII. Page 3 and page 4 [p] is used where capital "P" is replaced by a small "p" in a quotation. This is a typographical convention designating a change of capitalization in a quotation, and is used throughout the policy.

XIX. In table 2, "POPULATION SIZE (TOTAL WELLS)" is replaced with "TOTAL NUMBER OF WELLS (POPULATION SIZE)."

In §2.2, last paragraph, reworded the last sentence to no longer end with a preposition.

XX. In §2.4, first paragraph, remove reference to "or state health department." In third paragraph, remove "[i]t is not necessary to maintain sample chain-of-custody to the rules of evidence standard."

XXI. In §3.0, items 6 and 7 are reworded with input from Mr. McFadyen.

In item 10b), I change "17" to "a minimum of 17 " to clarify that 17 connections per mile is the minimum for an 80% positive response rate.

In item 11a), I remove the word "identified."

XXII. Response to question on Appendices 2 and 1 "is J.Miles reference required?" Yes, since the references are part of filenames: {"*Sampling Protocol (for J.Miles 1-30-2001).doc*," and "*Statistical Notes (for J.Miles 1-30-2001).doc.*"

XXIII. In version 1.8, this revision history section of the policy is restored to document changes, reasons for changes, and who requested changes. It also lists rejected requests for changes, and reasons for rejections.

XXIV. Signature Version 1.7 was identical to version 1.6, but the "DRAFT" designation and this revision history section were removed for signature.

Changes to version 1.6 from version 1.4, based on 10 May 2002 meeting:

XXV. Discuss cost effectiveness. Compare the cost of the project to the cost of every identified technically feasible alternative. Calculate the cost per household or per connection of each alternative. Then discuss limitations that may make an identified technically feasible alternative infeasible (e.g., poverty, politics). Discuss who proposes to sign up and consider this in cost/household that signed up. ***Addressed in §3, new item 11.***

XXVI. Note that, consistent with USDA Rural Development, PWS prefers to fund projects meeting 80% commitment at 17 connections per mile[7]. In certain cases, commitment proportion can be traded against connections per mile.

[7] Got this 80% commitment proportion at 17 connections per mile from Dennis DeLong of USDA Rural Development in a telephone call on 13 May 2002.

i. Require the applicant to sign a statement that describes the proportion of the households along the route that propose to sign up for the service.

ii. Require the applicant to document the number of connections per mile.

Addressed in §3, item 10 and item 11.

XXVII. Require the applicant to document notification to well owners for every positive well test. ***Addressed in §3, item 10.***

XXVIII. 25% for other MCLs confirmed. ***Left in §1***.

XXIX. "Appropriately certified drinking water laboratory" replaces "EPA CLP Certified Laboratory" in §2.4. Later add footnote to require certification appropriate to the analyte, and recognized in NC (based on advice from Michael Douglas).

XXX. Confirmed that the Applicant or Applicant's agent (engineer) can collect the sample. Does not need to be explicit.

XXXI. In the case of expensive analyses (e.g., pesticide), PWS may consider existing analytical data, to the extent that it corresponds to the required sampling. ***Addressed by adding footnote to §2.***

XXXII. Use the 90% confidence level rather than the 95% confidence level. This change is made throughout the document.

XXXIII. PWS will not require any attempt to superchlorinate or otherwise rehabilitate the wells. We also decided against various proposals to require certification of well construction; we decided it didn't matter why a well was bad; the water needs to be replaced.

XXXIV. Action Item. Vincent Tomaino will discuss tables vs. spreadsheets with Jessica and decide which approach to use.

Addressed in email from Harry Herrick, of the State Center for Health Statistics, 16 May 2002. Confirmed by email from Jessica Miles 17 May 2002.

XXXV. Add signature lines to the policy document. Addressed on cover page.