Methods For Easy Total Coliform Rule (TCR) Updates

"Compliance with the TCR may never be **easy**, but at least we can try to take the guess work out of sample site placement."

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Springfield Utility Board (SUB)

Sample Collection Procedures and Locations for Bacterial Compliance Monitoring

(Report)

Developing a Bacterial Sampling Plan

(Appendix – Guidance Manual)

Project # **2676**

AwwaRF (Water Research Foundation)

Why Public Water Systems (PWS) Need to Standardize Total Coliform Sampling Site Selection.

1. In 2004, a scientifically based sampling program that effectively monitors microbial water quality was published .

2. Ever since the TCR was enacted under the 1986 SDWA, very little guidance to PWS in.

- Sample site selection
- Sample tap conditions
- Flushing times
- Appropriate field testing apparatus.

3. PWS sample site selection has mostly been by visual examination of distribution system and convenience of sampling locations.

Why Public Water Systems Need to Standardize Total Coliform Sampling Site Selection.

4. Many states lack official policies, procedures, or regulations for selecting bacterial sampling sites.

5. Spatial distribution of sampling sites in only one component to sample site selection, many other critical factors need to be considered.

- Hydraulics
- Pressure zones/regions (demand variations)
- Cross contamination with multiple use sample sites
- Inadequate collection/handling procedures
- Lack of trained personnel
- Use of pipe material which promotes biofilm
- Inadequate service of sampling apparatus
- Stagnant conditions in long service lines

Guidance Manual Approach for Sample Site Selection

Step 1: System information assessment

Step 2: Define sector boundaries

Step 3: Calculate sector population

Step 4: Minimum compliance samples per sector

Step 5: Sample selection/installation guidelines

Step 6: TCR plan check list

1. System information assessment

System Maps	
Roads Map	Figure 1
Transmission Main Map	Figure 2
Water Supply Map	Figure 3
Emergency Use Well Map	Figure 4
Reservoir Map	Figure 5
Pressure Regulating Valve Map	Figure 6
Pressure Zone Map	Figure 7
Pump Station Map	Figure 8
Fire Hydrant Map	Figure 9
Chlorine Booster Station Map	Figure 10
Intertie Map	Figure 11
Land Use Map	
Zoning Map	Figure 12
Population Map	
Population Map	Figure 13

2. Define sector boundaries

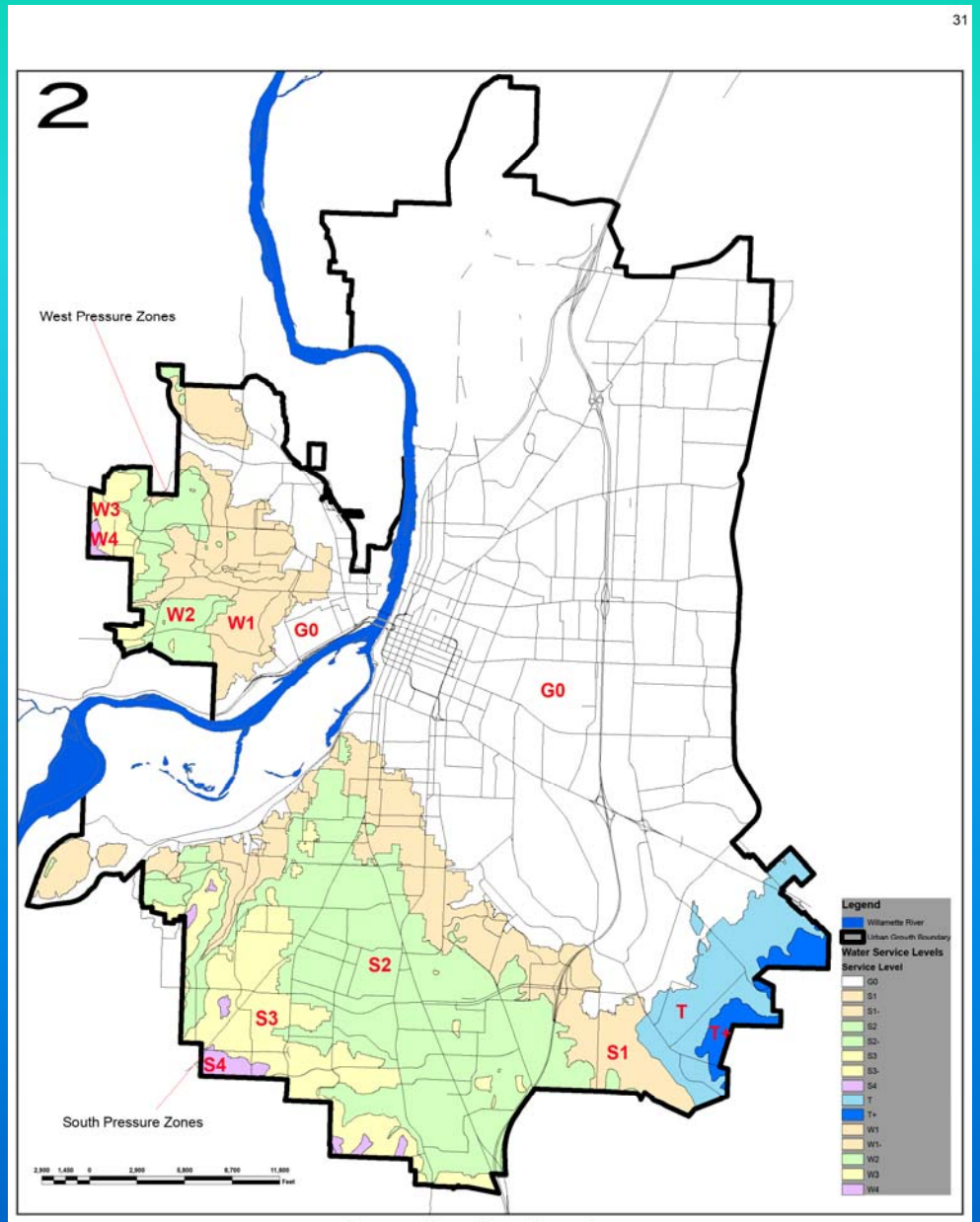
A. Use maps to delineate major spatial sectors.

- Political boundaries
- Pressure zones
- Distribution grids (transmission mains)
- Zone of influence from multiple sources
- Service area designations

B. Number of sectors based on PWS size.
(and based on 10 to 20 samples collected/day)

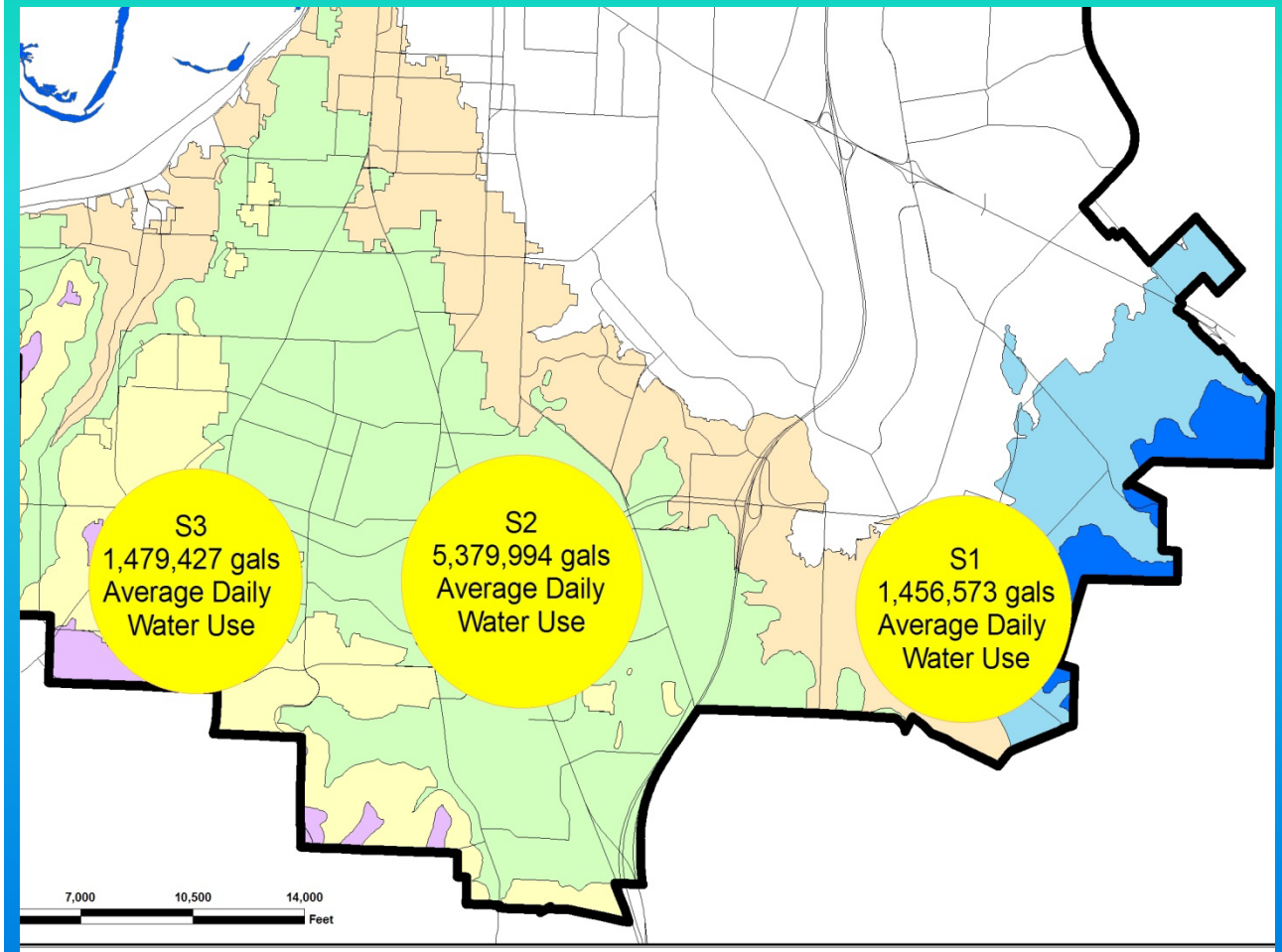
Population	Number of Sectors
25 - 12900	1
50,001 - 59,000	3- 6
130,001 - 220,000	**6 - 12**
600,001 - 780,000	11- 24

2. Define sector boundaries



Pressure Zone Map, Figure 8

2. Define sector boundaries



Pressure Zone Water Use Map, Figure 15

3. Calculate sector population

Option 1: Population Deduction Method

Step 1: **Total Daily Residential Water Use for PWS**

Step 2: **Convert to gal/day**

Step 3: **Total Daily Water Use / PWS population**

Step 4: **Equals Gal per Day per Capita (gpcd)**

Step 5: **Sector Total Residential Daily Water Use / gpcd**

Step 6: **Equals population of sector.**

$$\frac{\text{Total Daily Residential Water Use (gpd)}}{\text{Population of PWS}} = \textbf{gal per day per capita (gpcd)}$$

$$\frac{\text{Sector Total Residential Daily Water Use}}{\text{gpcd (gpd/person)}} = \textbf{Sector Population}$$

3. Calculate sector population

Option 2: Extrapolation Method

Step 1: **Determine average residential meter use**

Step 2: **Ave residential meter use per day/2.2 persons = Gallons per Day per Capita (gpcd)**

Step 3: **Sector Total Residential Daily Water Use / gpcd**

Step 4: **Equals population of sector**

$$\frac{\text{Total Daily Residential Water Use (gpd)}}{\text{Population of PWS}} = \textbf{gal per day per capita (gpcd)}$$

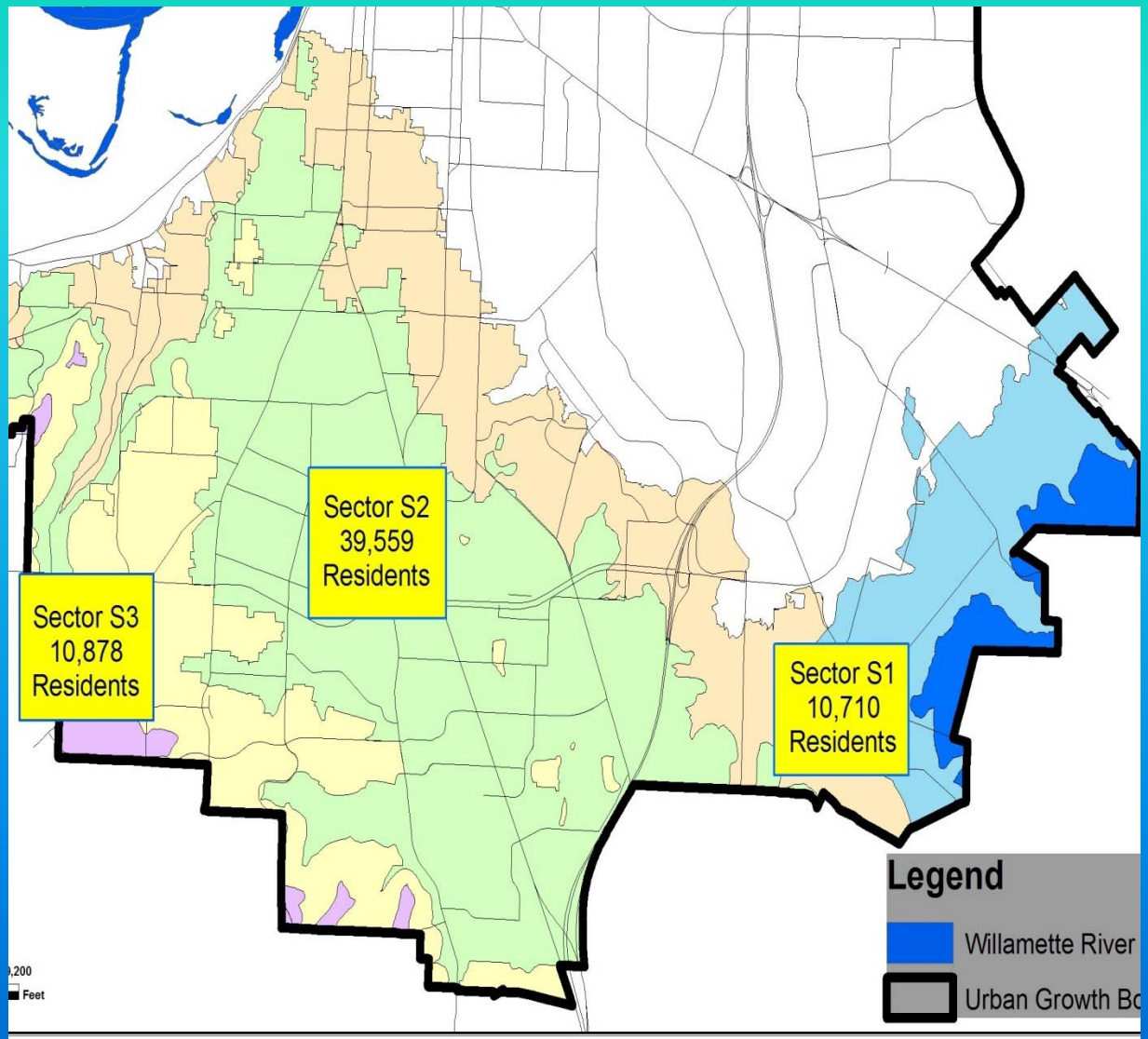
$$\frac{\text{Sector Total Residential Daily Water Use}}{\text{gpcd (gpd/person)}} = \textbf{Sector Population}$$

3. Calculate sector population

	Annual usage (100 cuft)	Total Usage (100 cuft)	Total Usage (gal)	Daily Usage (gal/day)	People served
	1	2	3	4	5
S1 2007	720,930	1,421,522	1,063,298,456	1,456,573	10,710
S1 2006	700,592				
S2 2007	2,809,133	5,250,529	3,927,395,692	5,379,994	39,559
S2 2006	2,441,396				
S3 2007	775,208	1,443,826	1,079,981,848	1,479,427	10,878
S3 2006	668,618				

1. Two years of water meter billing
2. Add two years together
3. Convert 1 unit to gallons: 1 unit = 748 gallons and
4. Divide total gallons by 730 days
5. Divide daily water use / 136 gallons per day per capita

3. Calculate sector population



Sectors Population Map, Figure 18

4. Minimum compliance samples per sector

	Sector Population	Population Share	Required BacT samples	Actual BacT samples	# of Sample Station	# of new sample stations
Sectors	**1**	**2**	**3**	**4**	**5**	**6**
S1	10,710	5.9%	7	0	0	3
S2	39,559	21.9%	26	32	11	0
S3	10,878	6.0%	7	9	3	0
Totals	**180,440**	**100%**	**120**	**130**	**45**	**4**

1. Sector population
2. Sector population / total population = % population
3. % population * 120 (required BacT/month)
4. (Current SS in sector/total current SS)*130 (actual BacT/month)
5. Current SS in sectors
6. Number of SS needed in each sector.

4. Minimum compliance samples per sector

	Actual Sample Stations	Proposed sample station changes	Proposed active sample stations	Proposed actual BacT samples
Sectors	**1**	**2**	**3**	**4**
S1	0	3	3	9
S2	11	-2	9	27
S3	3	0	3	9
W-G0	3	1	4	12
Totals	**45**		**44**	**130**

1. Actual sample stations (SS) in each sector.
2. Proposed SS - Actual SS
3. Proposed active sample stations
4. Sector proposed SS / Total proposed SS (44) X total actual samples (130)

4. Minimum compliance samples per sector

What to consider when selecting new sample sites?

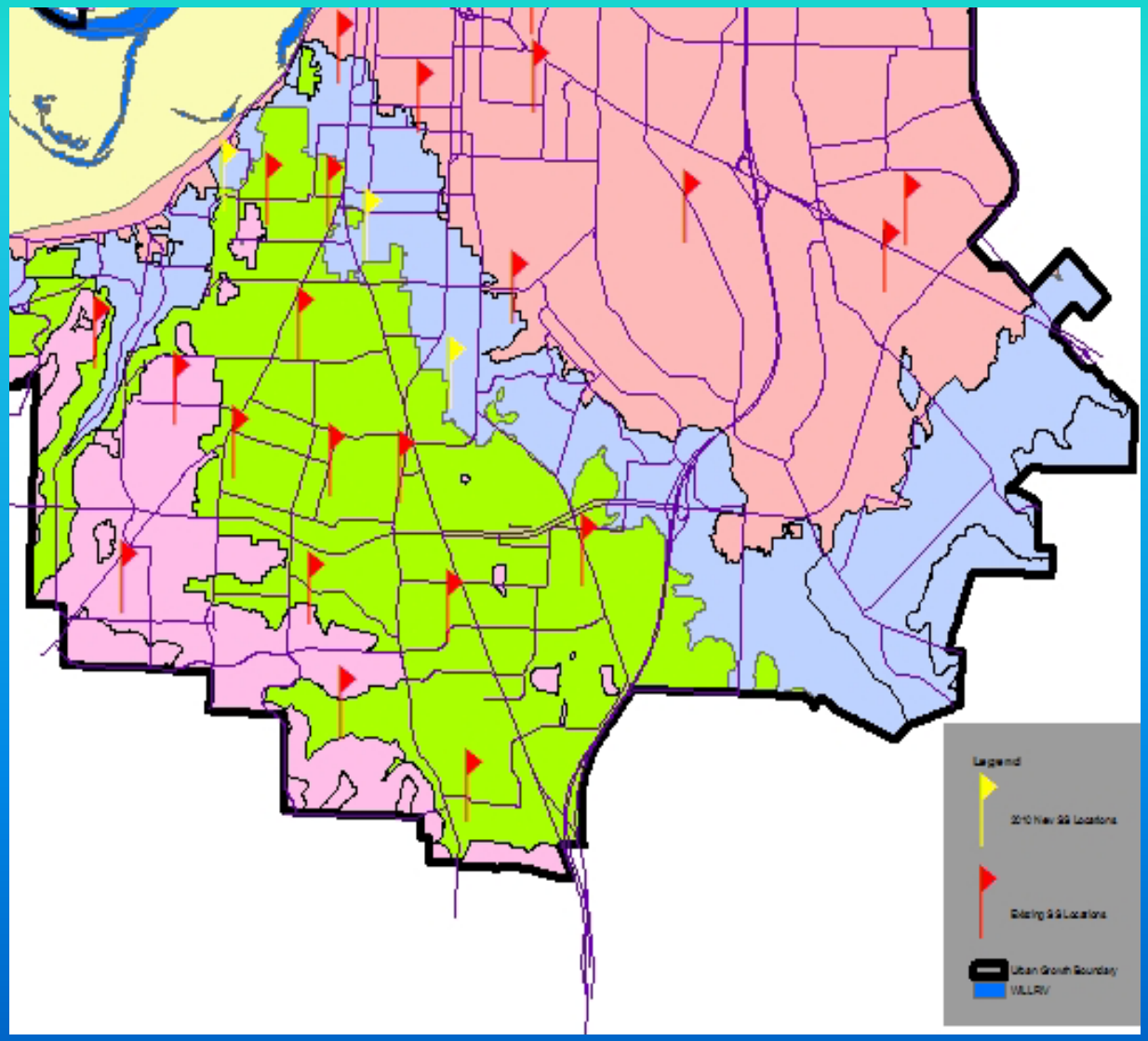
Critical Factors	
Pipe materials/age	Most important factor affecting bacterial water quality in distribution system. Unlined CI or DI pipe – 1960.
Trouble spots	Low Cl2, T&O or discoloration. *May want to have for research.
Low Pressure	20-25 psi
Low flow	
Seasonal/multiple source	
Sensitive populations	
Storage tanks/reservoirs	

4. Minimum compliance samples per sector

What to consider when selecting new sample sites?

SS#	Alt Source	Cl2	PZ	Pipe Install Date	Pipe Size (inch)	Pipe Mat	Demand	Land use	Dead Ends	Sensitive Pop	Reservoirs / Pump Station
35	No	1.22	E-G0	1974	6	AC	High	Indust Public	No	No	No
34	No	1.39	S-1	1981	16	DI	High	GenCom, SFR	No	No	Edward PS
33	No	1.38	G0	1984	16	DI	Low	Public	No	No	No
30	No	1.32	G0	1977	8	DI	Low	SFR	No	No	No

4. Minimum compliance samples per sector



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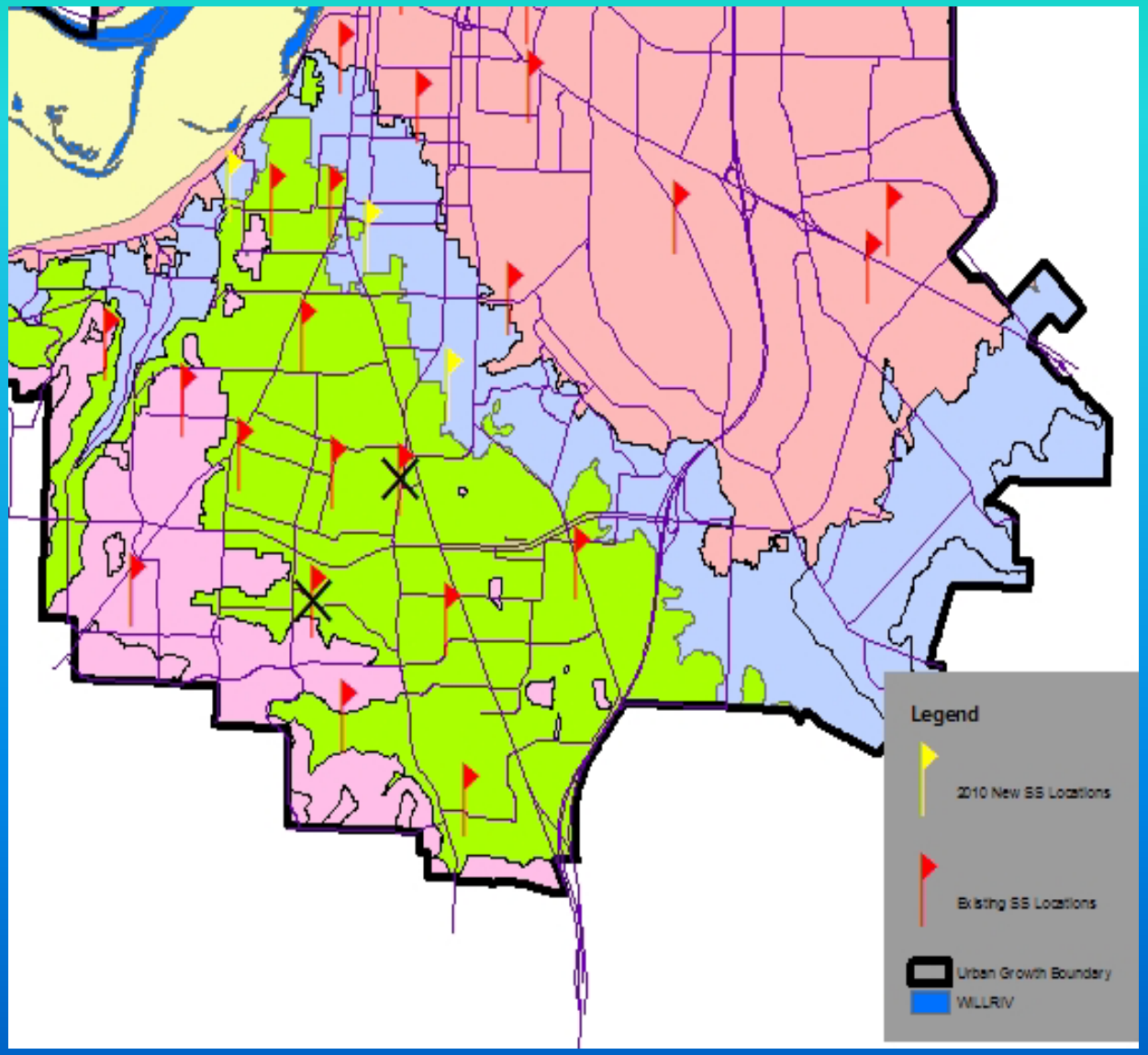

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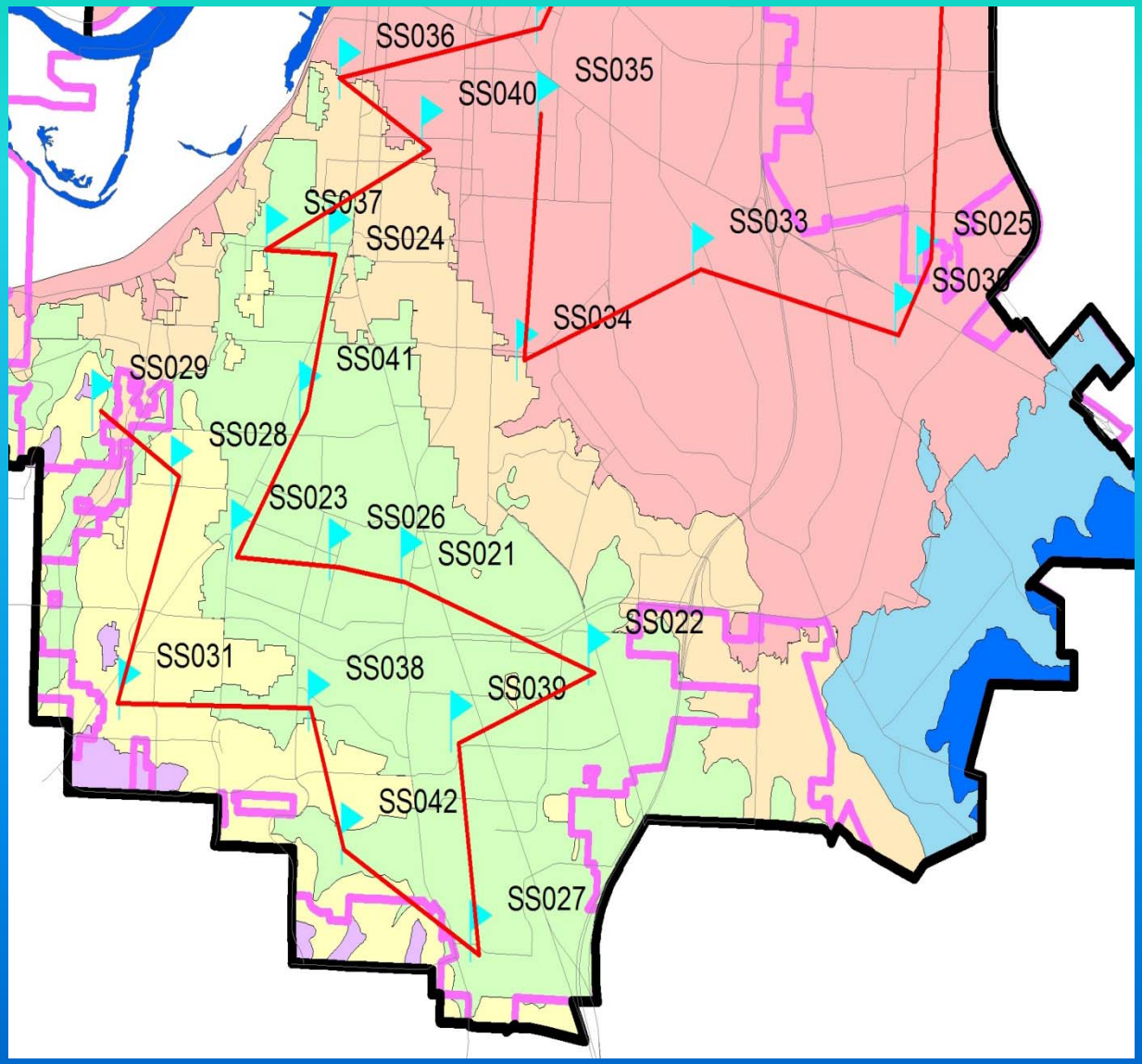
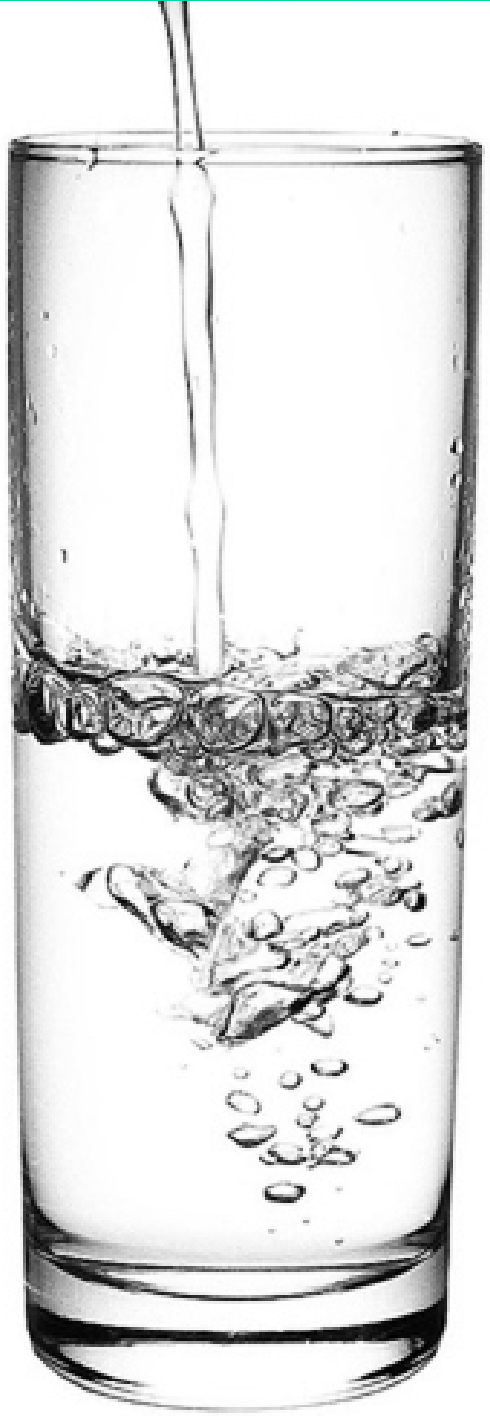


5. Sample site selection/installation guidelines

- **24 hour/day – 365 day accessibility**
- **Secure, not exposed to pets or general public, remove excess vegetation.**
- **Avoid threaded taps**
- **Avoid long copper service lines (service line volume should be flushed prior to sampling)**
- **Avoid dead ends**
- **Avoid using hydrants for sample**
- **Flush tap weekly**
- **Site location cards**
- **Alternate sites**



5. Sample site selection/installation guidelines

1. Short service line to sample station.

2. Disinfect tap with 10% chlorine solution and let water run for **3-4 minutes.**

3. Collect bacterial sample using aseptic technique.

6. TCR Plan check list

✓ **Maps**

- **Sectors boundaries on system map.**
- **Unique sector numbers**
- **Total number of samples in each sector**
- **Total sample sites within each sector.**
- **Individual sector maps with sample site locations.**

✓ **Tables**

- **Population in each sector**
- **Number of samples and sample site in each sector.**

✓ **List**

- **Sample sites that represent the critical factors.**
- **Primary sample station list, with addresses, map number and addresses of upstream/downstream repeat sample station.**

✓ **Sampling site location cards**

✓ **Sampling log**

✓ **SOP for sample collection**

Thank you!

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