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# DRAFT Technical Memorandum

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| **From:** | Nicki Pozos | **Reviewed by:** | Mark Knudson |
| **Date:** | May 25, 2007 | **WO#:** | 7650A.00 |
| **Subject:** | City of Ashland Revised CT Calculator | | |

The purpose of this memorandum is to describe the process used to develop a revised CT calculation spreadsheet for the City of Ashland (City).

## Background

The purpose of the CT calculation spreadsheet is to provide the City with a tool to evaluate compliance with disinfection requirements for its surface water supply. The CT is the product of contact time and free chlorine concentration. The City currently receives credit for contact time in two segments of the overall system:

- Through the Ashland Water Treatment Plant (WTP), from the point of initial chlorine application to a monitoring point at the end of the sedimentation basins.

- In the transmission pipelines between the Ashland WTP and the first user.

During recent improvements at Granite Reservoir, changes to the system operation were made such that the location of the first customer was changed. In response, the City has changed the second chlorine residual monitoring point to a sample station in Lithia Park.

As such, the City requires a new CT calculation spreadsheet that incorporates the detention time to the new sample site. The portion of the spreadsheet calculating CT through the WTP was not changed.

## CT Requirements

CT requirements are based on the City's inactivation requirements, as well as the pH and temperature of the water. The City's CT requirements are based on a one-log inactivation of *Giardia*. The calculation for required free chlorine CT for one-log *Giardia* inactivation is as follows (based on AWWA's *Guidance Manual for Compliance with the Filtration and Disinfection Requirements for Public Water Systems Using Surface Water Sources*):

$$CT = 0.2828 * pH^{2.69} * Chlorine^{0.15} * 0.933^{(T-5)}$$

$CT$ = product of chlorine concentration (mg/L) and time (min)

*Chlorine* = free chlorine concentration (mg/L)

*T* = temperature ($^{\circ}$C)

This calculation differs somewhat from the equation used in the existing CT spreadsheet, though both equations yield similar results. The revised equation was used because it is simpler.

## Calculated Detention Time through the Ashland WTP

The City's existing CT calculation spreadsheet includes a calculation of CT credits between the initial point of chlorine addition and the monitoring point at the sedimentation basin. The CT credits are based on the $T_{10}$, which is based on tracer test results. The empirical calculation in the existing CT calculation spreadsheet for $T_{10}$ was maintained in the revised spreadsheet and is as follows:

$$T_{10} = \frac{5.8}{Flow} * 88$$

*Flow* = Flow rate (mgd)

A typical chlorine concentration at the sedimentation basin outlet is 0.2 mg/L.

## Calculated Detention Time in Transmission System

Water flows from the Ashland WTP to the first user via five pipeline segments, as described by City staff. The transmission pipelines are shown in the schematic in Figure 1 and summarized in Table 1. The majority of the contact time will be along the 30- and 24-inch lines. There are four existing flow meters along the transmission pipelines shown in Figure 1 as Meter Nos. 1 through 4.

The simplest method for calculating CT credits in the distribution system would be to apply the flow measured at Meter 1 to the full pipeline volume between the WTP and the first customer. This would tend to underestimate the actual CT, as downstream of the 30-inch pipeline the actual flowrates would be lower and the detention times would be correspondingly greater. The pipelines could also be divided into additional pieces. However, this additional level of complexity is expected to produce little gain in CT credits.

Based on the above assumption, the contact time in the distribution system will be calculated as follows:

$$T = \frac{32,850}{Flow * 92.84}$$

*Flow* = Flow rate measured at Meter 1 (MGD)

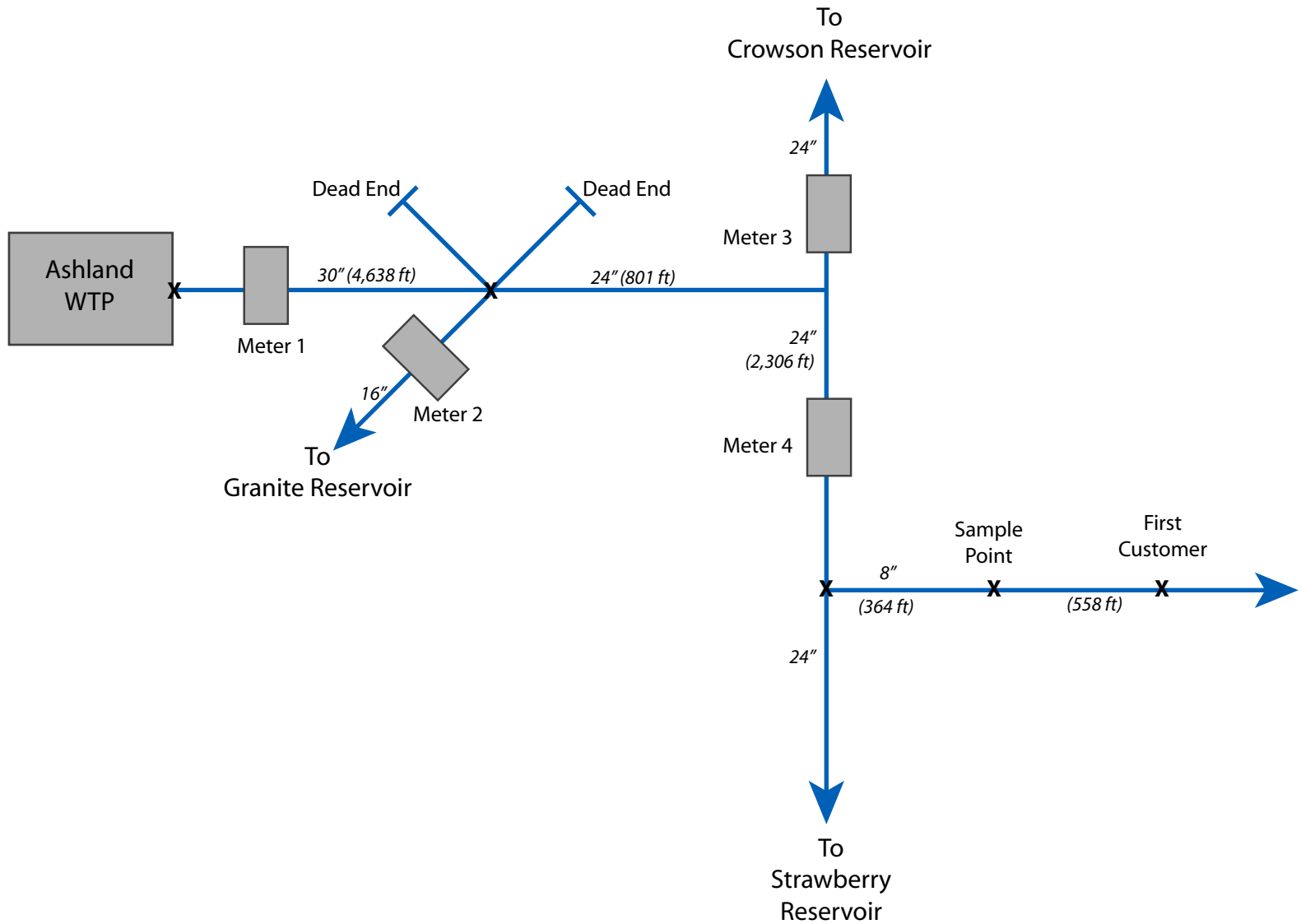| Table 1 | Summary of Pipeline Segments CT Calculation Spreadsheet City of Ashland | | | | |
|---|---|---|---|---|---|
| | **Segment** | **Diameter (inches)** | **Length (feet)** | **Volume (CF)** | **Flow Measurement Point** |
| 1. | 30-inch line from the Ashland WTP to the connection with the 24-inch line | 30 | 4,638 | 22,767 | Meter 1 |
| 2. | 24-inch line along Glenview from the connection to the 30-inch line to the "T" split to two 24-inch lines | 24 | 801 | 2,516 | Combined flows at Meters 3 and 4 |
| 3. | 24-inch line along Glenview from the "T" to the connection to the 8-inch line | 24 | 2,306 | 7,245 | Meter 4 |
| 4. | 8-inch line along Granite from the 24-inch connection to the sample station in Lithia Park | 8 | 364 | 127 | Flow not metered |
| 5. | 8-inch line along Granite from the sample station to the first customer | 8 | 558 | 195 | Flow not metered |
| | Total Volume | | | 32,850 | Meter 1 |

## Calculation of Required Residuals under Future Demands

A brief evaluation was conducted to determine whether CT requirements would be met under projected future demands with typical disinfectant residuals. The anticipated CT requirements and credits were determined under two sets of conditions:

- *Summer Conditions.* This condition was based on the following assumptions: peak flow rate of 10 mgd; water temperature of 15$^{o}$C; pH of 6.8 and chlorine residuals of 0.2 and 0.5 mg/L at the sedimentation basin outlet and the Lithia Park sampling point, respectively. Under these conditions, the ratio of actual to required CT was 1.3.

- *Winter Conditions.* This conditions was based on the following assumptions: peak flow rate of 5 mgd; water temperature of 2$^{o}$C; pH of 6.8 and chlorine residuals of 0.2 and 0.5 mg/L at the sedimentation basin outlet and the Lithia Park sampling point, respectively. Under these conditions, the ratio of actual to required CT was 1.1.

## CT Calculation Spreadsheet

The attached revised CT calculation spreadsheet incorporates the above equations. The spreadsheet is locked such that changes cannot be made to cells that contain calculations. If the City needs to make revisions, the spreadsheet can be unlocked by selecting Protection/Unprotect Sheet under the "Tools" menu in Excel.

To
Crowson Reservoir

24"

Dead End          Dead End

Meter 3

Ashland
WTP          Meter 1          30" (4,638 ft)          24" (801 ft)          24"
                                                                              (2,306 ft)

16"          Meter 2          Meter 4

To
Granite Reservoir

Sample          First
Point          Customer

8"
(364 ft)          (558 ft)

24"

To
Strawberry
Reservoir

Graphic is not to scale.

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**Figure 1**
**TRANSMISSION SCHEMATIC**
**CT CALCULATION SPREADSHEET**
CITY OF ASHLAND