WEST YOST ASSOCIATES

Can You See It Now? Using Tracer Field Testing for Model Calibration

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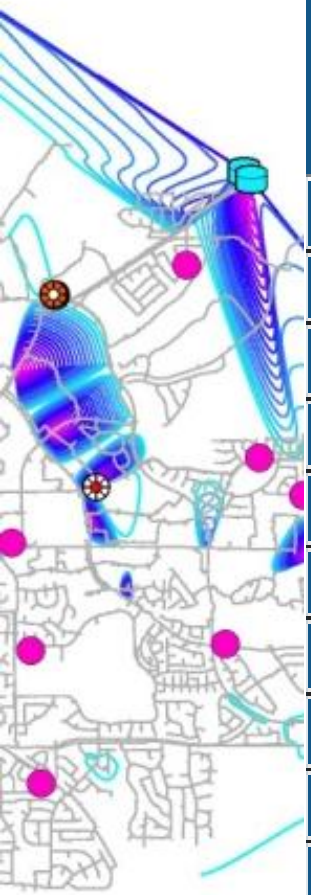

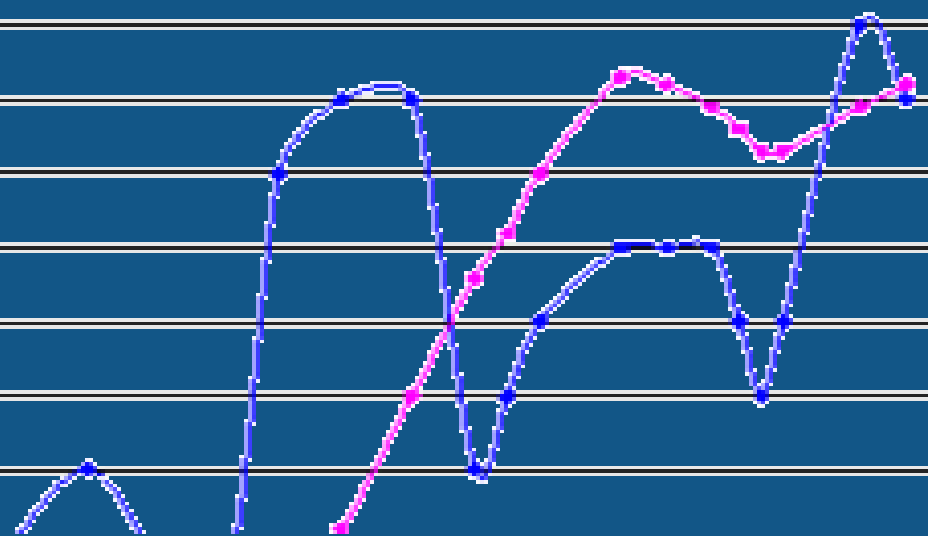

May 5, 2011

Today's Presentation

- Distribution Model Calibration
- Successful Tracer Study Planning
- Roseville, CA Case Study
- Questions

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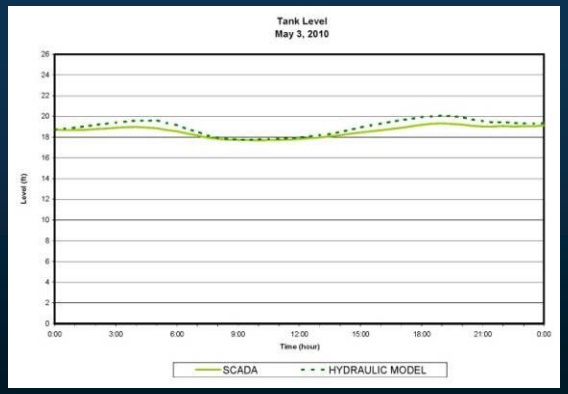
Traditional Distribution Model Calibration Focuses on Pressure

C-factor Calibration using Hydrant Tests

Dynamic Calibration Using Operating Data



C-factor Calibration Validates Model for Stressed Conditions

Collect pressure and flow for select pipelines based on material, age, and diameter

Benefit

Validation of pipeline roughness coefficient and identification of potential close valves in the system

Limitation

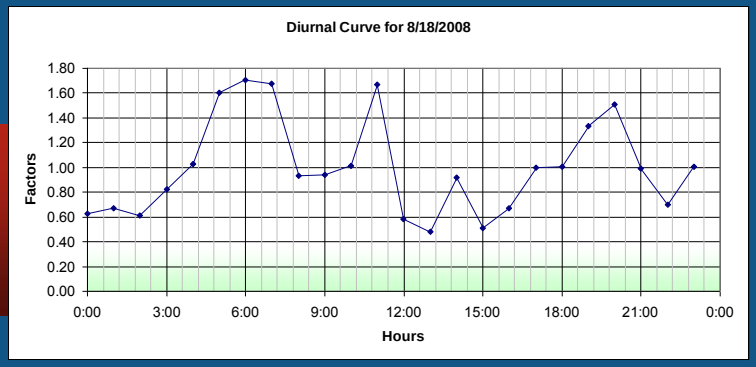
Only provides static or 'snapshot' analysis to simulate system condition at time of field test

Dynamic Calibration Verifies Model for Normal Operations

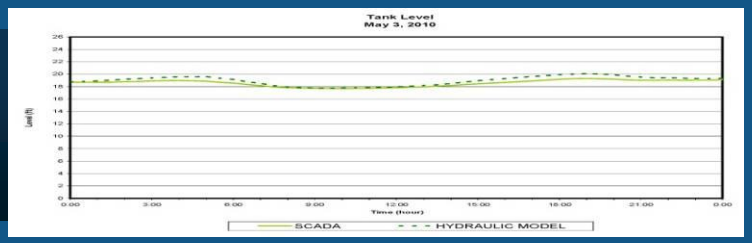
Dynamic calibration requires development of an Extended Period Simulation

Process

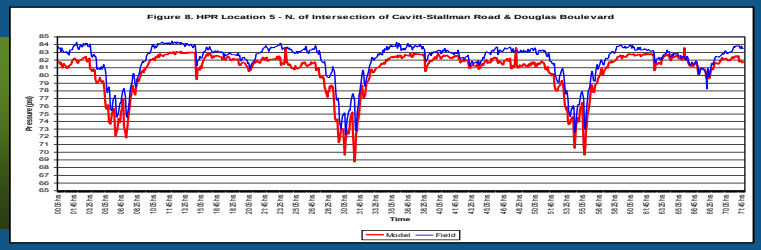
Developing diurnal system demand



Confirming operation of facilities

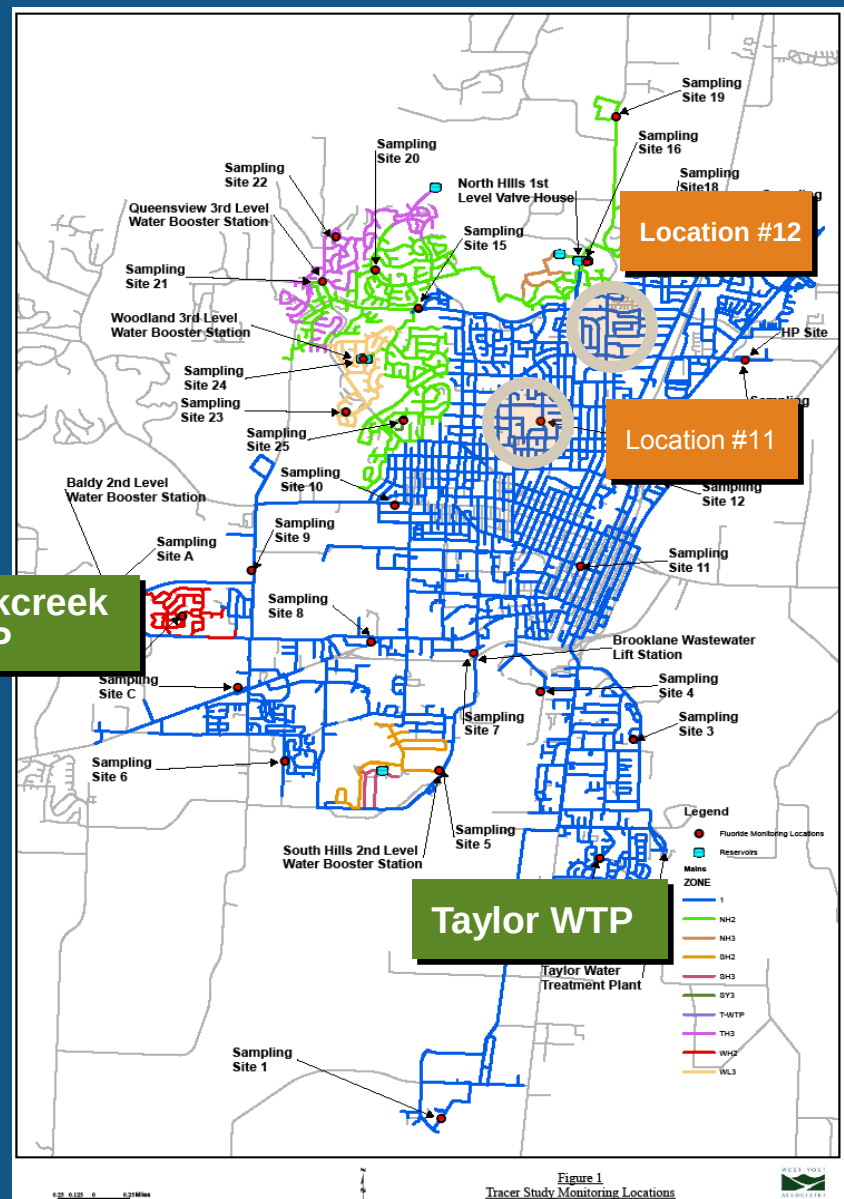


Validate normal operating pressures



Tracer Test Calibration Further Validates the Model Hydraulics

- Identifies flow patterns and velocities
- Reveals model inaccuracies

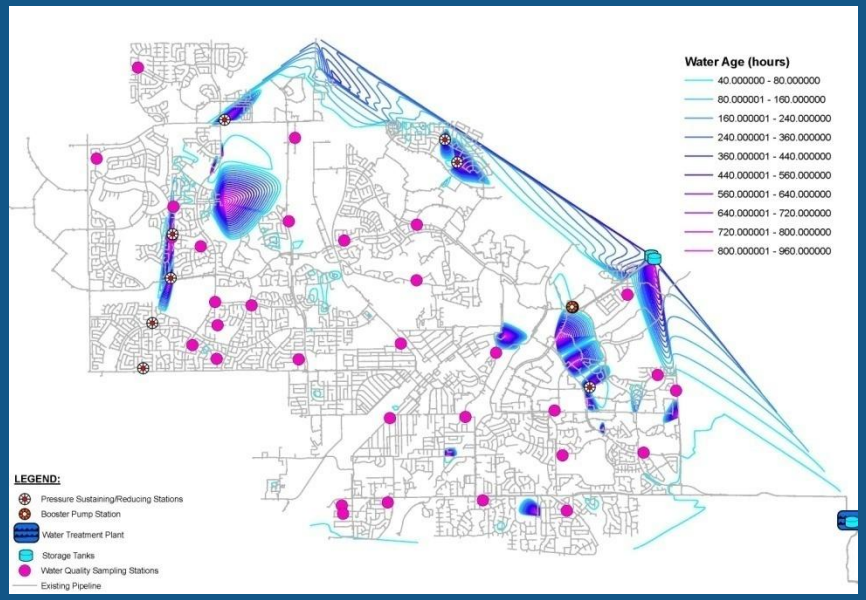


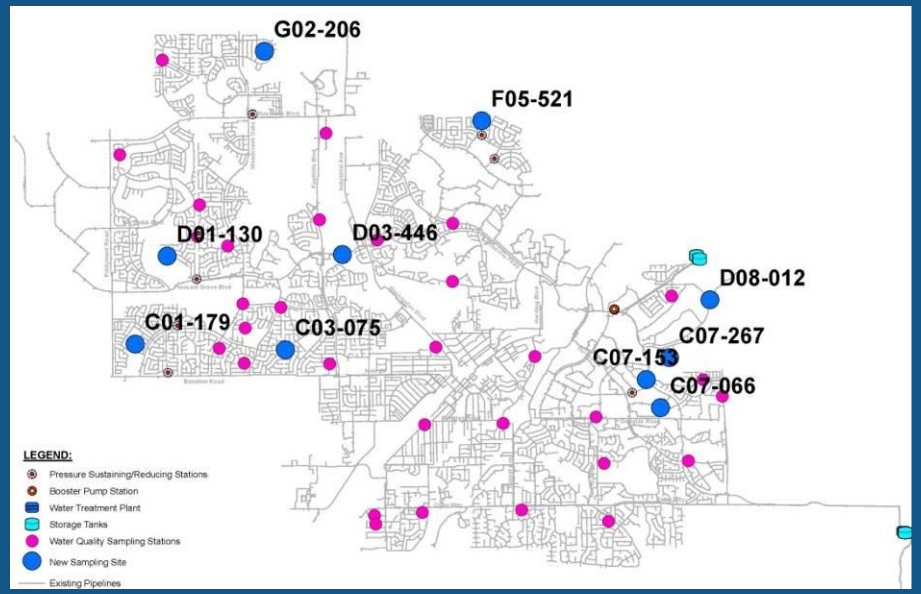
Tracer Calibrated Model Allows Many Types of Water Quality Evaluations

- Impact of Contamination Evaluation

Tracer Calibrated Model Allows Many Types of Water Quality Evaluations

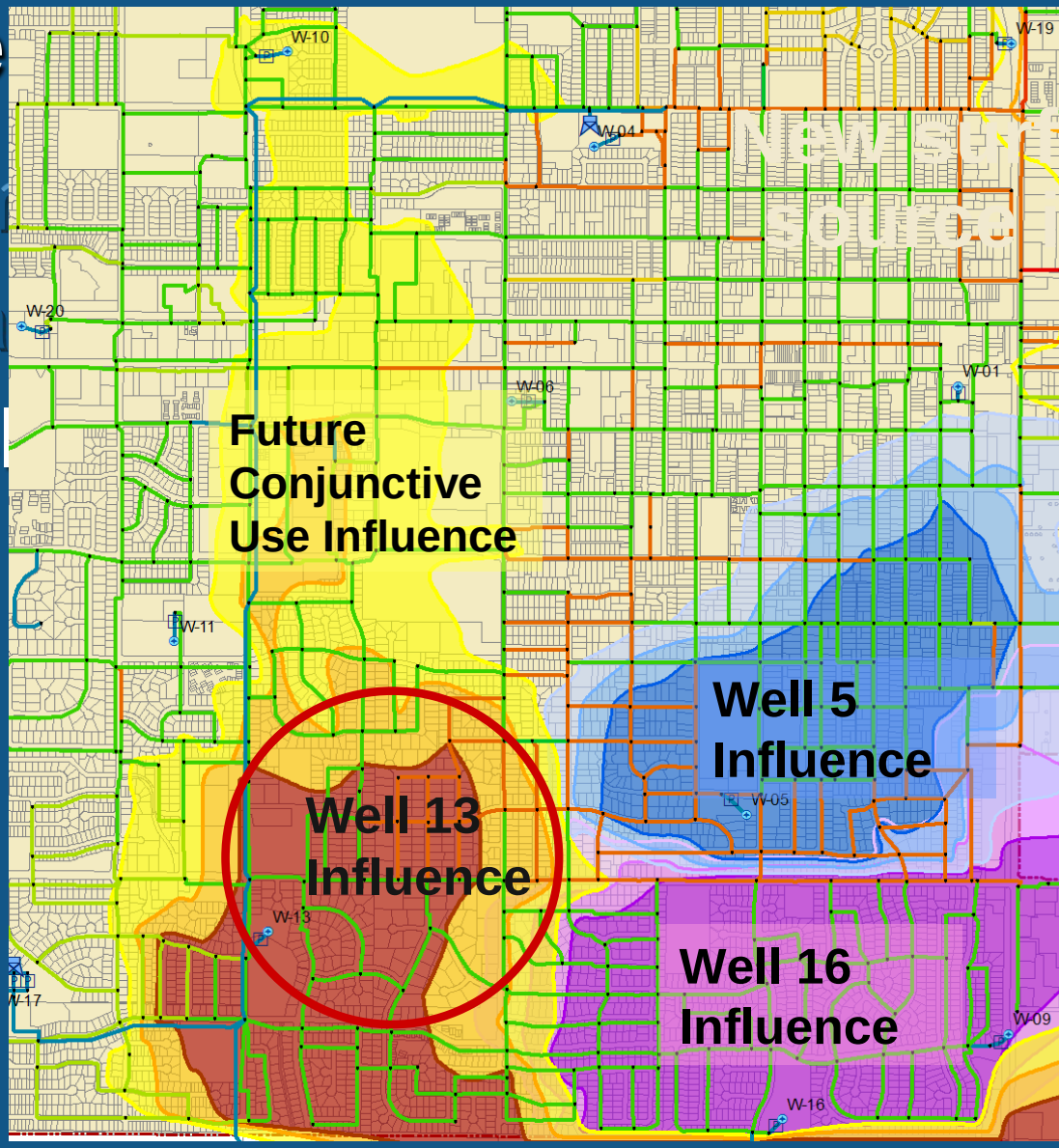
- Impact of Contamination Evaluation
- Water Quality Sampling Identification
  - Determine Compliance Location
  - Determine Additional Sampling Site





Tracer Calibrated Model Allows Many Types of Wate

- Impact of Contan
- Water Quality Sa
- Supply Source B



Tracer Calibrated Model Allows Many Types of Water Quality Evaluations

- Impact of Contamination Evaluation
- Water Quality Sampling Identification
- Supply Source Blending Study
- Reactive Constituent Analysis

Today's Presentation

- Distribution Model Calibration
- **Successful Tracer Study Planning**
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A Successful Tracer Field Test Requires Thorough Upfront Planning

Tracer Selection

- Familiarity with the tracer chemical used in study
- Local regulatory requirements (different States)

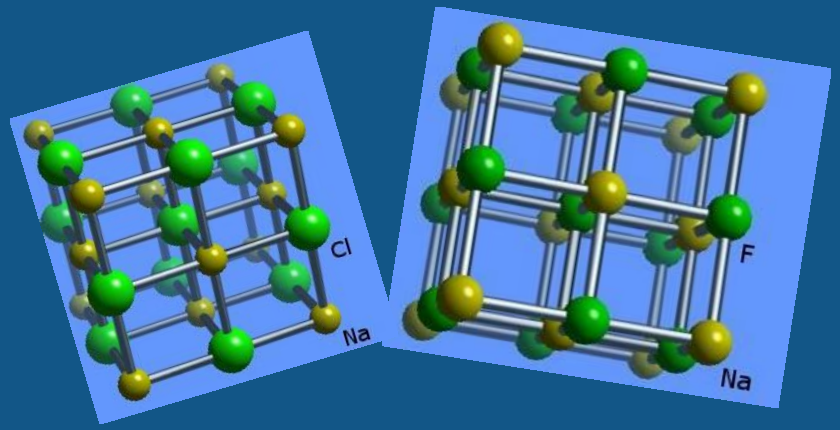
Program Implementation

- Type of program and cost
- Staffing
- Equipment selection

Other Requirements: Public notification

Several Factors Guide Tracer Selection

- Considerations
  - Safe for human consumption, easy regulatory approval
  - Ease of tracer injection
  - Economical
- Typical Tracers: Fluoride and Salts (Calcium chloride, Sodium chloride)
  - Depend on utilities choices and local regulation



Many Elements Must Be Considered in Program Planning

- Specify chemical dosage rate
  - Discuss with field staff or treatment plant staff
- Determine location of injection
- Select location of sampling
- Determine study time-lines
  - Establishing timing of wave front

Samples of Public Notification

- Press Releases
- Notification in Bill Stuffers
- Notification on Website

FOR IMMEDIATE RELEASE

CONTACT: Thomas Petrik
1390 Pennsylvania
Des Plaines, IL
(w)
(h)

EIGHTH GRADE STUDENT EARNS EAGLE RANK

DES PLAINES, NOVEMBER 1 — Scout Joe Jones of Troop 73, chartered by the Des Plaines United Church of Christ, will be presented the highest rank in Boy Scouting when he becomes an Eagle Scout in a ceremony at the church at 3:00 on December 10th.

This will be a recognition of his three years of work with the Troop and the community, providing service through several projects, including the one he planned himself and carried out as a leader of others. At the same time he earned over 21 merit badges and progressed through six other ranks.

Scoutmaster Sam Smith told of Joe's work, "He planned and carried out a project that required that he and other Scouts and even members of his school to put in over 200 hours of work and planning and provid the Salvation Army with a truck load of winter clothing they distribute."

The public is invited to join the Troop guests at the church for the ceremo

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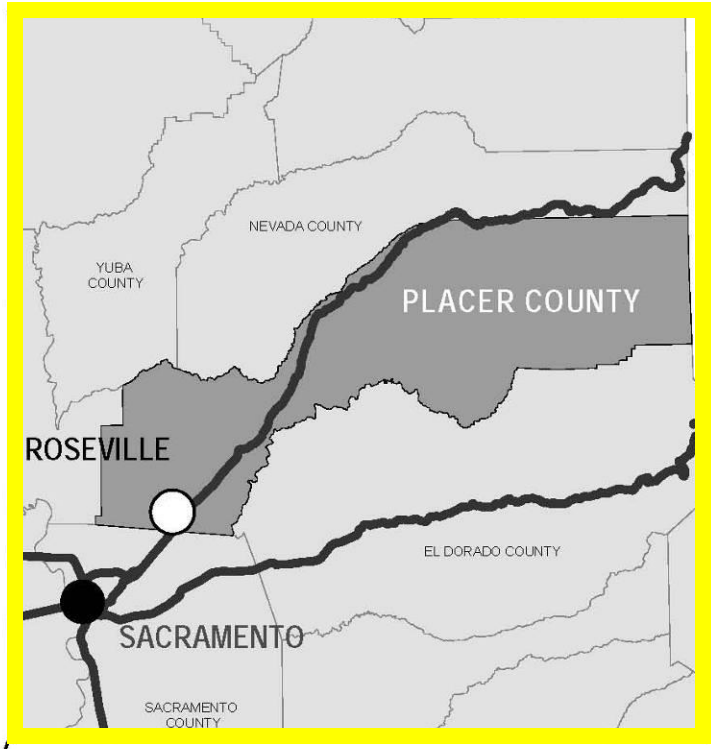


Roseville, CA

- Placer County
- East edge of Sacramento Valley
- At base of the Sierra Nevada foothills
- 16 miles from Sacramento
- 104,655 residents (2006)

Roseville, CA Distribution Network

Services	35,000
Avg. Daily Demand	30 MGD
Pipelines	411 miles 4- to 66-inch Diameter
Treatment Plant	1 Conventional (3 Clearwells)
Storage Tanks	3
Booster Pump Stations	1
Fluoridation	Yes, 0.8 mg/l

Characteristics of City's Hydraulic Model

Physical Network	Hydraulic Model
411 miles of Pipes	377 miles of Pipes
4- to 66-inch Diameter	4- to 66-inch Diameter
20.90 MG of Total Pipe Volume	20.83 MG of Total Pipe Volume
IDSE Recommended Length – 50% Total Pipe Length	Model Total Pipe Length – 91.8%
IDSE Recommended Volume – 75% Total Pipe Volume	Model Total Pipe Volume – 99.7%

City Wanted a Dynamic Model to Study Several Key Issues

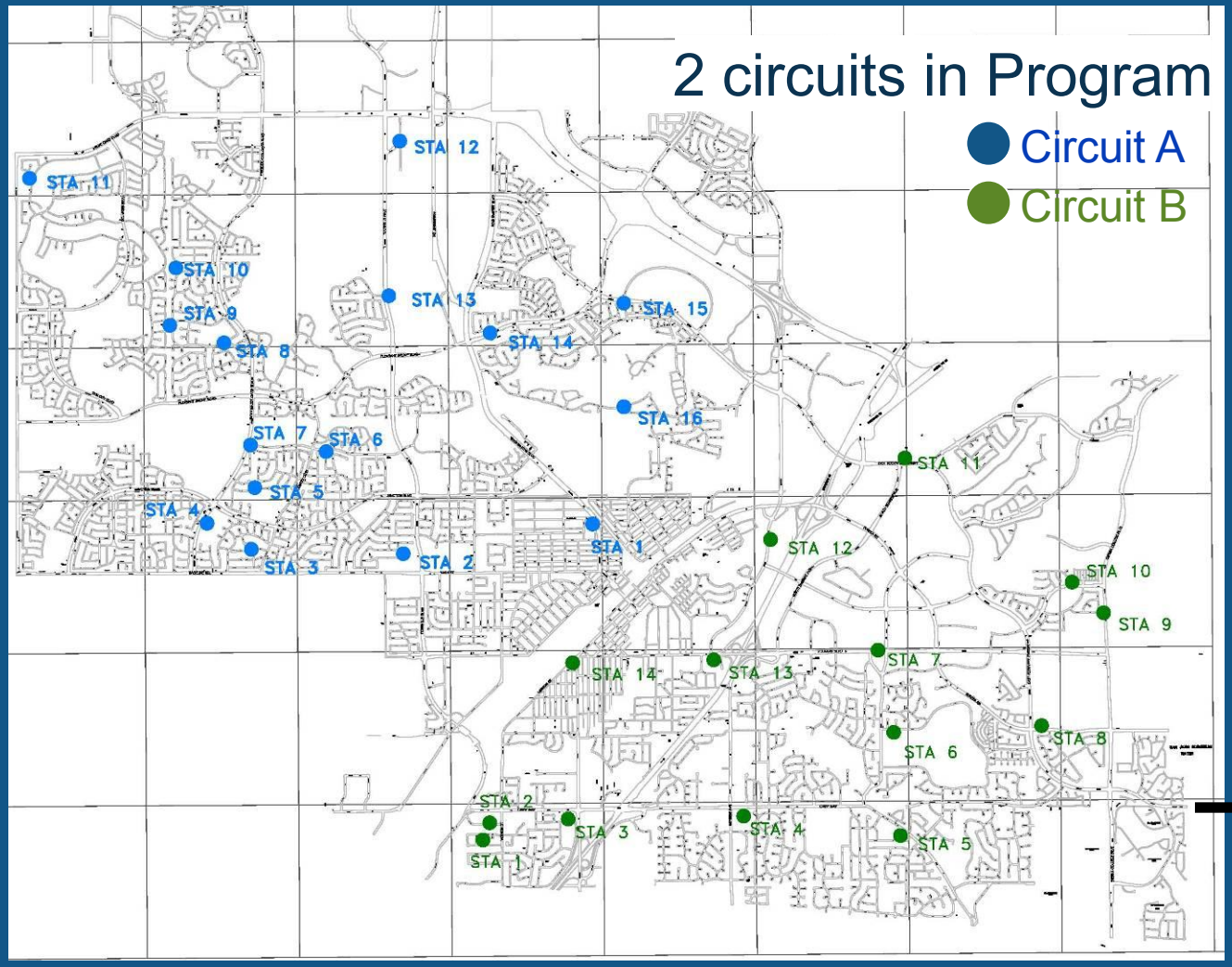
Refine the City's calibrated hydraulic model to study:

- Potential water exchange through existing emergency connections
- Source blending from neighboring agencies
- Initial Distribution System Evaluation Planning

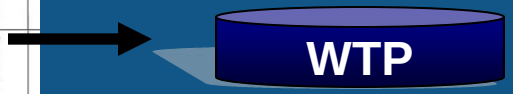
Program Planning for Roseville Considered Simplicity and Cost

- Fluoride Selected for Tracer
- Manual Sampling Program Selected
  - Low Cost
  - Available Staff
  - Available WQ stations for sampling
- Public Notification Through Bill Stuffer and Website

A 3-Day Manual Sampling Program Was Developed



- 4 sampling teams (2 per circuit)
- One full circuit could be covered in about 3 hours
- Sampled at existing water quality stations to facilitate access
- Provided additional training prior to sampling



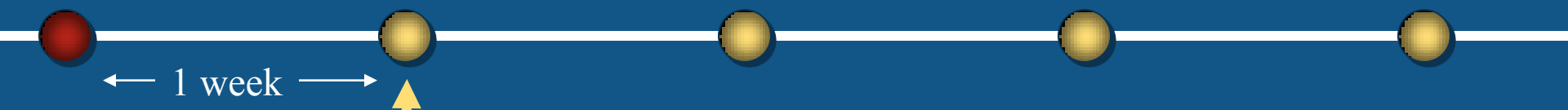
Pocket Colorimeters Selected for Ease of Use and Economy

- Pocket Colorimeter
- Fluoride Standard Kit
- Fluoride Reagent Ampules
- Thermometer
- Clean Beakers
- Distilled Water

Tracer Test Plan Stopped and Resumed Fluoride Injection

One Week Prior to Testing: Stop Normal Fluoridation of Drinking Water

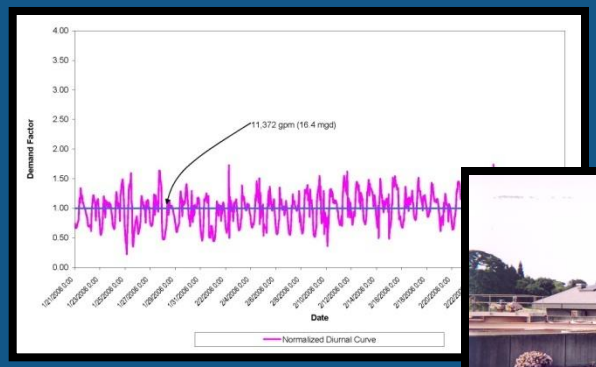
background fluoride concentration in network should be 0.1 mg/L

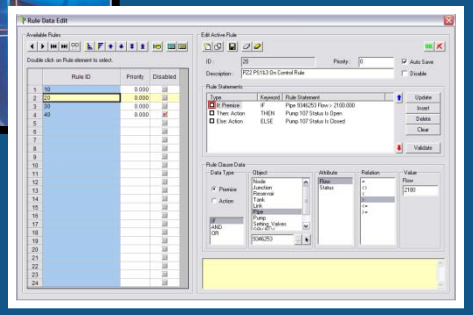


1st day of sample collection, re-initiate fluoride injection at rate of 0.8 mg/L

Model Was Configured to Meet Field Operational Conditions

- Tracer Test Diurnal
- Injected Tracer Concentration Based on Field Program
- Confirmed Operation of Facilities





Model Results Match Well to Collected Field Data

Circuit A

- 16 Total Test Sites
  - ✓ Good Match – 12
  - ✗ Doesn't Match Well – 4

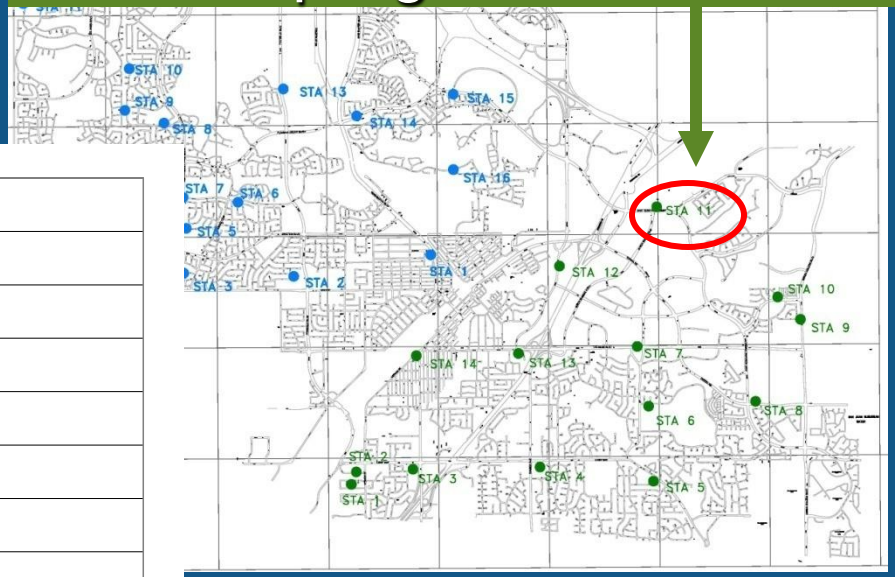
Circuit B

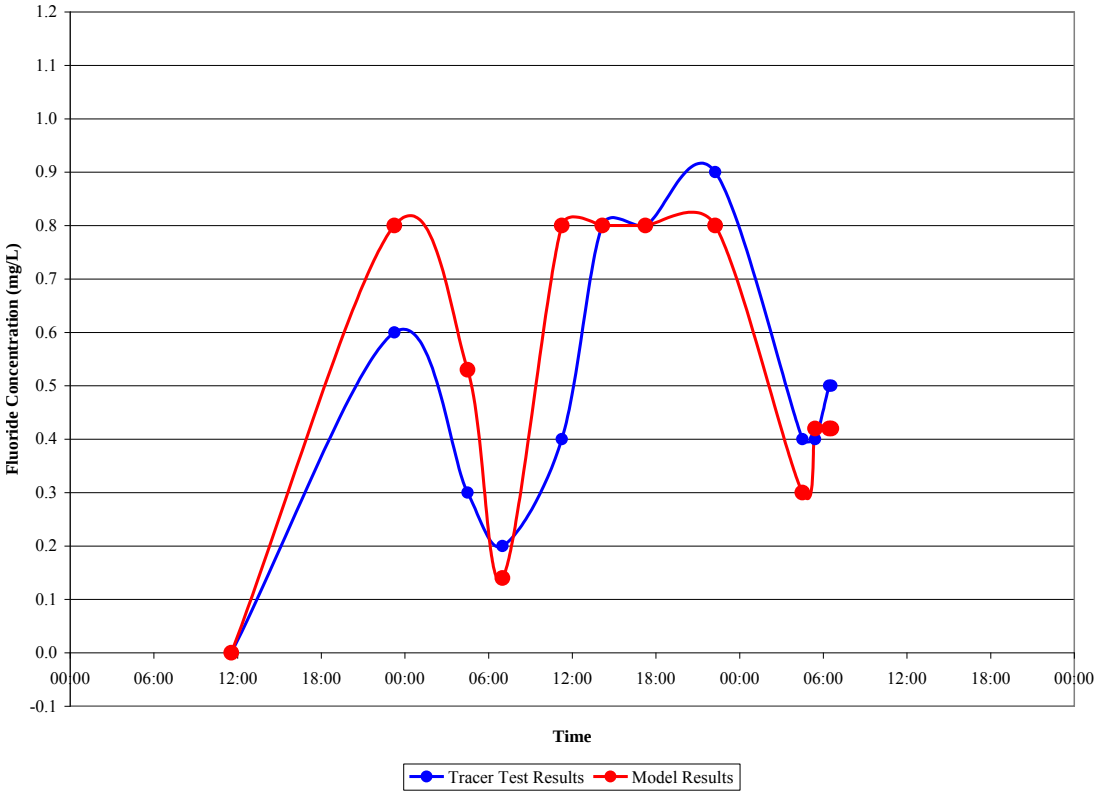
- 14 Total Test Sites
  - ✓ Good Match – 10
  - ✗ Doesn't Match Well – 4

73% Model Results Matched Well

Tracer Modeling Showed Good Results for System Transmission Lines

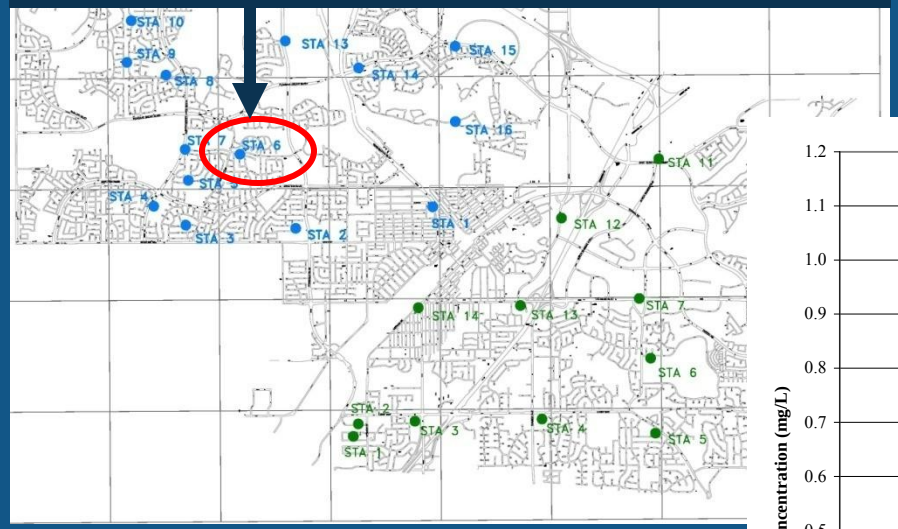
Circuit B
Sampling Station No. 1

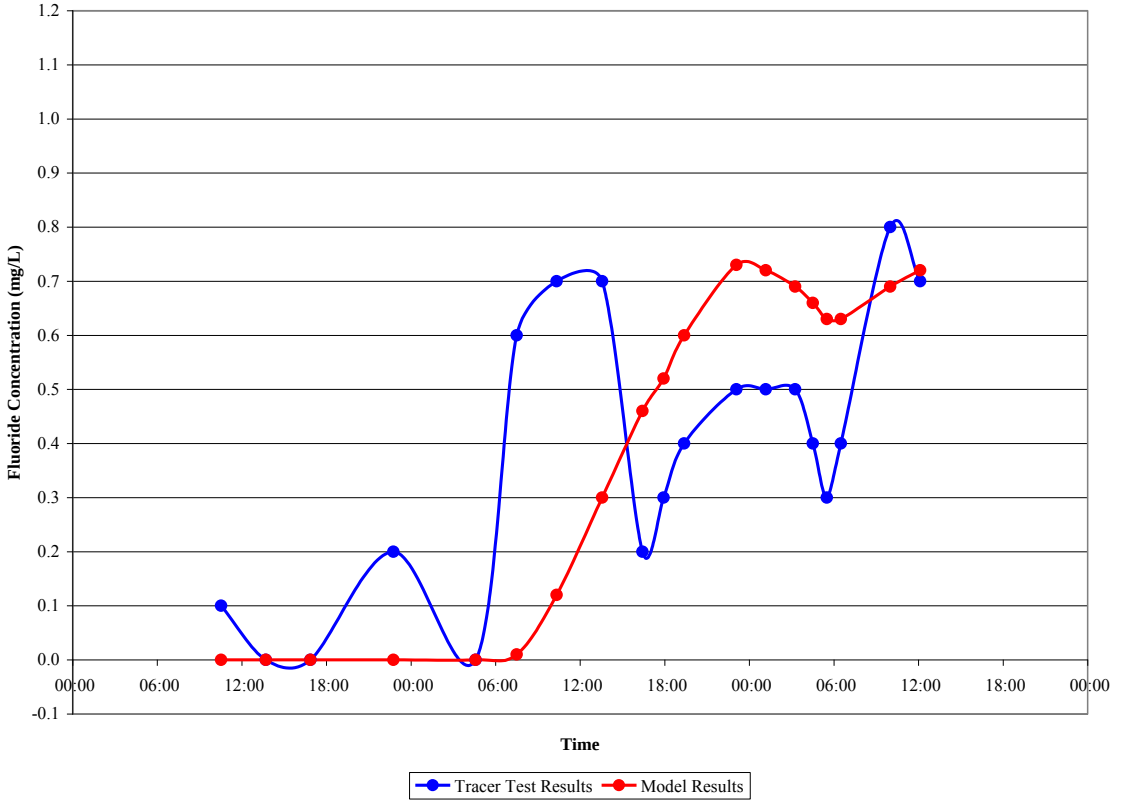




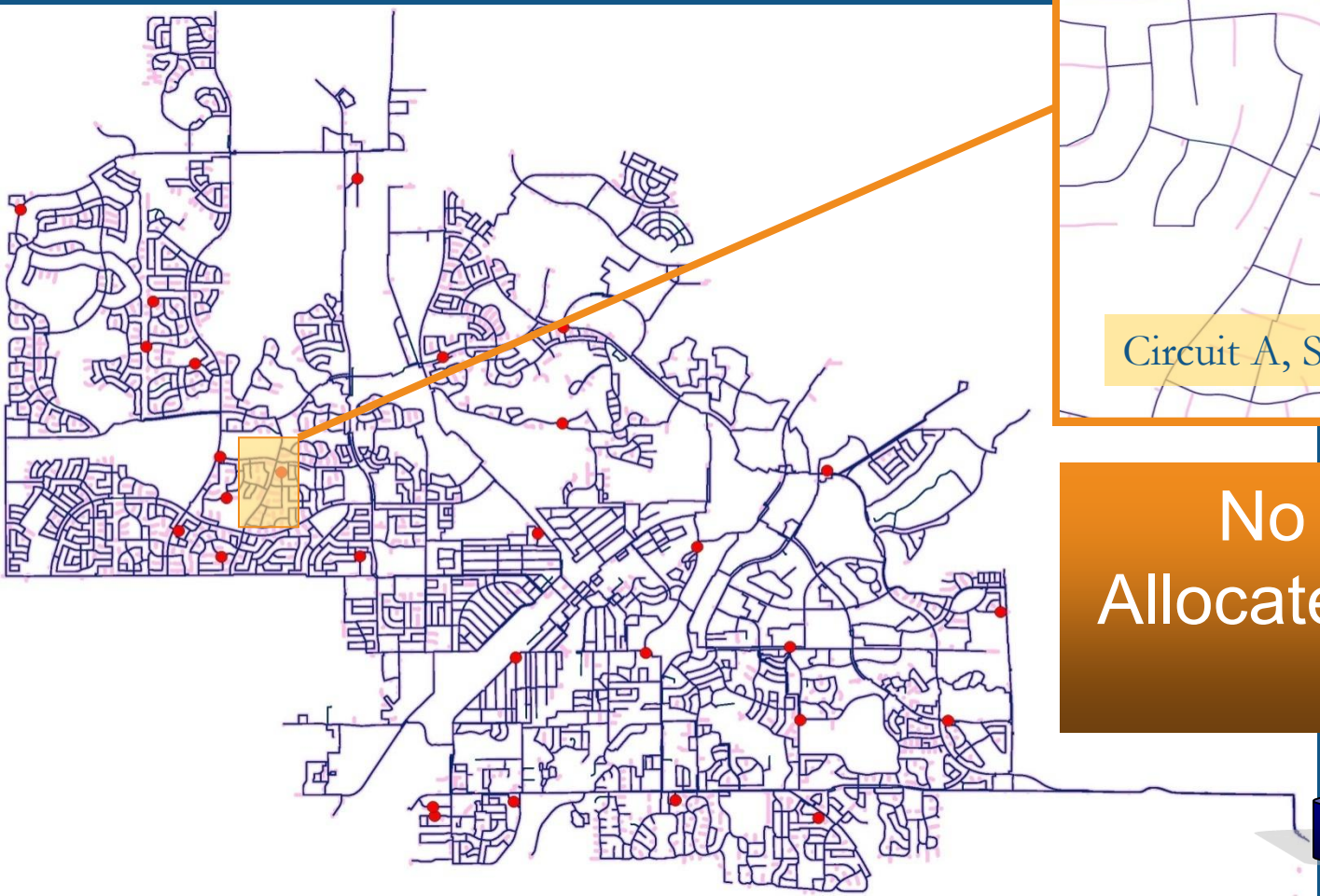
Model Results for Some Distribution Areas Didn't Match As Well

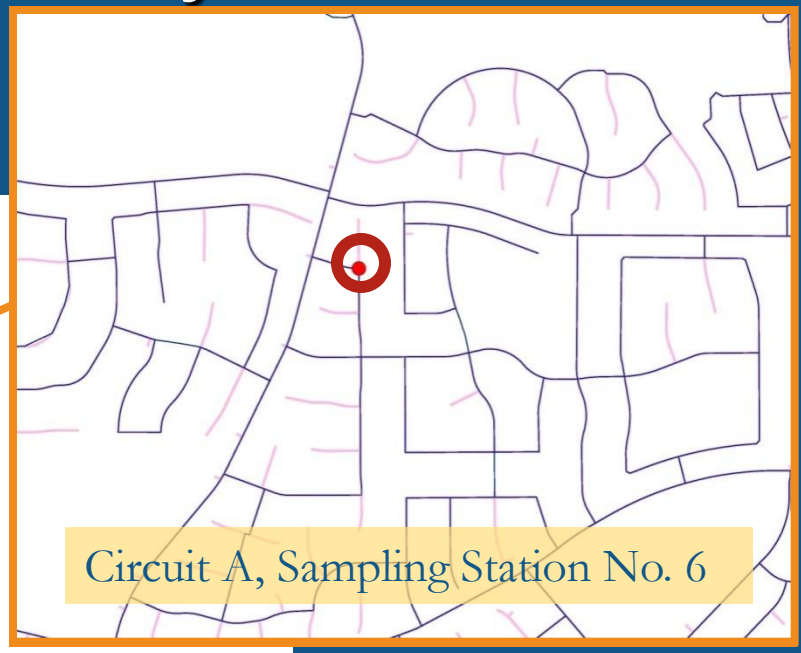
Circuit A
Sampling Station No. 6





Even Minor Skeletonization (Trimming) Can Affect Water Quality Model





No Demand Allocated; Trimming Node

WTP

Study Conclusions – Tracer Testing

- Careful planning pays off; the field collection went smoothly

- Internal staff coordination is important; planning by engineering and implementation by operations

- Mother Nature and logistical issues need to be factored into data collection

Study Conclusions – Model Calibration

- Tracer study excellent method for model calibration -- good way to validate model velocities and flows
- Even minor skeletonization (trimming) can impact results – best to include all pipes when possible
- For conservative tracer modeling, accurate demand allocation and diurnal curves are essential

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