ONE COMMUNITY ONE PURPOSE

> Going Deep: Lessons Learned from Thirty Years of Sewer I/I Analysis

Patrick Stevens ADS Environmental Services

April 20, 2023

AC23 CONFERENCE AND EXPO | APRIL 18-21

CONTACT HOUR INFORMATION

- » All session attendance will now be tracked through badge scanning.
- » To earn contact hours, your badge must be scanned upon entering the session room.
- » The full session must be attended to receive contact hour(s).
- » One (1) contact hour will be issued per 50- minute session attended.



Agenda

- » Brass Ring in this Business is Pre- and Post-Rehabilitation
- » Scattergraph almost universally adopted for QC and for Hydraulic understanding
- » Results affected by Basin Size, Rainfall Strategy and Depth Technology
- » Methods of normalizing I/I
- » Control Basins work better that Q vs i plots for post-rehab analysis
- » Peak vs Volumetric analysis. Q = C x i x A is becoming round peg in a square hole.
- » Differences in I/I Practice in Canadian and U.S.
- » Rainfall DDF vs IDF



Fates of Sewer RDII Reduction Projects



(A) BEWAWA

Capture Coefficient vs. Basin Size Model Basins and RDII Basins





Relationship between Basin Size and Effectiveness



() BOWINA

With small basins 80% of RDII comes from 20% of the system.

Percent of System (LF) Producing 80% of RDII Volume as Function of Meter Basin Size



Findings from Phase I



Findings from Phase II – Smaller Basins

Thornton Academy 24 gpd/LF/Inch

Bear Brook 20 gpd/LF/Inch



Laying out meters for an RDII study The 10/20 Rule

- 1. Select a Basin Size, e.g., 10,000 LF
- 2. Consider a sewer network as a tree with leaves, branches, limbs and a trunk
- 3. Place meters on the 'leaves' creating sewersheds of 10,000 LF and no subtractions.
- 4. Place meters downstream on the branches and limbs creating sewersheds of 10,000 LF or a Net subtraction of NO LESS than 20%.
- 5. Meters do two things: Flow and Hydraulic Capacity. When considering a meter location, place upstream of a junction, a turning manhole, a siphon or a RR/Highway crossing.
- 6. Identify a likely Control Basin
- 7. If using GIS, place meters on sewer line, not a manhole.

Placing Meters Upstream of Likely Restrictions Determines Operational Capacity



(A) BCMANA

Scattergraphs Universally Accepted as Tool for QA/QC and Hydraulic Understanding

ADS ENVIRONMENTAL Scattergraph Principles and Practice

Sewer Sociology is a Offshoot of Flow Metering

Dry Day Diurnal Patterns



Land use affects the shape of the diurnal pattern

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Water Consumption in Edmonton During Olympic Gold Medal Hockey Game



Flushed with fame and fortune

Kevin L. Enfinger and Patrick L. Stevens

sew'er so-ci-ol'o-gy, the science of society, social institutions, and social relationships viewed through the eyes of a sewer; specifically, the systematic study of the development, structure, interaction, and collective sewer use of organized groups of human beings.

Most sewer flows are characterized by repeatable diurnal patterns that vary across weekdays, weekends, and holidays. Differences in land use also are apparent, and distractions and disruptions of daily life often can be observed.

> his month we have a little something for our music-loving fans and take a look at Justin Bieber in concert.

Teen sensation Justin Bieber cruised into suburban Detroit on Aug. 15, 2010. He performed at the Palace of Auburn Hills in front of a sellout crowd of 15,667. The concert was part of his debut tour *My World*, promoting his studio albums *My World* and *My World* 2.0.

Although no sewer sociologists attended this concert, a sewer flow monitor was located conveniently downstream from the venue. The figure shows a composite hydrograph that chronicles the concert through the eyes of a sewer. The concert began at 7 p.m., and sewer flows peaked just before it began.

According to *Billboard* magazine, the concert generated \$702,008 in gross receipts. According to the flow monitor, the concert also contributed 628,310 L (166,000 gal) of wastewater. Based on the reported attendance, this results in a sewer use rate of 40.1 L (10.6 gal) per concertgoer.

Kevin L. Enfinger is a region engineer, and Patrick L. Stevens is vice president of engineering at ADS Environmental Services, a division of ADS LLC (Huntsville, Ala.).



Sewer use from Justin Bieber concert



Certificate of Achievement



For

Meriturdius Service

Presented To

Your Name Here

Be it known that the aforementioned is hereby acknowledged for outstanding contributions to the advancement of sewer sociology and is hereby conferred membership in the American Society of Sewer Sociologists with all rights and privileges thereunto appertaining. In testimony whereof witness the signatures of the Founding Fathers of Sewer Sociology this 12th day of October 2011.

Member No. ASSS-052

Ken L. Enfe

Kevin L. Enfinger, P.E. President



1 Steven

Patrick L. Stevens, P.E. Vice President

Technology used to measure depth in a flow meter makes big difference in RDII analysis. Pressure Transducer are subject to drift.

A large RDII metering project will experience the following Accuracy ranges:

- 30% of meters have accuracy of greater than 20%
- 40% of meters have accuracy of between 20% and 50%
- 30% of meters have accuracy of greater than 50%

A meter with no pressure sensor drift - good Q vs. i



(C) BCW/WA

A meter with large pressure sensor drift - poor Q vs. i



Q vs i - U008 Total Event Net RDII Volume vs. Rainfall Depth

Q vs i plot resulting from poor data is indistinguishable from plot with varying RDII Response



Why Normalizing RDII by Inch-Diameter/Mile Is Not Proper

Four Rainfall-to-RDII Relationships

- 1. Peak Rainfall vs Peak RDII
- 2. Rainfall volume contributing to Peak RDII vs Peak RDII
- 3. Rainfall volume vs RDII volume in first 24 hours
- 4. Rainfall volume vs RDII volume in total event

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Q = C*i*A

- The Rational Method is a Rate-to-Rate relationship
- Has been the core of hydrology for 150 years.
- Works great for watersheds and sewersheds in which rainwater purposefully finds it way to the outlet.
- Rainwater entering a sanitary sewer is not purposeful, but accidental and the Rate-to-Rate relationship is poor.

The Initial Q vs. i of Full Season of Rainfall and Flow Data.

Grouping into Growing (Summer) and Dormant (Winter) Seasons

Pre- and Post-Rehab analysis relies on comparing seasons.

Variation in Responses due to Variation in rainfall is often greater than magnitude of RDII reduction

Control Basins Eliminate Variation due to Rainfall.

Differences in Canadian and US I/I Practice

- » RDII is calculated in Gross Basins not Net Basins
- » Appears to be due to years of experience with meters using pressure transducers as Primary Depth Measurement.
- » Analysis leans toward a Peak-to-Peak basis vs. a Volumetric basis
- » May be due to discipline established by the US Environmental Protection Agency (EPA) in 1975.
- » Preference for viewing storm statistics in IDF form vs. DDF.

Difference between IDF and DDF displays

IDF Graph FACT Rain Gauge in Factoria Nov 13, Nov 28, Dec 15 & Jan 6

