OneRain
The Rainfall Company
Fall 2006
CONTRAILS

Louisville MSD

Real-time Control System

Louisville/Jefferson County Metropolitan Sewer District (MSD) currently maintains approximately 3,100 miles of separate and combined sewers, serving a population of about 700,000 throughout the 385 square miles of Jefferson County. This includes 6 regional wastewater treatment plants, 19 small treatment plants and roughly 300 pumping stations.

The Morris Forman Wastewater Treatment Plant (MFWTP) is the oldest and largest wastewater treatment plant in the Louisville MSD service area. It has a treatment design capacity of 120 million gallons per day and a wet weather capacity of 350 million gallons per day. The collection system serves approximately 500,000 people with 2,500 miles of pipe. The combined sewer area encompasses 25,000 acres, which is about one-third of the MFWTP service area, and serves approximately 324,000 people with 670 miles of combined sewer.

The Louisville combined sewer system has two unique characteristics that lend themselves to the successful application of real-time control (RTC). The first is the size of the interceptors in the system and the second is the interconnectivity of the system. There are two locations where the separate sanitary sewers enter the combined system where flow can be diverted.

LOUISVILLE'S RTC STRATEGY

The purpose of RTC is to use sewer system capacity more effectively. Maximum efficiency and applicability have been demonstrated by the use of RTC, and control decisions are based on observed conditions, prediction data and system-wide analyses. The Louisville MSD strategy to reduce combined sewer overflow (CSO) discharges using RTC is designed to:

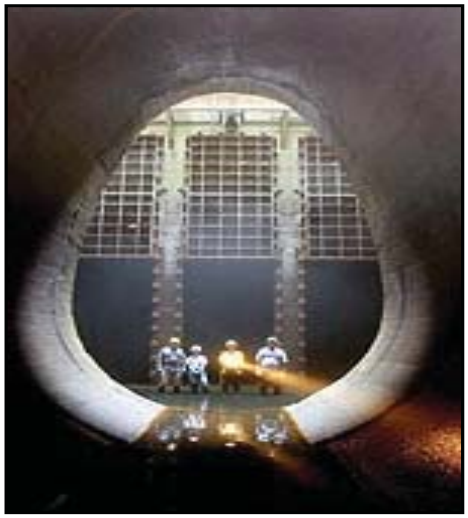
- Reduce the frequency of CSO discharges and increase the size of wet weather event that will cause CSO discharges;
- Minimize the CSO average annual overflow volume;
- Maximize the collection system conveyance capacity;
- Optimize in-line storage potential.

The RTC feasibility analyses completed in 2001 projected a system-wide 20% increase in capture for treatment. The total cost of the RTC component of the CSO long term control plan, including the RTC system, five additional storage basins and other complementary interventions, is now estimated at $83,000,000.

THE RTC TECHNOLOGY TOOLBOX

Louisville's RTC system is made up of several sub-systems. They include:

- A central supervision and control station, located at the MFWTP, includes:
  - A Human Machine Interface for system supervision and operator remote control;
  - Csoft, a global optimal decision support system;
  - A radar rainfall based evaluation and prediction system.
- A cellular-based telemetry system
- Remote local stations within the collection system.



Southwestern Outfall Sluice Gate Chamber

Each RTC sub-system is designed and configured to achieve the level of performance expected during normal and abnormal operating conditions. Particular attention is dedicated to the configuration of robust, reliable and adaptive software and hardware tools. This allows MSD to obtain a performing and safe control system under various situations. Proper responses have been defined and planned for in case of failure of any component.

As stipulated in Louisville's Wet Weather Consent Decree, Phase I was completed, performance verified and operational on August 31, 2006. Phase II, as defined in Louisville's Interim CSO Long Term Control Plan, will be completed, performance verified and operational by December 31, 2008.

Inside This Issue

Standalone StormLink Rain Gage

StormLink™

Real-time Satellite Telemetry

A significant challenge for managers of real-time environmental monitoring networks is the reliable extraction of critical information from remote sites. To meet this challenge, OneRain developed the StormLink family of real-time satellite telemetry data products.

StormLink is designed for operation in remote locations. Sites are typically solar powered and packaged in vandal-resistant structures. There are two configurations: StormLink-equipped sensing sites and StormLink ALERT Concentrators. The latter collects data from multiple ALERT sites onto the real-time satellite channel. This adds redundancy to ALERT repeater networks and minimizes the risk of data loss.

Currently, there are dozens of StormLink sites operating in the field, reporting data from hundreds of sensors. StormLink is the solution for remote and high-value data collection.

Contrail® Web 2.2

Preview of Software Update

A new release of Contrail® Web, OneRain's Internet-based tool for visualizing rainfall data, is coming out this year. The new features in this release include:

- Graphing of up to six sensors on a single display
- Precipitation and stream flow summary views
- Access to reports as a user assignable privilege
- Access to acknowledge alarms as a user assignable privilege
- Integration with Google Earth

For an advanced view of these features, join OneRain's Rainfall Visualization webinar via the Internet on December 5 at 3:00 PM EST. See the "Upcoming Webinars" article for more details.

New Bookkeeper

Korene Supino, our Bookkeeper and HR Assistant since 2001, is getting married and has moved to Grand Junction. We wish her well and miss her dearly! Korene trained our new Bookkeeper, Brian Loflin, who comes to us from Watkins, Ludlam, Winter & Stennis, a large law firm in Jackson, Mississippi, where he was a financial analyst. Brian and his wife, Sandra, enjoy bicycling great distances and climbing, hiking and exercising. Colorado is going to be the perfect place for them!

Brian Loflin, new Bookkeeper on staff

DIADvisor™

Your Mission-critical Base Station

If rainfall data are critical to your mission, you need a base station. Now that there are many Internet-based tools available, some agencies may think they can eliminate their dedicated base station for collecting ALERT data. Contrail® Web, used with OneRain's real-time satellite StormLink™ ALERT Concentrator, doesn't require an ALERT base station to bring the data to you, so you might think you no longer need a dedicated platform with radios and decoders. I'm here to tell you this is a wrong thought.

ALERT is the ultimate mission-critical toolset. Although using Internet tools for normal life is cost-effective and enables us to work efficiently, it is a mistake to depend solely on regular telecomm and network facilities for life-safety information. In serious emergencies (e.g., rainstorms and floods) these facilities are often compromised.

The ALERT base station is your connection to rain and stream gages, regardless of other chaos going on at your agency. When the phones fail, the ALERT base station is still collecting data. Whether you use DIADvisor or another similar product, don't get rid of it. You will come back to DIADvisor for those emergencies when other applications fail. If you are using DIADvisor, OneRain keeps your DIADvisor in synch with Contrail Web, the most efficient way to see your data every day, and you get free, real-time backup of your DIADvisor data in OneRain's Harbor.

If you are using OneRain's StormLink™ ALERT Concentrator, you'll continue getting your data on Contrail even if your base station PC or hard drive fails. So for either type of failure, you're covered.

Take-home message: Don't even think about eliminating your base station – that's your insurance!

Upcoming Webinars

Join Us to Learn More

OneRain's webinars provide education, training and topical information on rainfall instrumentation, data collection and use. Topics for webinars are posted on www.onerain.com. Sessions are 60-90 minutes and can be attended from anywhere with Internet connection and a telephone. Webinars provide an opportunity for discussion among professionals dealing with rainfall and its consequences. Upcoming topics include:

- Radar Rainfall; Tuesday, November 14 at 1:00 PM EST. Provides details on current technologies for measuring rainfall, spatial and point data, quality control issues, sample applications and a preview of future directions for rainfall measurement.
- Rainfall Visualization via the Internet; Tuesday, December 5 at 3:00 PM EST. Provides an overview of rainfall visualization via the Internet including GIS, graphing, alarming and decision support.

For more details or to sign up, call OneRain at 888.758.rain or email information@onerain.com.

Measuring Rainfall

Difficulty a Reality

It's a challenge to measure rainfall. The goal is to know how much rainfall makes it to the ground and where it fell. Short of spreading a blue tarpaulin over the area of interest, there isn't any direct way to know this. Everything we do is a guess about the "blue tarp" truth.

Rain gages and radar are used together to get the best answer. For each radar pixel with a rain gage, the gage acts as "ground truth" and is used to calibrate the radar pixels between rain gages. Each data source compensates for weaknesses in the other. However, we have way too few rain gages and the spatial resolution of radar is still way too coarse.

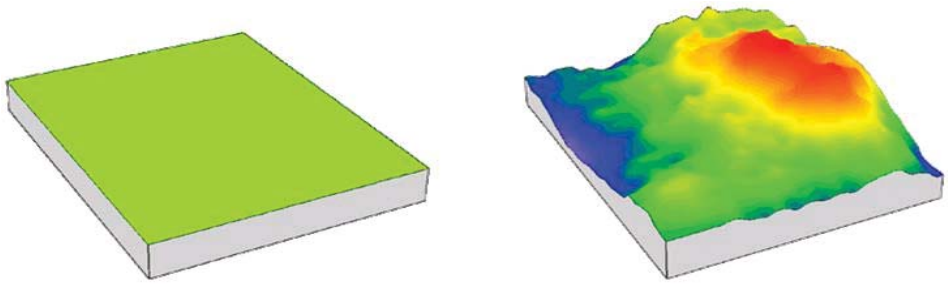


Figure 1: Averaged (left) and Actual (right) Radar Rainfall Pixels

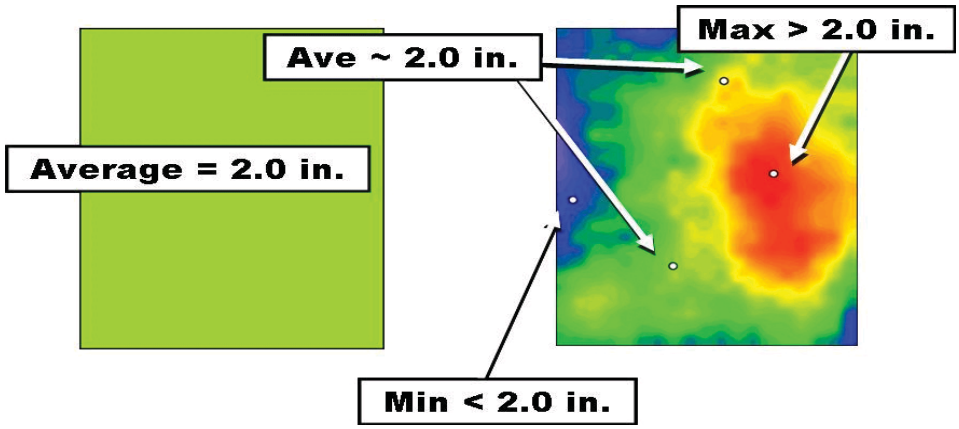


Figure 2: Rain Gages in Radar Pixels

Figure 1 illustrates the problem for radar: The pixel on the left represents the averaged rainfall number we receive from a real-world area on the right. Clearly the average on the left is not correct for many places in the real world; some areas in the "real" pixel got less rainfall than average and some got significantly more. We know that rainfall is extremely inhomogeneous, so this situation is the rule not the exception.

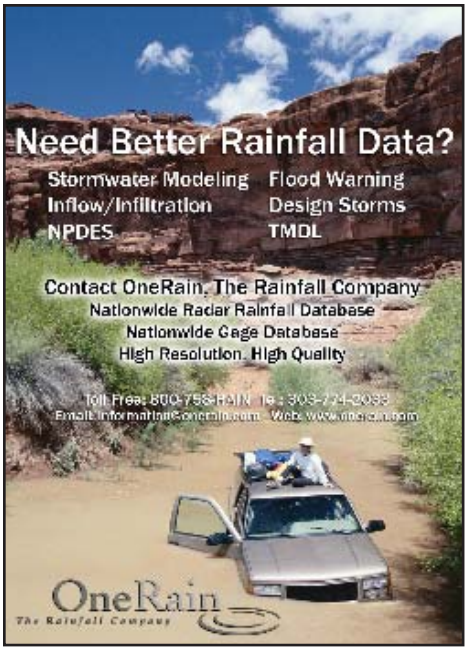
Figure 2 shows some rainfall accumulations for rain gages planted in the real world (right side). If this is a real 2-km or even 1-km square area, the chances of being able to have four rain gages in that area are small; most likely there are many more radar pixels than we have gages. This illustration shows how inadequate the methods we can afford to use are in reflecting real rainfall.

Nevertheless, using good-quality rain gage data and clean, uncluttered radar reflectivity data as a starting place maximizes our ability to know what rainfall really fell across a specific area. OneRain focuses on delivering high quality rainfall estimates using the following methods:

- optimizing and tracking maintenance practices and rain gage network performance;
- throwing out missing or invalid rain gage data;
- correcting radar for clutter, hybrid scan discontinuities and other noise sources.

Once these are done, the gage data are used to calibrate the radar reflectivity and transform it to rainfall that likely reached the ground. After going through a variety of radar, rain gage and common sense-based QA/QC procedures we can be satisfied we have created the best estimate possible for actual rainfall accumulation.

And when we're done, we'll still be wrong to some degree and we won't know how wrong. One challenge going forward is to find different ways to validate our estimates. It may be that space-based remote sensing will help in the future. Runoff models can also be "run backwards" to use observed flow to arrive at the rainfall estimates. These are potential methods that OneRain will explore in our continued effort to improve rainfall information.



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