***Contained below is a report which outlines key milestones and outcomes to reduce Combined Sewer Overflows for the City of Bowling Green's Water Pollution Control Facility.***

## Executive Summary

The City of Bowling Green has made significant progress in mitigating CSOs since 2007. Specifically, the City has modified its operating procedures and has also increased the Water Pollution Control Facility's capacity. These improvements and their outcomes are detailed in this report and summarized in the following table.

| Milestone | Improvement | Outcome |
|---|---|---|
| **December 2007** | Modified WPCF standard operating procedures to maximize treatment capacity | Increased WPCF peak capacity from 16 to 21 MGD |
| **May 2009** | Replaced original sand filters with Aqua-Aerobics cloth media disk-type filters | Increased WPCF filtration capacity from 12 MGD to 30+ MGD |
| **May 2009** | Replaced 24-inch in-pipe influent meter with a 30-inch Doppler meter, decreasing hydraulic restrictions in the force main from the Poe Road pumping station to the WPCF | Increased WPCF peak capacity from 21 to 23 MGD |
| **April 2010** | Installed new ultraviolet (UV) disinfection system | Increased WPCF disinfection capacity from 14 MGD to 30+ MGD |
| **December 2012** | Replaced the (4) 8 MGD pumps at the Poe / Mercer pumping station with (4) 10 MGD pumps | Increased flows from the pumping station from 23 MGD to 30 MGD |

In addition to items listed in the above table, the City has taken a number of other actions to reduce the volume and flow rate of stormwater entering its collection system, including construction of the South Maple Street Stormwater Retention Project, designed to remove flows of up to one MGD from the combined sewer system following rainfall events.

In 2009, the City engaged Dr. C. Gibson Chen of Avetin Engineering, Ltd., to conduct a typical rainfall analysis and to study the correlation between typical local rainfall and CSO events. Based on the results of this study, Dr. Chen concluded that the City meets the national CSO policy requirements under typical year conditions. These study results were shared with Ohio Environmental Protection Agency staff on December 8, 2009.

## Characterization of Increased Capacity of the Water Pollution Control Facility

From the time it began operations in 1982 until late November 2007, the Bowling Green WPCF typically operated at a 16 MGD maximum flow rate during wet weather conditions. In December 2007 standard operating procedures for wet weather operation were modified. The changes consisted of running the Poe Road pumping station at maximum capacity and treating the first flush rather than limiting pumping rates to 16 MGD and capturing the first flush.. This change required that all (4) 8 MGD pumps be running, while the design was for a maximum of 3 pumps to be run at any given time. The Storm Water Overflow Holding Basin is now utilized only when flow exceeds the pumping station's capacity. With these changes, average treated wet weather flows increased from 16 MGD to approximately 21 MGD.

During a January 25, 2008, meeting to discuss the City's proposed Comprehensive Wastewater Strategy at the Northwest District Office, with representatives from Central Office present by conference call, Ohio EPA representatives suggested that increasing the WPCF's capacity to 30 MGD should limit CSOs to four or fewer annually during a typical year. Following this meeting, a modified NPDES Permit was issued that required the City to increase its WPCF filtration and UV disinfection system capacity to effectively treat 30 MGD.

In response, in May 2009, the City replaced the WPCF's original 1982 vintage Hydro-Clear sand filters with Aqua-Aerobics cloth media disk-type filters and replaced a 24-inch in-pipe influent meter with a 30-inch Doppler meter.

Over more than 25 years of operation, the plant's Hydro-Clear sand filters had become irreparable and inefficient, capable of handling maximum flows of approximately 14 MGD for short durations only, due to plugging and excessive backwashing—resulting in filter bypasses during most wet weather events. The Aqua-Aerobics cloth media disk-type filters are capable of treating 30 MGD with one unit out of service. Aqua-Aerobics' guaranteed performance criteria are to treat 30 MGD with pre-filter total suspended solids (TSS) of 20 mg/l while achieving effluent TSS of 12 mg/l. The City's average effluent TSS since the filters were placed in operation is <4.0 mg/l, significantly below the performance standard requirements. This project has allowed the City to fully treat greater flows while producing a higher-quality effluent.

The 24-inch in-pipe influent meter was replaced due to the hydraulic restriction it created in the force main that connects the Poe Road pumping station to the WPCF. This 30-inch force main was reduced to 24 inches at the WPCF to accommodate the meter, and then increased to 30 inches before connecting to the first treatment process. This hydraulic restriction (higher head loss) reduced Poe Road pump station's transfer capacity. The meter was replaced with a 30-inch spool piece and a Doppler meter (out of pipe configuration), eliminating the 24-inch flow restriction. Removal of the metering flow restriction increased the Poe Road pump station's capacity approximately 2 MGD to 23 MGD.

In April 2010, the WPCF's UV disinfection system was replaced. The original UV disinfection system was designed for 16 MGD but due to hydraulic limitations was only capable of effectively treating 14 MGD. During wet weather events, flow exceeding 14

MGD bypassed the disinfection process. The new Trojan 3000 plus series UV disinfection system features two channels with two banks per channel and 64 UV lamps per bank. The operation is fully automated and allows effective disinfection from the lowest flow rates up to the system's rated 30 MGD capacity.

In December of 2012, the pumping capacity of the Poe / Mercer Rd. pumping station (the main pumping station to the WPCF) was increased to 30 MGD. The increased capacity was realized by replacing all (4) of the original (1982) pumps with (4) 10 MGD which allows for 30 MGD pumping with 1 pump out of service for redundancy. In addition the WPC installed an additional screw pump at the plant proper to ensure that with the new flow rates coming to the plant, it could get the flows through the plant if one of the screw pumps were to be out of service.

Exhibits 1 through 15 below, demonstrate how the City's new operating procedures and WCPF upgrades have effectively increased treated volume while fully treating increased flows.

**Exhibit 1** (Credit: C. Gibson Chen Ph.D., P.E.)

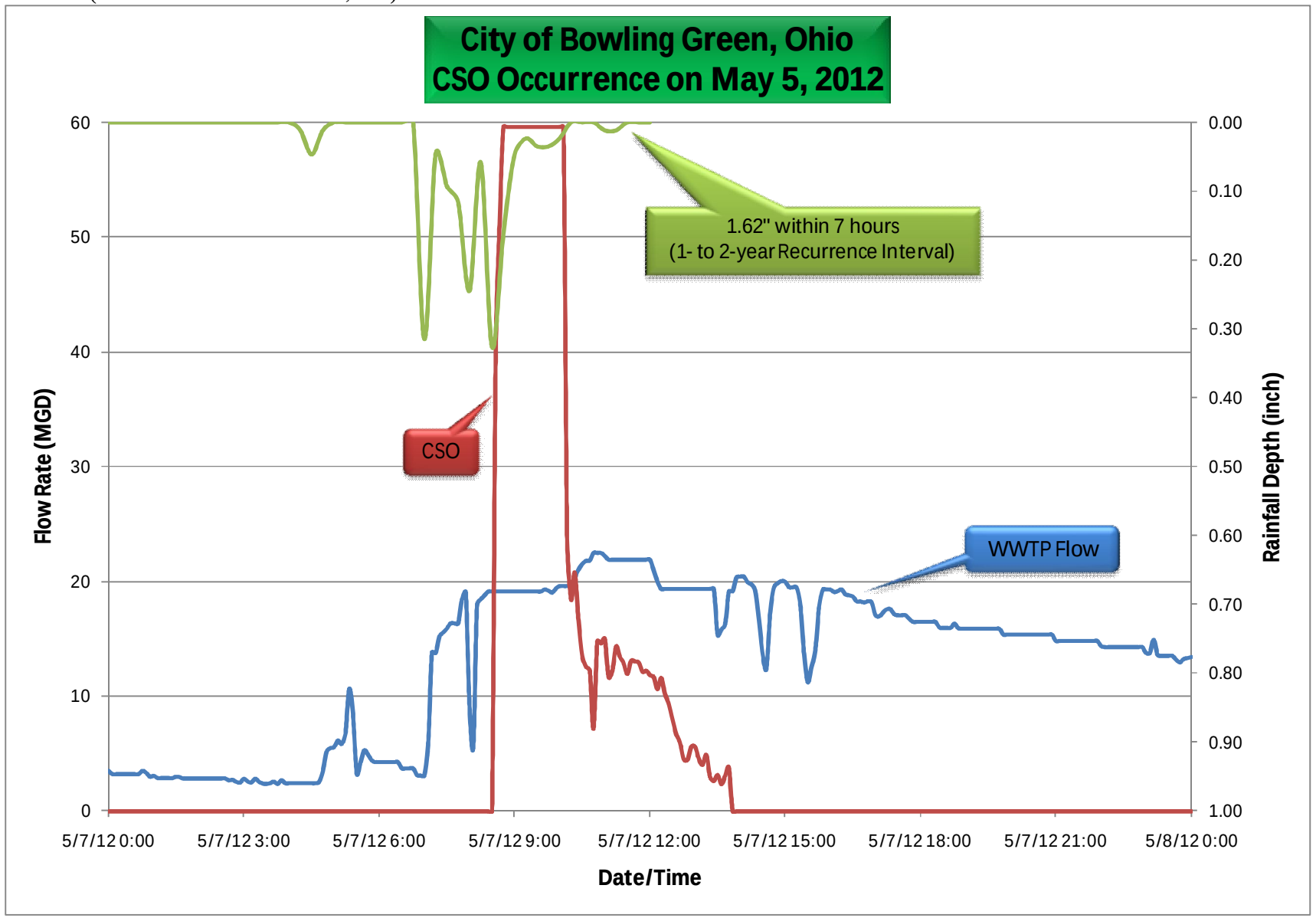


**Exhibit 2** (Credit: C. Gibson Chen Ph.D., P.E.)

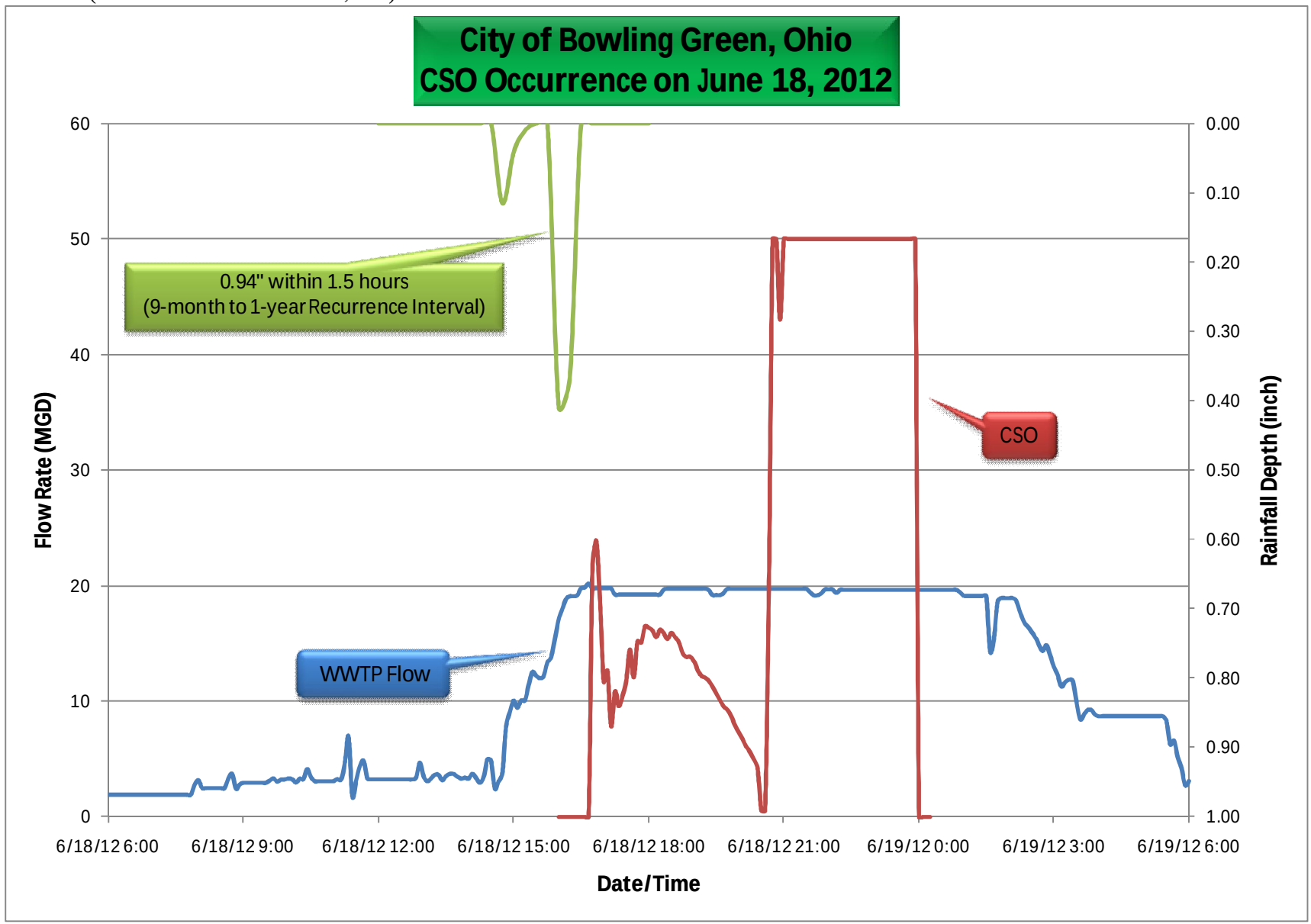


**Exhibit 3** (Credit: C. Gibson Chen Ph.D., P.E.)

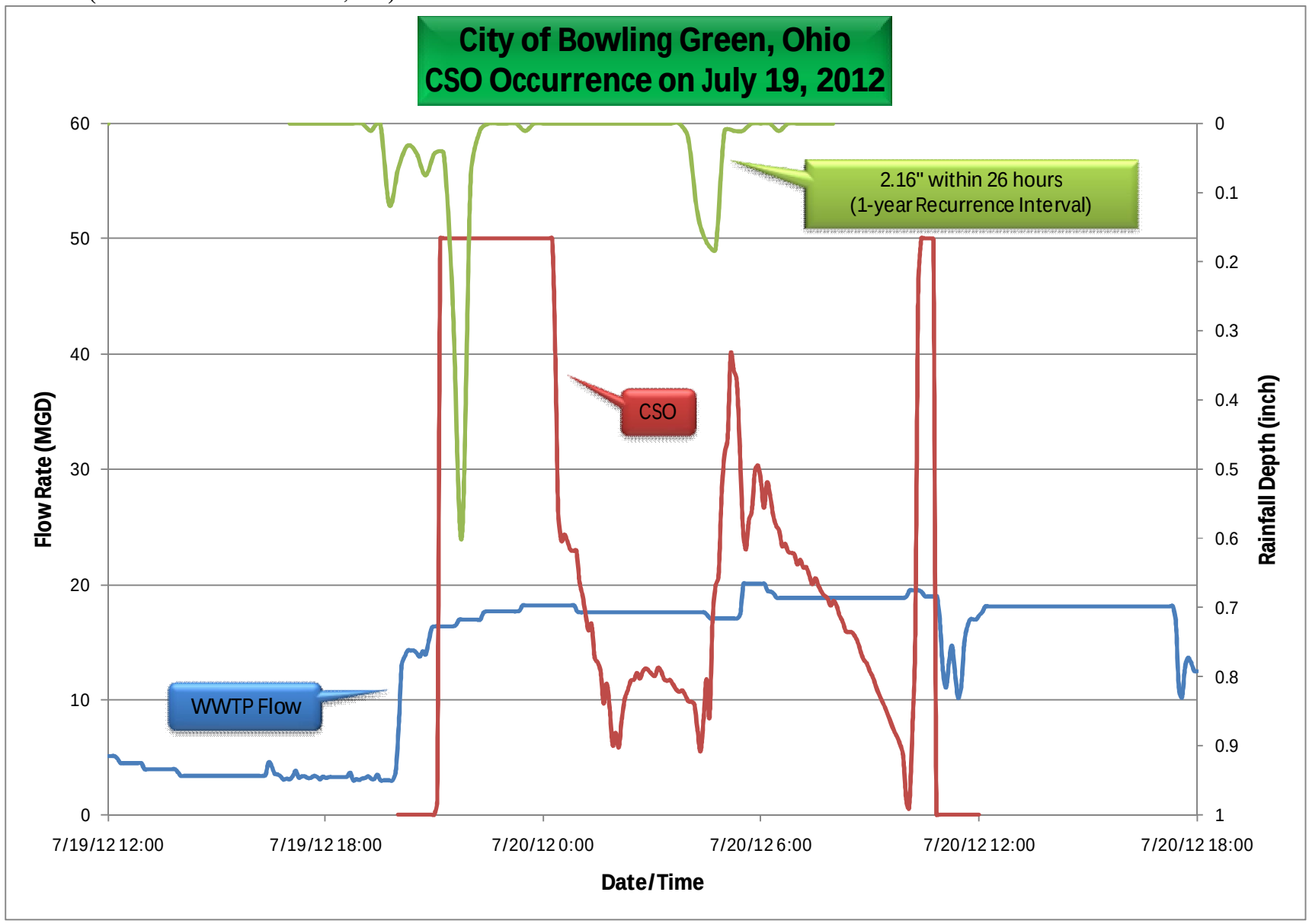


**Exhibit 4** (Credit: C. Gibson Chen Ph.D., P.E.)

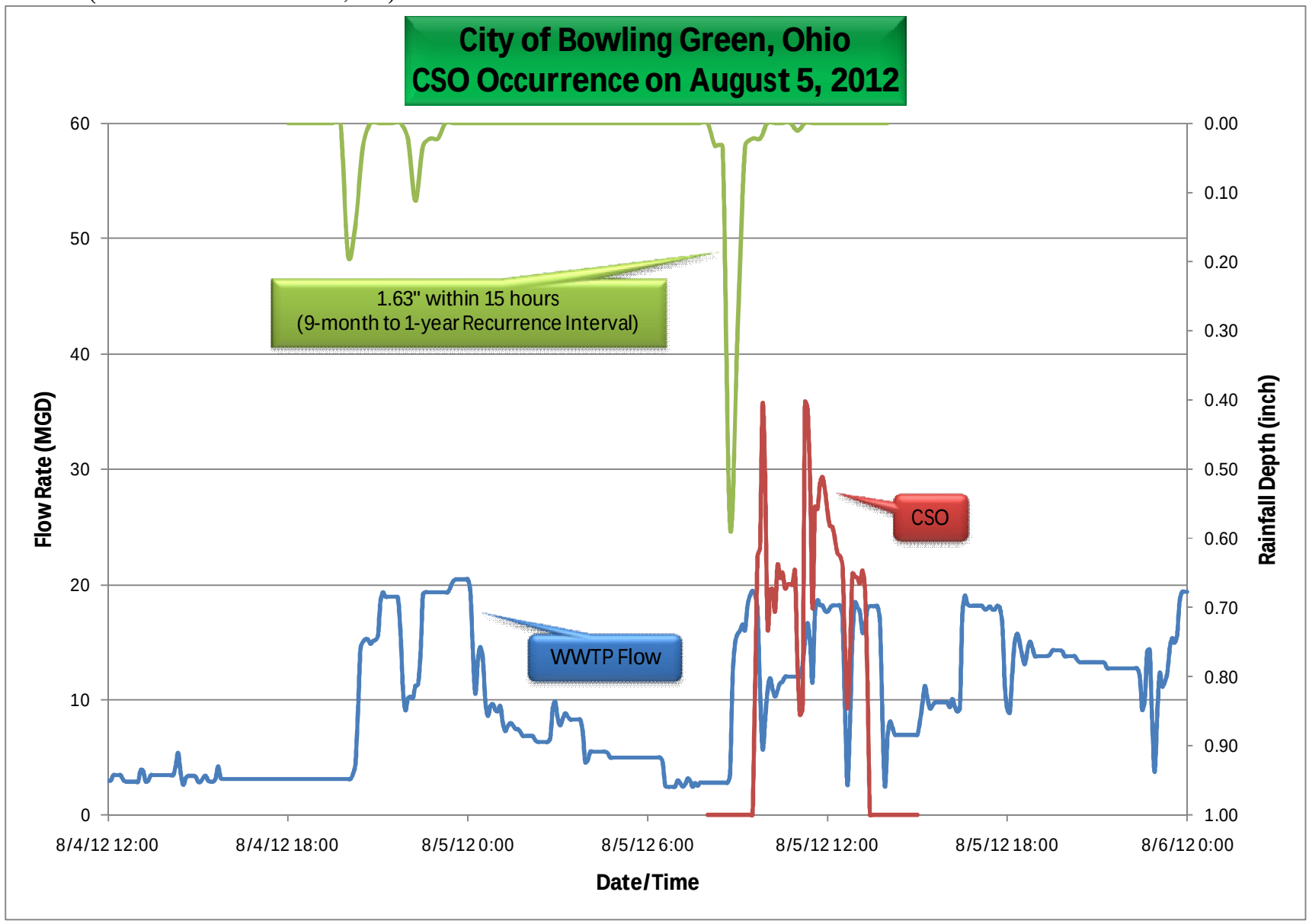


**Exhibit 5** (Credit: C. Gibson Chen Ph.D., P.E.)

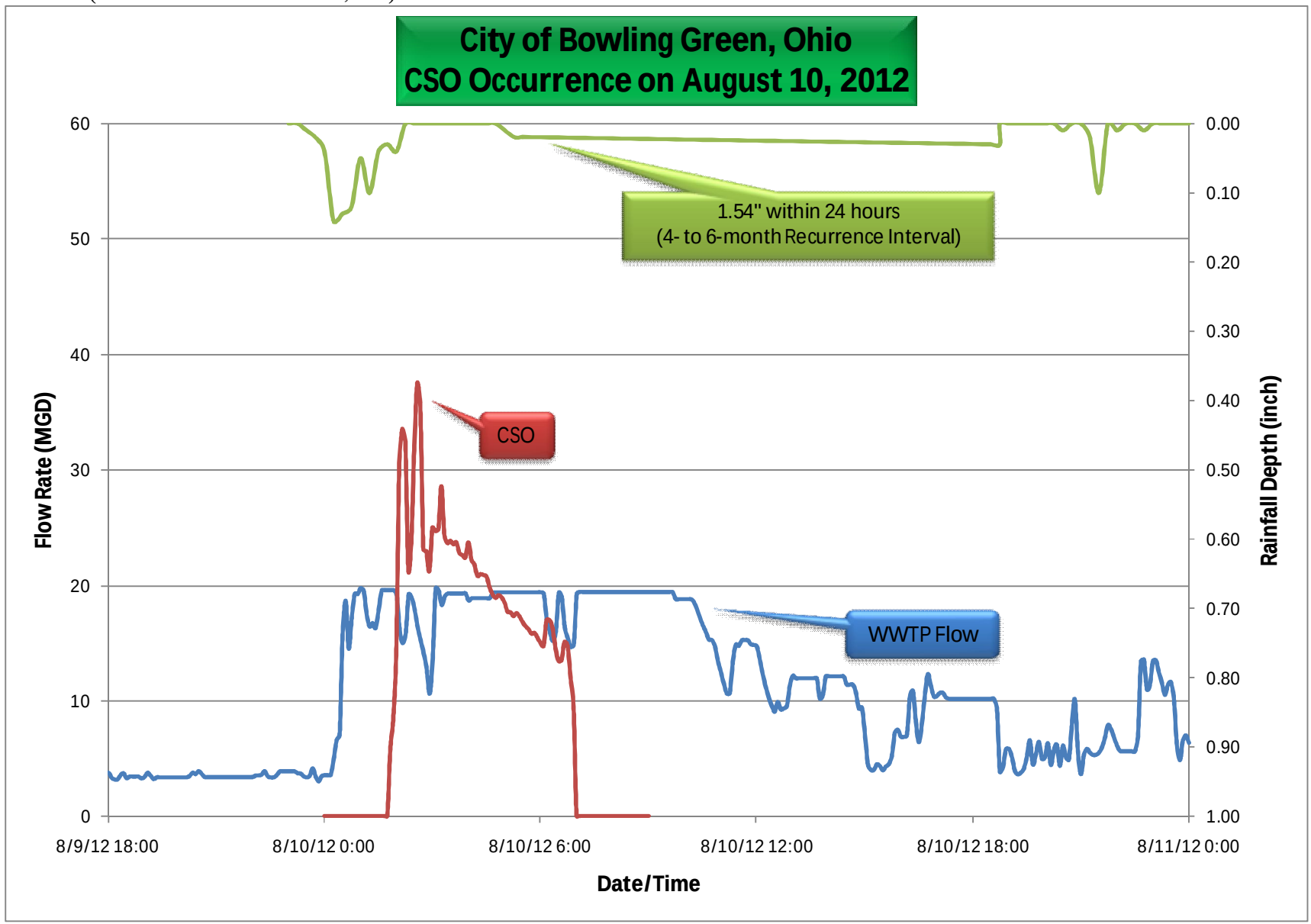


**Exhibit 6** (Credit: C. Gibson Chen Ph.D., P.E.)

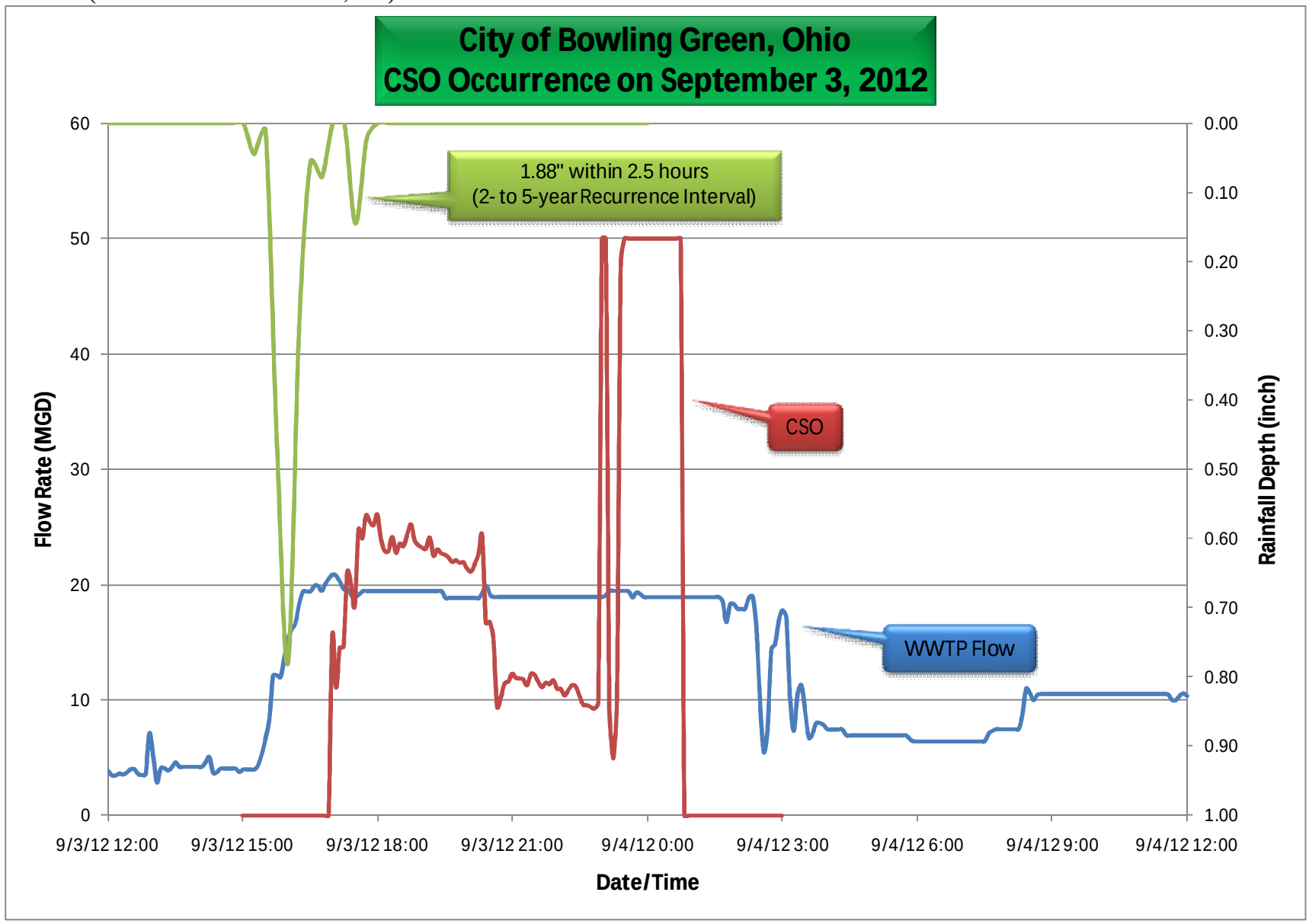


**Exhibit 7** (Credit: C. Gibson Chen Ph.D., P.E.)

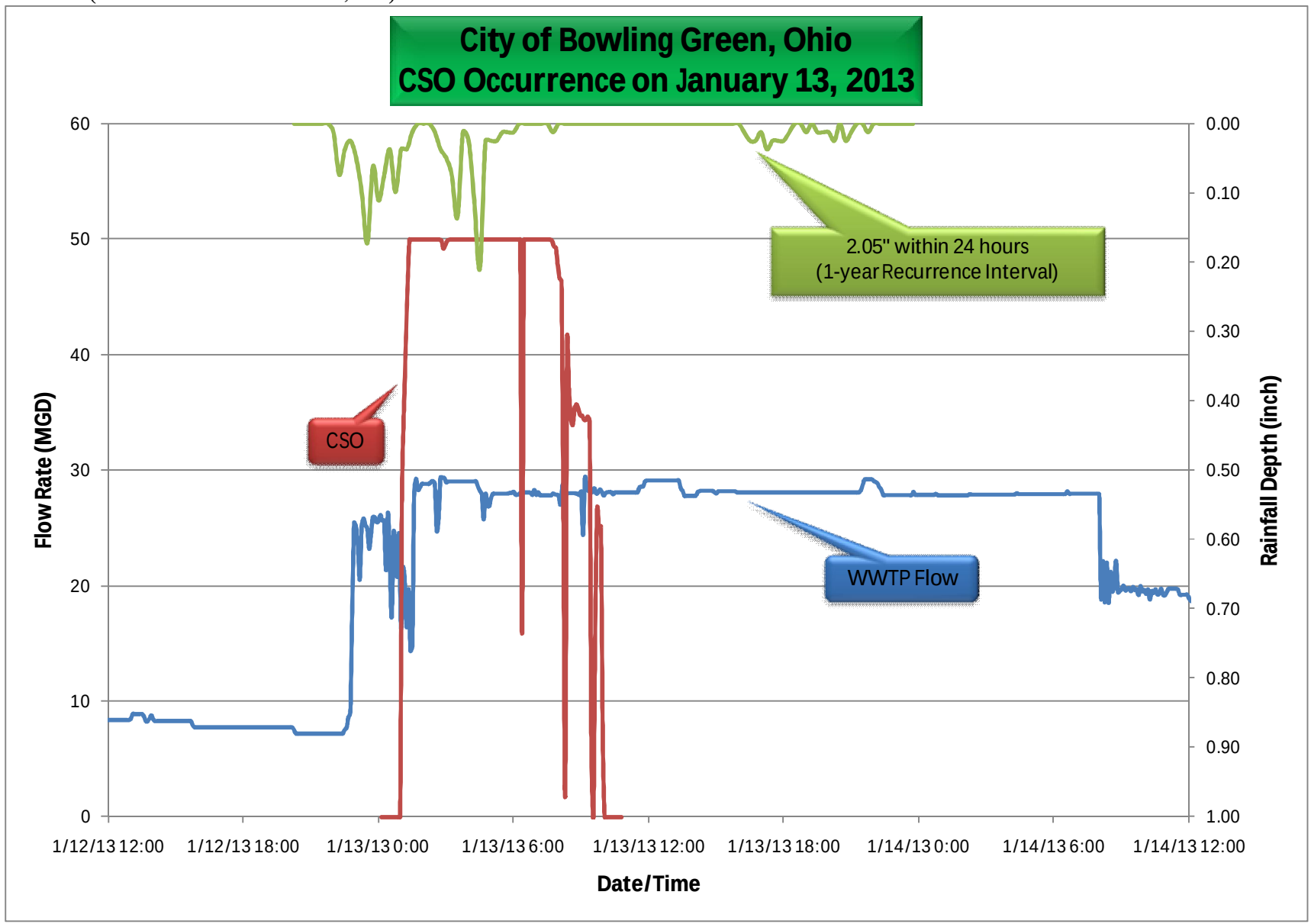


**Exhibit 8** (Credit: C. Gibson Chen Ph.D., P.E.)

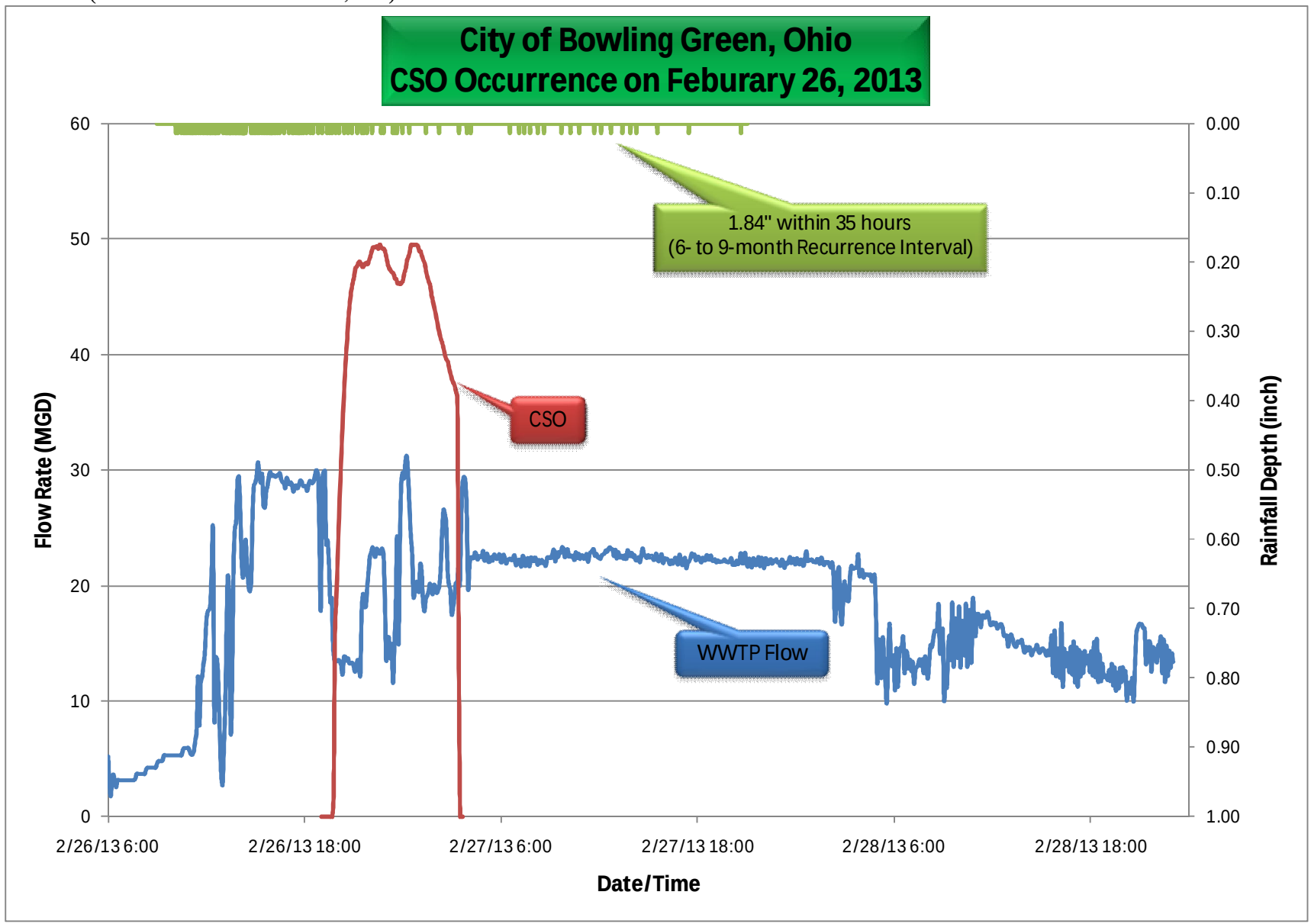


**Exhibit 9** (Credit: C. Gibson Chen Ph.D., P.E.)

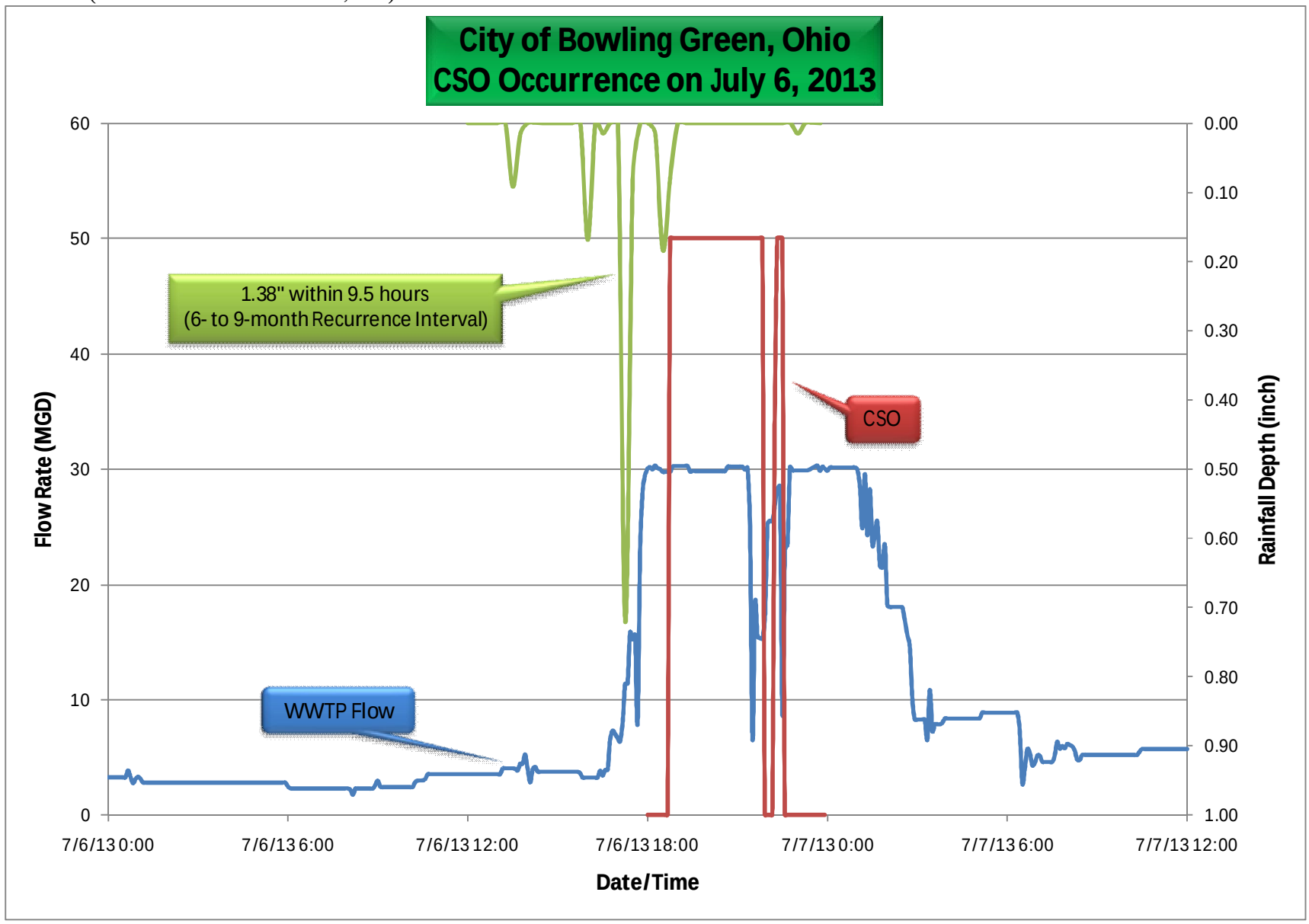


**Exhibit 10** (Credit: C. Gibson Chen Ph.D., P.E.)

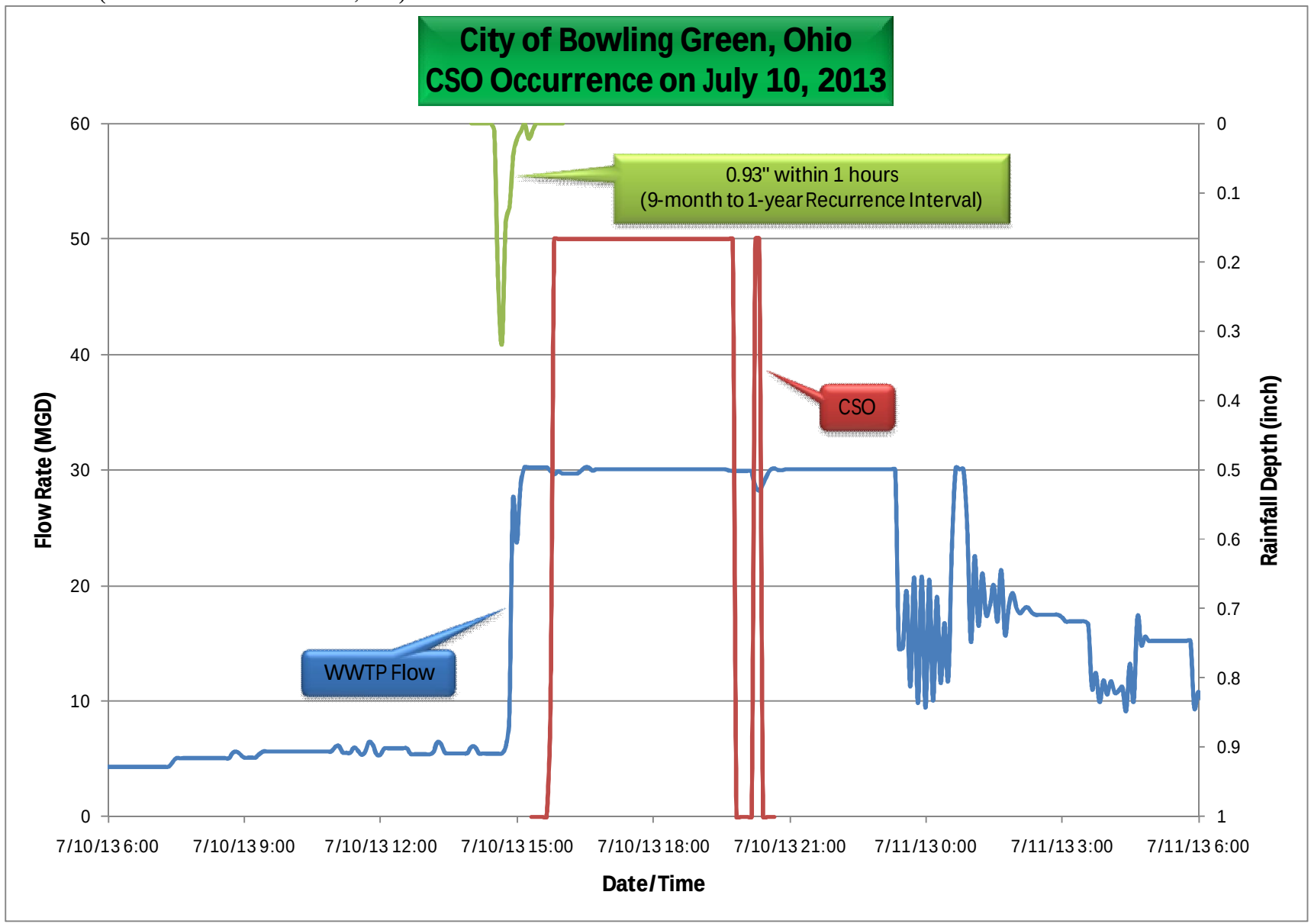


**Exhibit 11** (Credit: C. Gibson Chen Ph.D., P.E.)

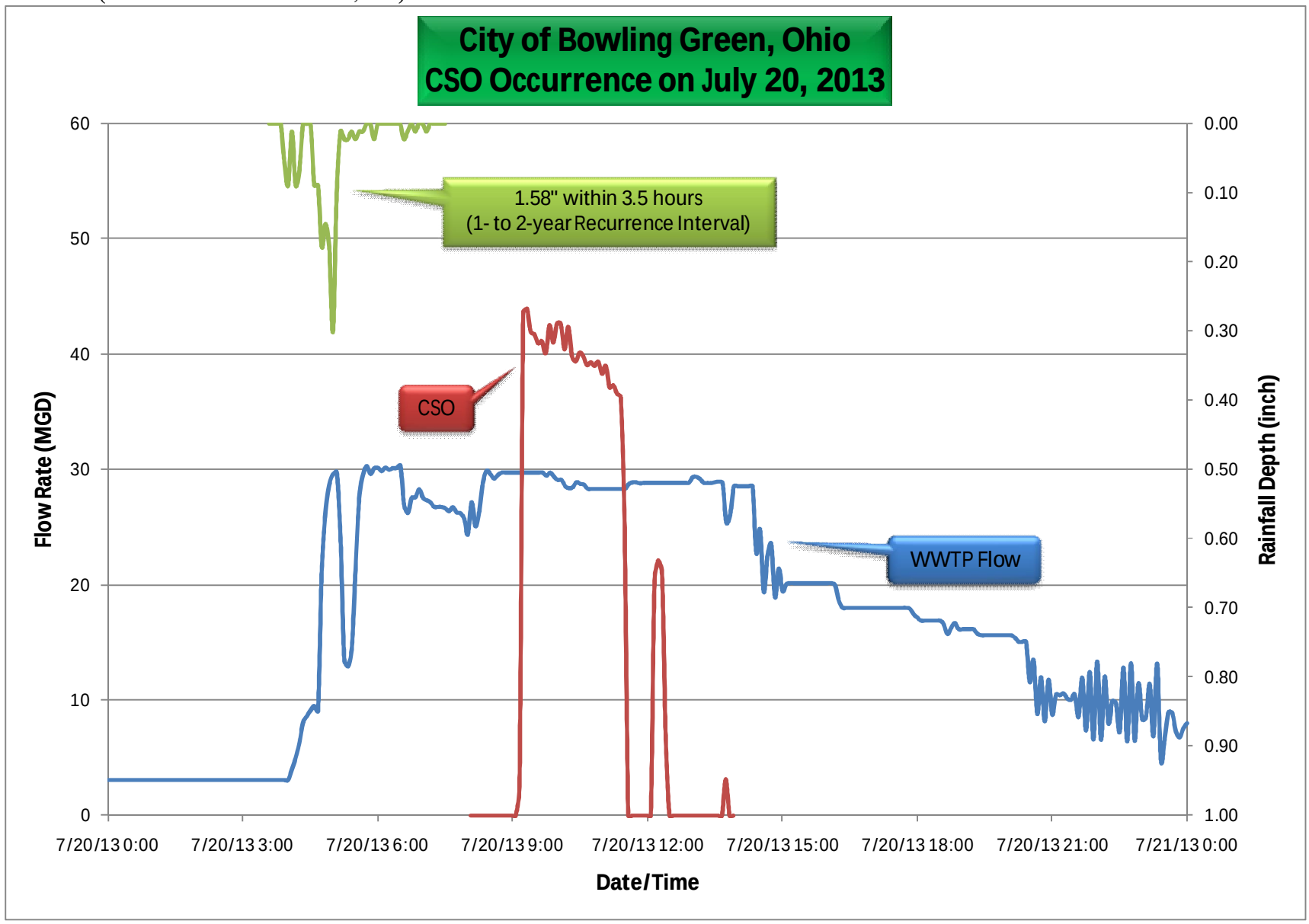


**Exhibit 12** (Credit: C. Gibson Chen Ph.D., P.E.)

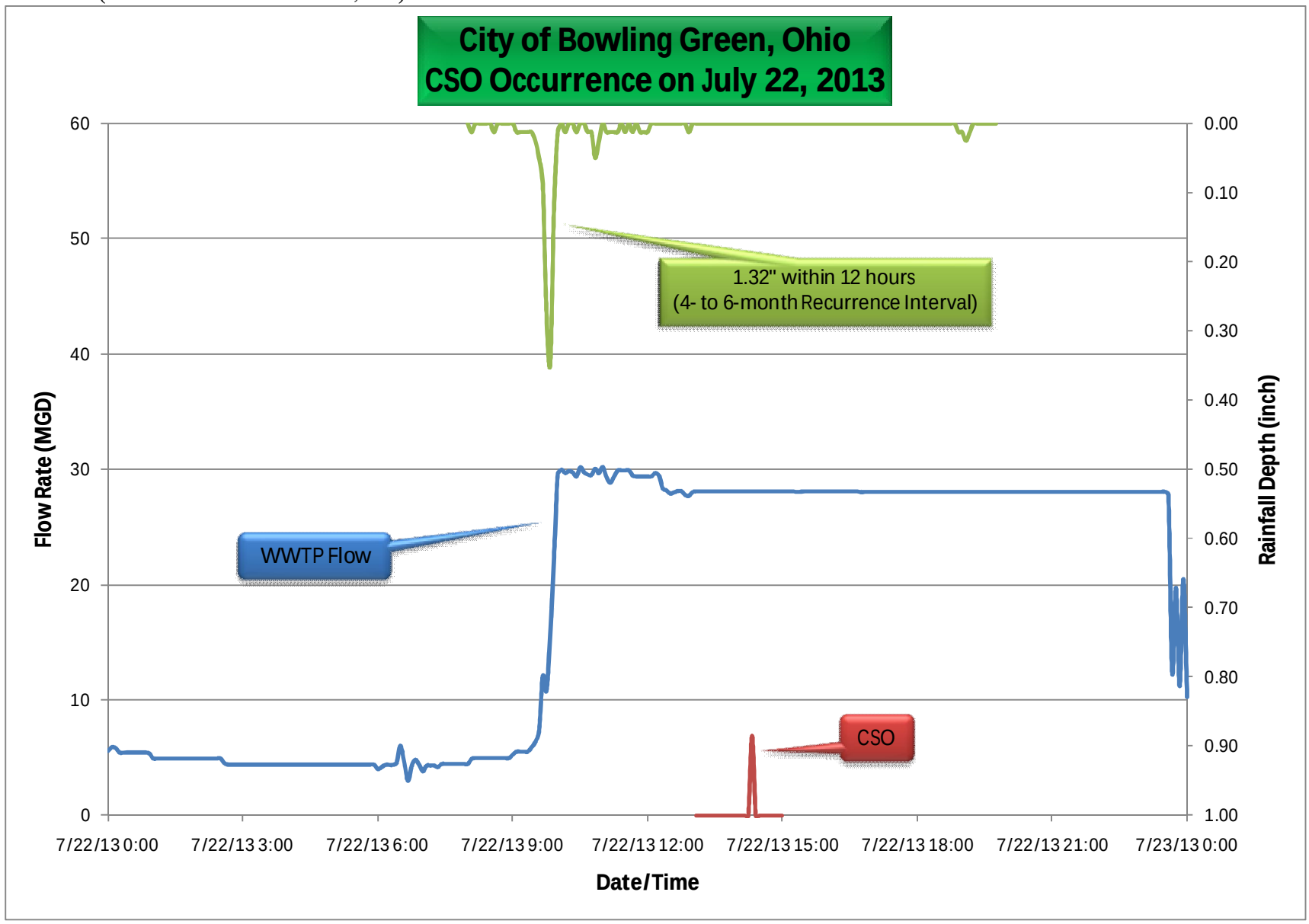


**Exhibit 13** (Credit: C. Gibson Chen Ph.D., P.E.)

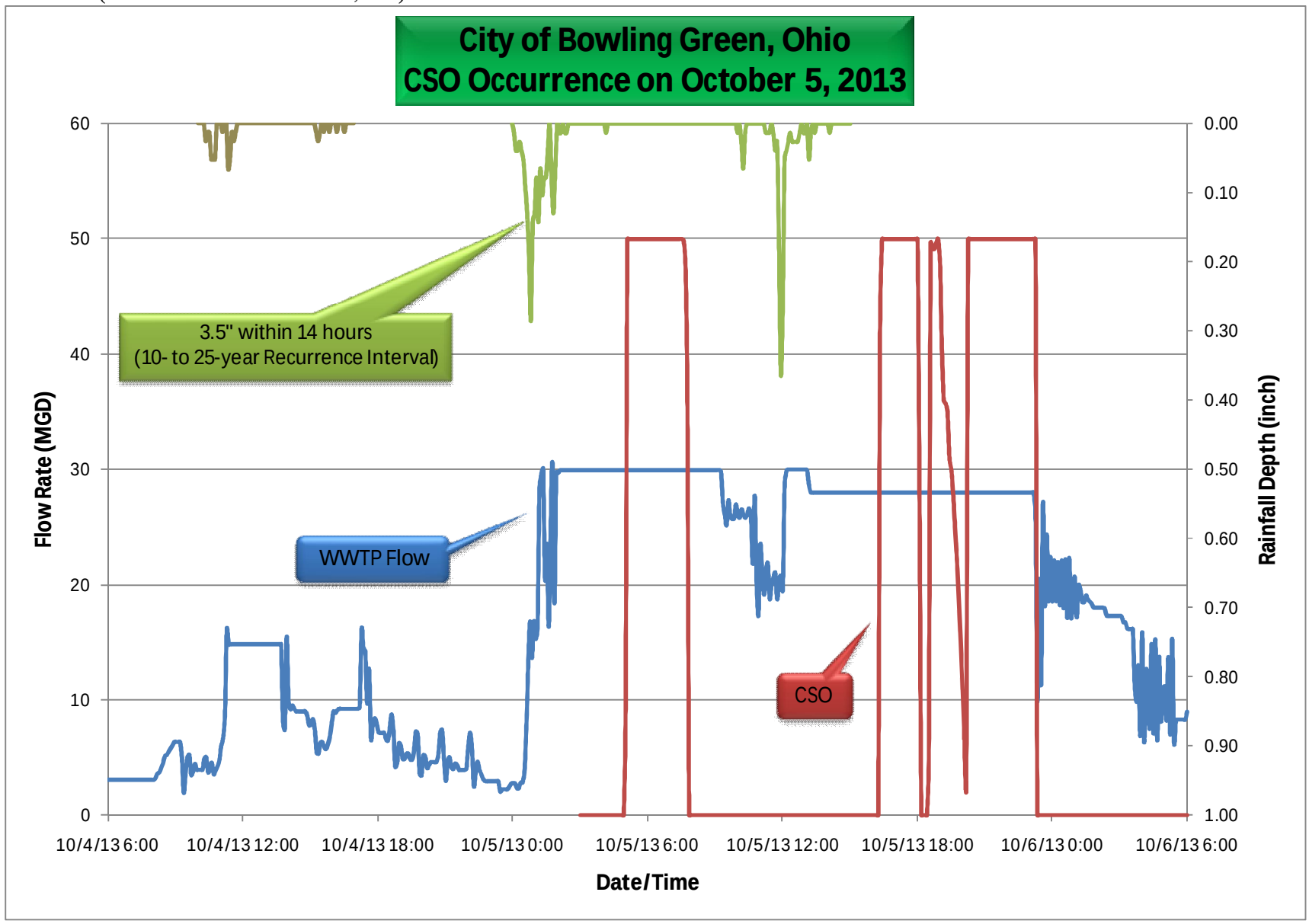


**Exhibit 14** (Credit: C. Gibson Chen Ph.D., P.E.)

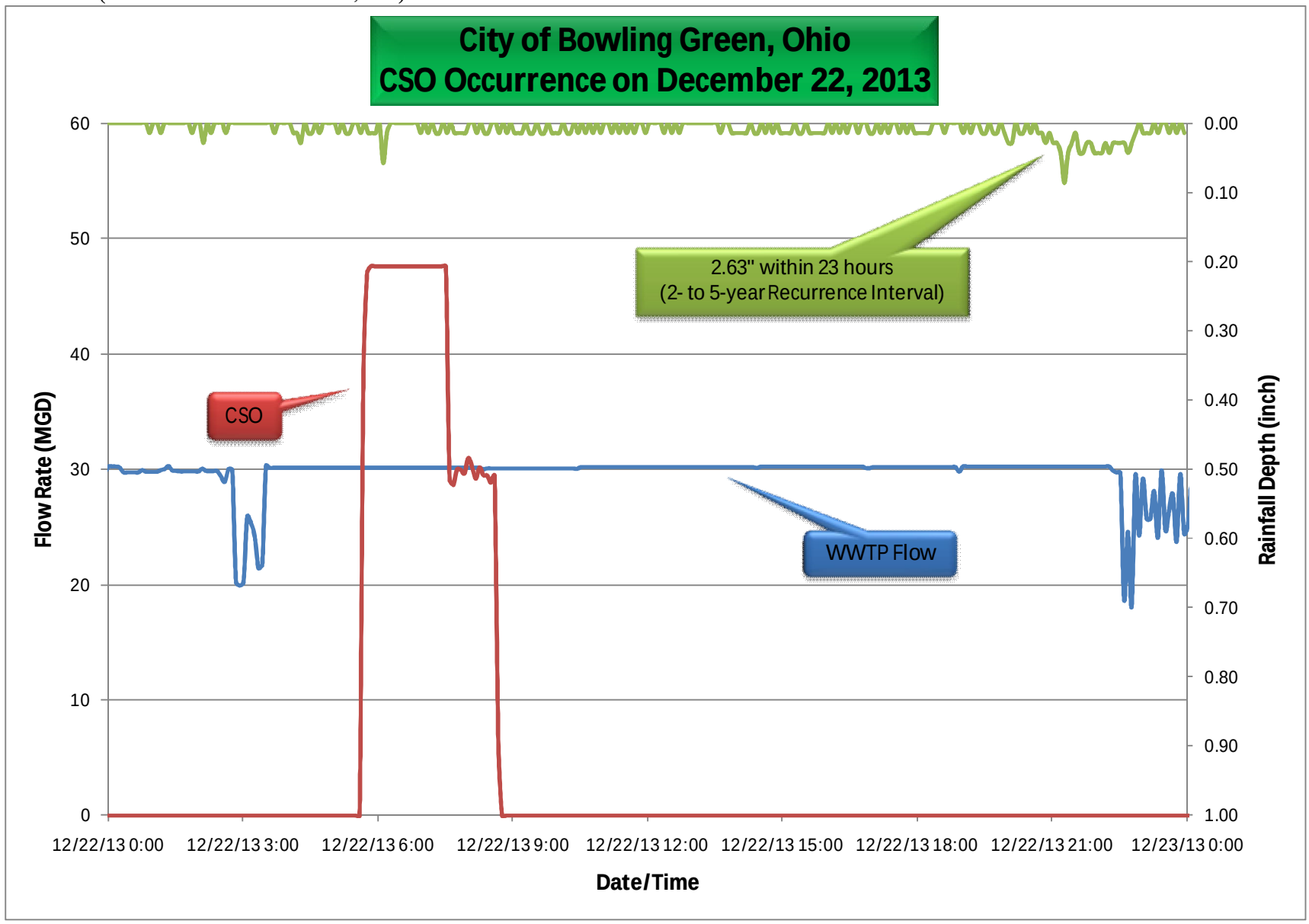
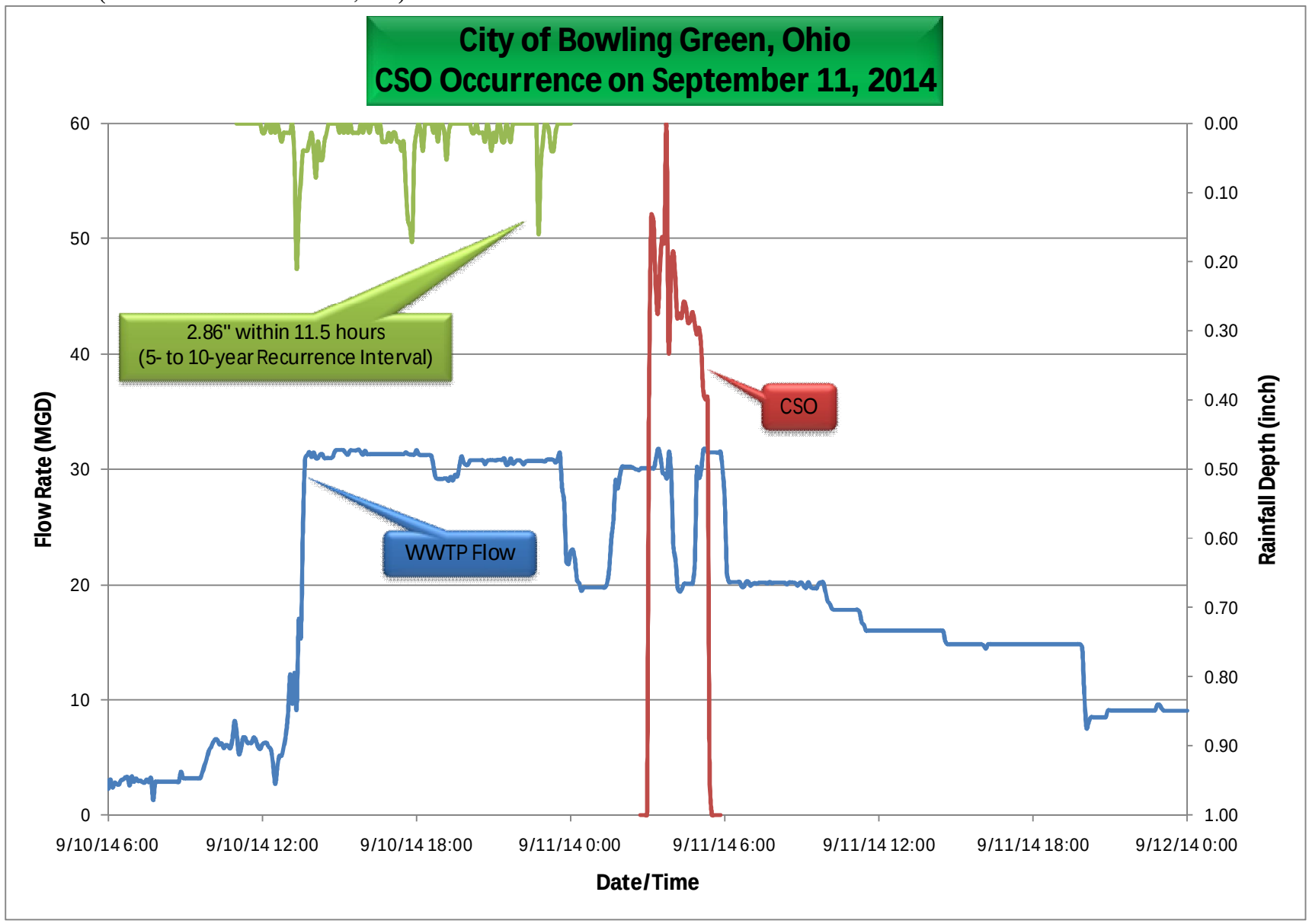


**Exhibit 15** (Credit: C. Gibson Chen Ph.D., P.E.)



## Characterization of the Storm Water Overflow Holding Basin

Normal flow to the Poe Road pumping station occurs through two parallel 96-inch elliptical combined sewers that discharge to the diversion chamber's first compartment and one 48-inch separate sanitary sewer that discharges into the pumping station's wet well.

In the diversion chamber's first compartment, flow from the 96-inch elliptical sewers is diverted to the 48-inch sanitary sewer (via a gated tee) and conveyed to the pumping station wet well.

As the flow rate and wet well level increase during wet weather events, the raw water pumping rate increases to maintain set liquid levels and flow conditions. When flow exceeds available pumping capacity and the wet well level reaches its first set point, the 48-inch gated tee gradually closes, reducing flow from the 96-inch elliptical sewers and storing combined wastewater in the elliptical sewers and sending the separated sanitary sewer to the wet well for treatment. The gated tee modulates between open and close as needed to allow maximum pumping while maintaining desired wet well levels.

When flow exceeds the station's pumping capacity and the wet well level increases to the second set point, the gate fully closes, dedicating all pumping capacity to sanitary sewer flow. Once this occurs, the combined sewer level rises above the first chamber's headwall and flows into a second chamber and the Storm Water Overflow Holding Basin's gates open—filling the second chamber and the Holding Basin simultaneously.

When the Storm Water Overflow Holding Basin reaches its maximum liquid level, its gates automatically close preventing backflow into the second chamber. When the holding basin reaches maximum level—approximately 17.4 feet—it detains about five million gallons.

Flow from the elliptical sewers then continues into the second chamber, causing the liquid level to rise until it flows over a headwall and into a third chamber—the outfall to the combined sewer overflow which discharges into Poe Ditch. At this point the elliptical sewer lines are at peak storage capacity. As flows subside, the above sequence reverses, draining the holding basin. Only when flow exceeds total pumping capacity, the storm water holding basin reaches its capacity, and the twin 96-inch elliptical combined sewers are fully utilized for storage, does an event occur at this site which is the only CSO location within the City's collection system.

## Combined Sewer Overflow Characteristics Evaluation

In an effort to quantify how the new operating procedures and WPCF improvements have impacted volume and frequency of combined sewer overflows, the City engaged Avetin Engineering, Ltd. (Avetin), to analyze annual rainfall to determine "typical year" rain events. United States Environment Protection Agency Region 5 has approved the "typical year" rainfall analysis methodology employed by Avetin's Dr. C. Gibson Chen, P.E.

Dr. Chen utilized 120 years of rainfall data from sources including NOAA MRCC, a weather station at west Bowling Green (Station ID KOHBOWLI3), a weather station at southwest Bowling Green (Station ID KOHBOWLI1), and Toledo's Metcalf Field Airport. This data was filtered until the most reliable numeric value for typical year rainfall was produced.

After this data was processed it was determined that "typical rain events" with a three-month (four per year) or less recurrence level fall into two types; 1) less than 1.40-inch rainfall in a 24-hour period and 2) less than 0.55-inch rainfall in a one-hour period. With this information, Bowling Green CSO events were plotted against typical rain event criteria to determine compliance of the "less than 4 total occurrences during a typical year".

**Evaluation of need for additional storage to reduce Combined Sewer Overflows:**

The City believes it meets the requirements of the National CSO Policy under typical year conditions as well as the conditions outlined in the Ohio Permit 2PD00009*SD. As demonstrated in Exhibit 16, the City is achieving four or less occurrences during a typical year and does not believe additional storage is warranted. However, the City is pursuing another improvement that will further enhance its goals of eliminating wet basements, reducing the volume and duration of CSO events, reducing total CBOD and TSS loadings to Poe Ditch, and protecting water quality for downstream users.

The WPC is currently looking to upgrade/expand its grit removal system from the original design of 16 MGD to meet the current 30 MGD flow being delivered to the plant. Within this project, an automated cleaning system for the storm water holding basin is being considered to help reduce odors and more importantly to regain tank capacity that has been lost due to the accumulation of debris over the past 30 years. It is believed that approximately 25% of the total tank capacity is not being utilized due to the solids accumulation.

**Other Actions**

Although not required by the terms of the NPDES Permit, the City has taken the following actions to not only increase the reliability of the plant to treat higher flows, but also reduce the volume of storm water entering its combined and separate sanitary sewer systems:

In 2008, the Water Pollution Control Facility replaced the final settling tanks drive units, muliti-draw tubes, sludge flights and skimmer arms at a cost of $54,860 to ensure

reliability in treatment, thus reducing potential CSO occurrences in the event of failure during wet weather. To continue assurance of reliability of the WPCF, in 2009 the primary clarifiers drive units were replaced at a cost of $97,500. In 2014, weir washers were installed on the final clarifiers to reduce the buildup of algae and debris on the V-notched weirs which improves filter performance under higher flow conditions.

In 2009, the City constructed the $307,233 South Maple Street Stormwater Retention Project, which consisted of disconnecting a storm sewer (which served a 117.5-acre drainage area) from the combined sewer system and diverting its flow to a wetlands area. Flow monitoring showed storm sewer discharges of up to one million gallons per day into the City's combined sewer system during wet weather events, taking up valuable capacity in the collection system and at the WPCF, contributing to CSO events and increasing treatment costs.

The storm sewer's flow was diverted to a new 300 gallon-per-minute pump station. Stormwater that collects in the station wet well is pumped through about 4,500 feet of force main and discharged on upland areas, where it filters down into wetlands that provide stormwater detention. Stormwater can also be discharged to Gypsy Lane Road Ditch if the wetland reaches its storage capacity—but only after stormwater in the Gypsy Lane Road Ditch has receded. If necessary, (never utilized to date) flow can also be diverted into the combined sewer system.

When the potential for a CSO is apparent, Standard Operating Procedures require the WPC staff to notify the Northwestern Water Sewer District to shut down the Wood County Landfill's leachate pumping station to allow more capacity at the Poe Road pumping station.

The City has performed televised inspections of the collection system for many years and a new camera system was purchased in 2014 ($238,000) that will allow for the

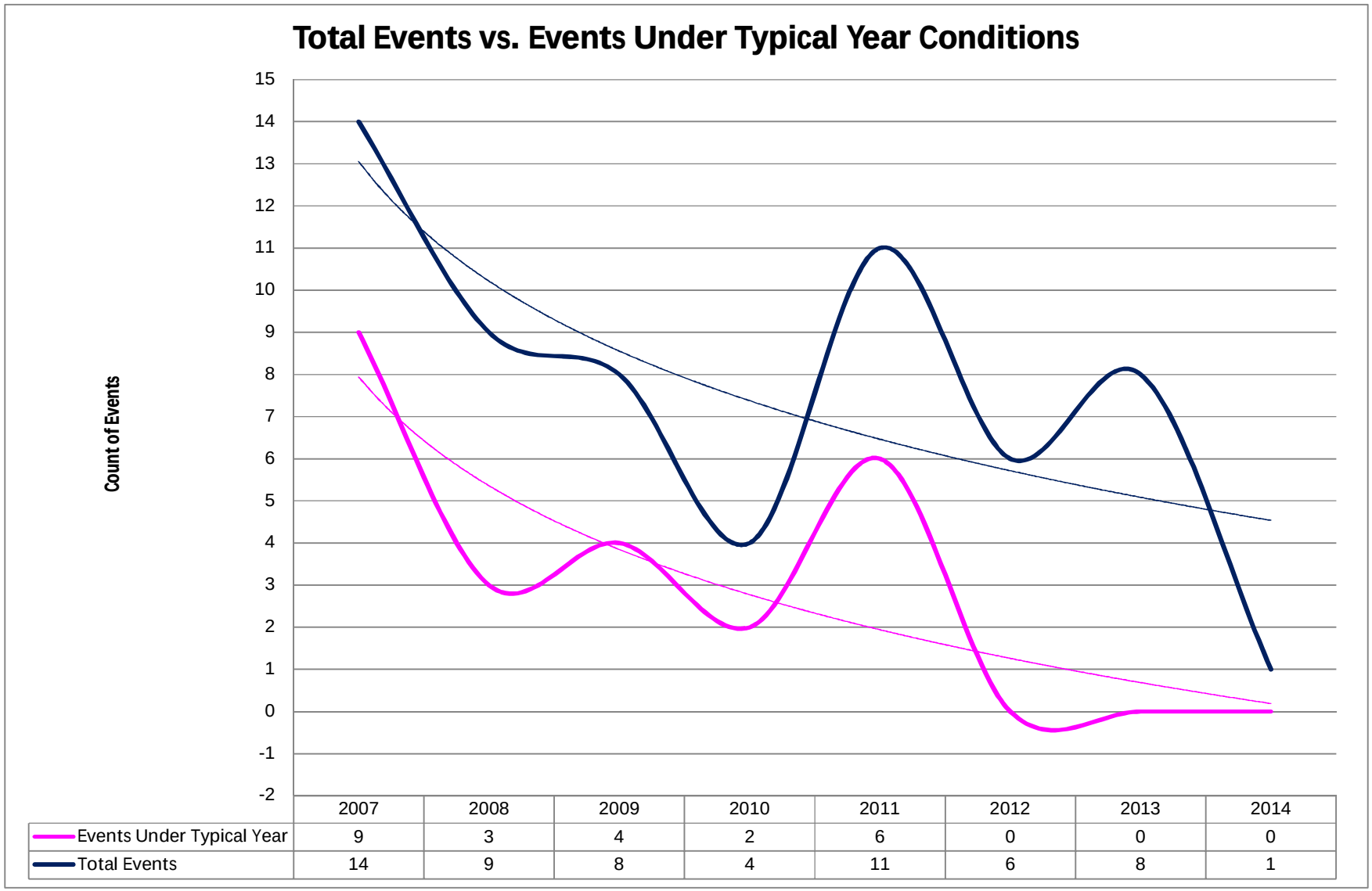
inspection of mainline sewers as well as customer laterals including GPS capabilities. When located, ground water infiltration in the collection system has been removed by utilizing traditional excavation methods as well as in-pipe relining methods. The City is also actively dye-testing customer sump pumps to ensure they are not connected to a sanitary sewer. The City provides financial incentives up to $2,000 to homeowners to remove sump pumps from the sanitary sewer system. Financial incentives are also available for customers in the combined sewer area, but alternatives must be provided to discharge sump pumps and downspouts. The City sponsored a Rain Garden seminar at the Bowling Green Community Center on May 20, 2010, and has constructed a rain garden at the City Administrative Services Building, 304 North Church Street, in 2010 as a demonstration project for local residents. The City also plans to meet with local landscapers and nurseries to explain available financial incentives and solicit their assistance in promoting removal of sump pumps and downspouts from the combined sewer system.

**Conclusion**

Exhibit 16 demonstrates that the WPCF has greatly reduced the total number of CSO events and more importantly, reduced CSO occurrences during a typical year to the "not more than four (4) total occurrences during a typical year" as required in the City of Bowling Green's permit #2PD00009*RD and USEPA's policy of 4 or less CSO events during typical year conditions.

In summary, it is clearly evident throughout this report that the City of Bowling Green takes wet weather flow operation, treatment and reduction very seriously. With the information supplied in this document the City of Bowling Green concludes that not only it is in full compliance with the intent, spirit and obligations of the Ohio EPA and United States EPA Combined Sewer Overflow Policy of 4 or less evens per typical year, but on the occasion when a CSO event does occur, the discharge of the CSO does not substantially affect the quality of the receiving stream.

**Exhibit 16** (For 6 months in 2009, the WPCF had one screw pump out of service, flows to the WPCF were reduced so flooding of the plant would not occur.)




| | 2007 | 2008 | 2009 | 2010 | 2011 | 2012 | 2013 | 2014 |
|---|---|---|---|---|---|---|---|---|
| Events Under Typical Year | 9 | 3 | 4 | 2 | 6 | 0 | 0 | 0 |
| Total Events | 14 | 9 | 8 | 4 | 11 | 6 | 8 | 1 |