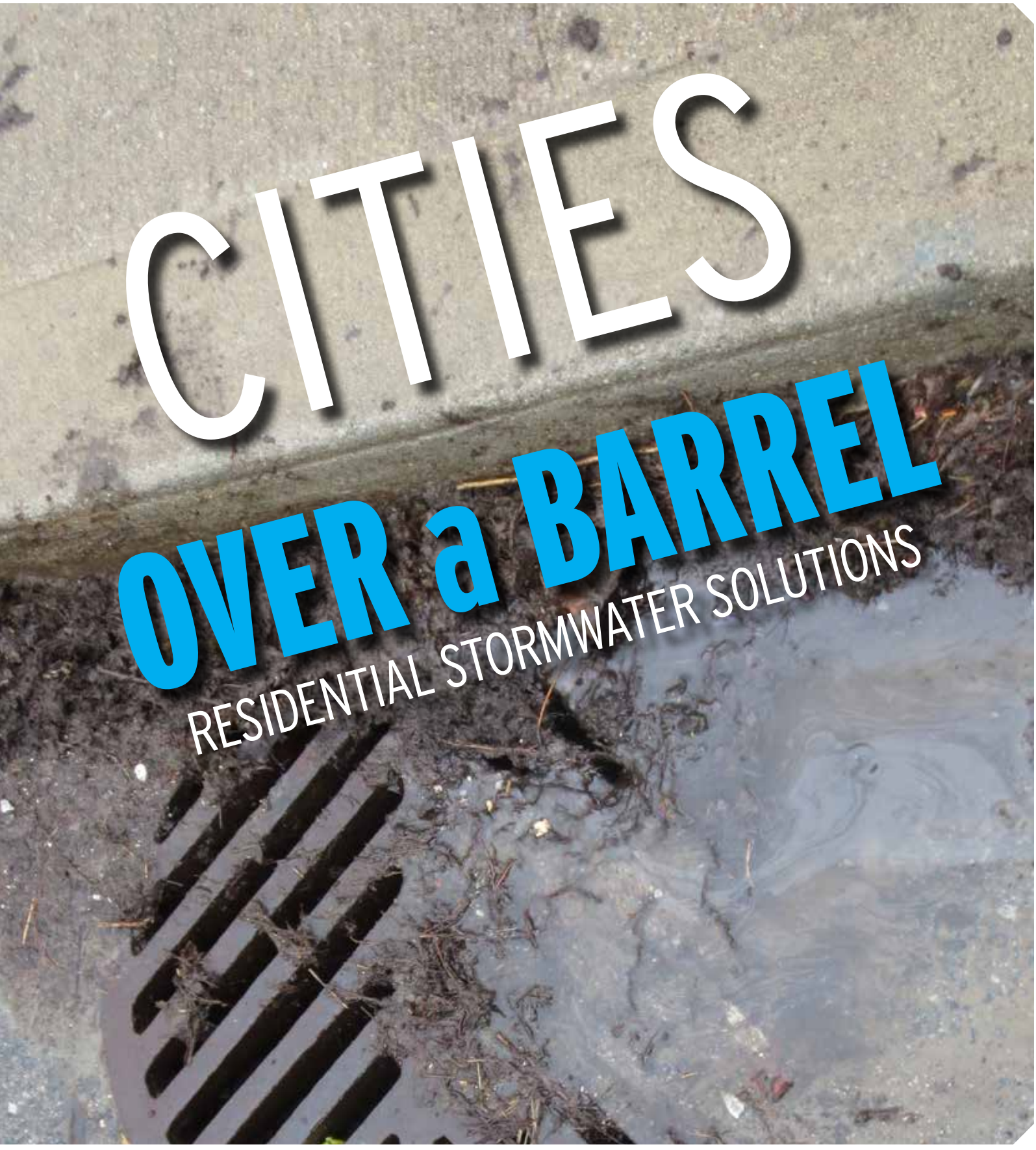


CITIES OVER a BARREL

RESIDENTIAL STORMWATER SOLUTIONS

RiverSides
Where Water Quality Begins

2016 TORONTO AUTOMATED RAIN BARREL PILOT PROJECT SUMMARY REPORT

MAY 2017

Storms Threaten Cities

Flooded basements. Closed beaches. Chemical and bacterial pollution running untreated into water bodies. Overburdened sewer systems causing combined and sanitary sewer overflows.[1]

Storms related to climate change are becoming more frequent and flood events are costly. Floods and overburdened sewer systems cause direct damage to municipal and private properties, increase insurance rates (raising issues of liability), and increase already expensive water storage and treatment costs.

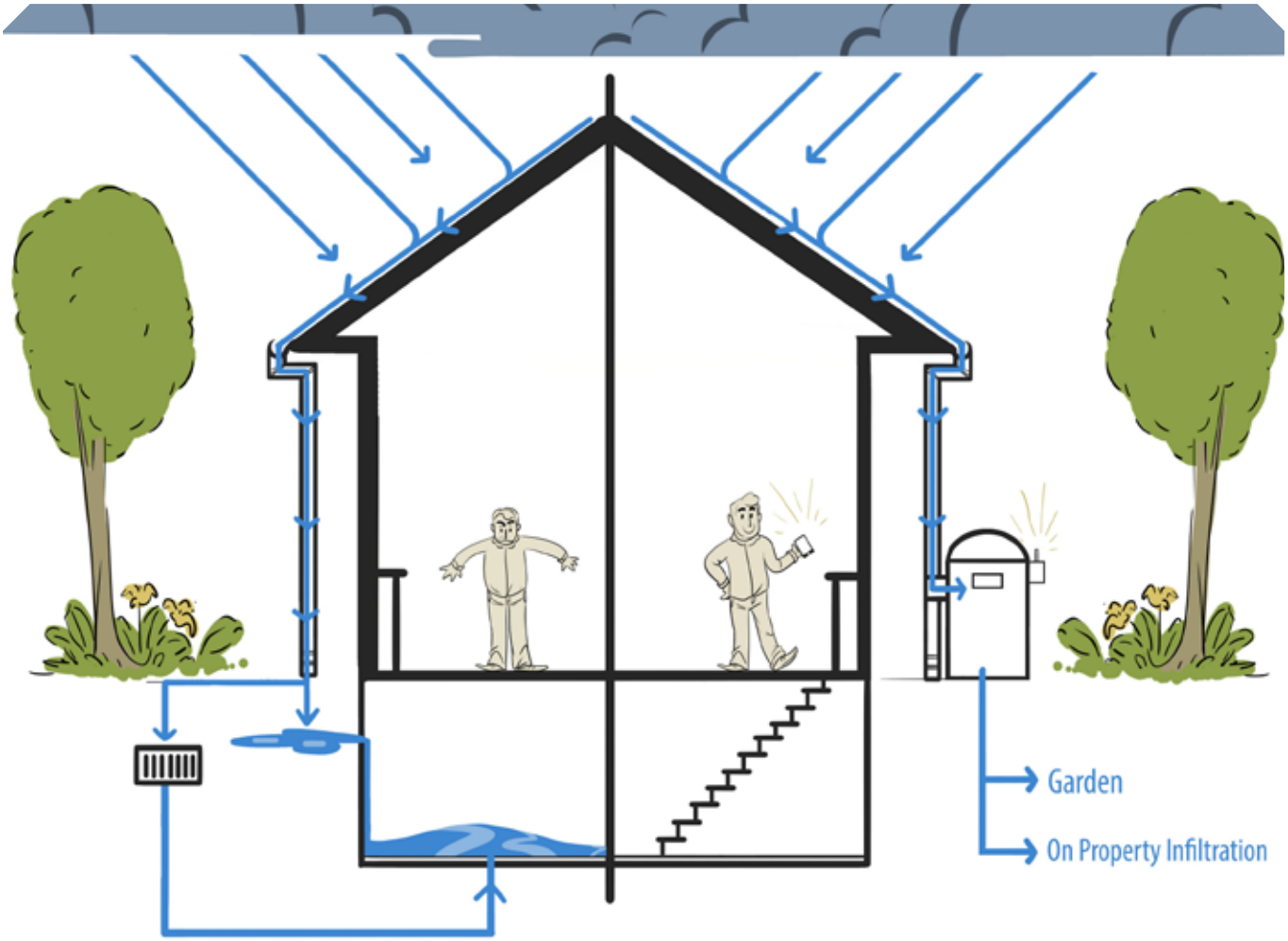
Clean rainwater is not just being wasted. It's also being transformed into a damaging, costly, contaminated waste product.

Large-scale solutions to these problems, such as stormwater surcharges and infrastructure development, are expensive and take a long time to discuss, decide on, and implement.

The ARB Solution: Pollution Prevention in Action

The stormwater costs and damages that eat away at city budgets can be eased. The automated rain barrel, or ARB, is a traditional-meets-cutting-edge, game-changing solution. A sturdy barrel combines with user-friendly wireless technology that anticipates storms and allows users to remotely monitor and empty their barrels as desired. It allows lot-level storage, use, and treatment of stormwater by diverting it from rooftops to naturally filter through gardens and lawns. It's an intuitive, easy-to-use, and cost-effective alternative to the current expensive city stormwater-treatment systems, standard rain barrels, or downspout disconnects that dump water over property surfaces and onto city roads, collecting further contaminants to flow with the water into sewers.

Cities need relief, and citizens want greener urban spaces without the worry of their basements flooding.



The Problem

The Solution

The ARB is a stand-alone residential system that can also be scaled up to expand into a targeted local network. Tested through a first-of-its-kind pilot project in 2016, it received great feedback.[2] Urban householders became enthusiastic and sustained "stormwater stewards." They liked simply, conveniently, and remotely redirecting stormwater from their roofs to use in their own gardens and yards while saving tapwater costs. They were happy to reduce their city's water-treatment costs, support the existing urban stormwater infrastructure, and contribute to the health of their local watershed.

This summary report shares the key findings from our pilot project. We hope that you will be as interested and enthusiastic about implementing this system in your city as the pilot's participants were in theirs.

The ARB lets us do less and save more. And its potential has yet to be fully exploited.[3]

The ARB System and How It Works

Once householders signed up to participate, we did site visits. We cut off and capped downspouts that ran directly from eavestroughs to the municipal sewer system, took out disconnected downspouts that still drained over paved property directly into the sewer, and removed any existing rain barrels. We custom-redirected downspouts to flow into their new ARBs, and we custom-located the barrels to address each household's needs and space.[4] The hard wiring (with solar-powered battery back-up) allows the automated valve and water level sensors to connect with the computer or phone app.

We showed participants the few simple things necessary to maintain and operate the system, and explained the system's technological components.

And we explained how to see what was going on with their ARB by using the online dashboard (see page 5 for images of the dashboard and water-level graphs).

The ARB's app, manufactured by RainGrid Inc., has a dashboard that can show

- predicted rainfall,
- barrel capacity,
- and litres collected.

It calculates and describes total water diverted

- daily,
- weekly,
- monthly,
- and to-date.

The system's internal sensor

- monitors the barrel's water level,
- calculates capacity needed to capture maximum amount of predicted rainfall,
- sends a message to the ARB to drain to required level when storms are imminent,
- and then calculates further litres collected as rainfall occurs.

Householders can bypass this, and drain the ARB as much as they wish, from wherever they happen to be.

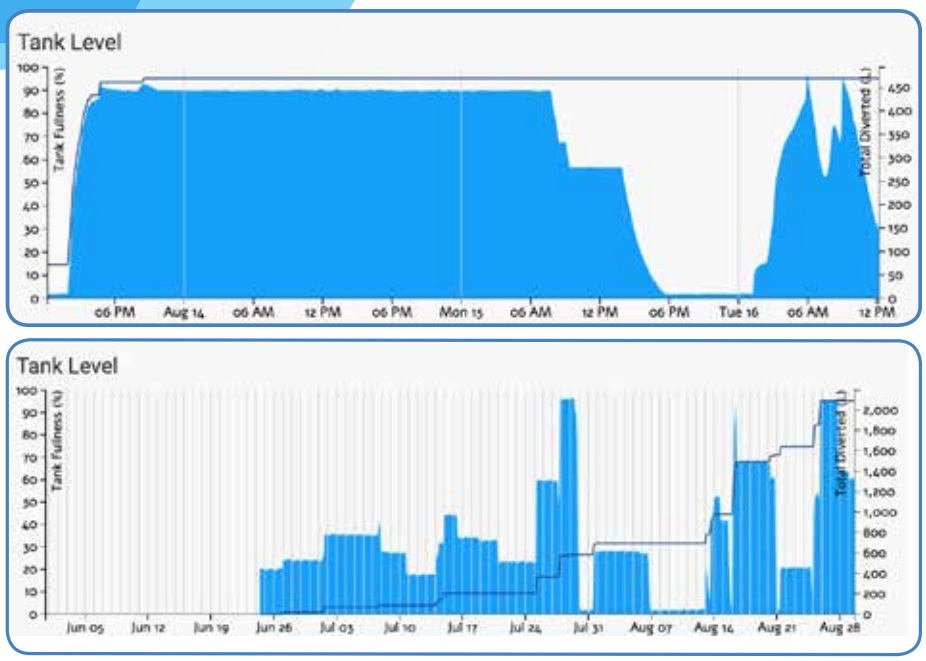
- **DIVERTER BOX** (with fine mesh filter)
- **WATER LEVEL SENSOR** (to "see" inside the barrel)
- **SOLENOID VALVE** (to open and close drain)
- **SOLAR PANEL** (for recharging battery)
- **AUTOMATED CONTROLLER** (for wireless communication to gateway)
- **ROUTER** (inside house, for secure communication between controller and internet)
- **STORM SURGE FUNNEL** (directs heavy rain flow into diverter)

The 2016 ARB pilot project used automated rain barrels purchased from and maintained by RainGrid Inc.

The ARB Experience

A system won't work if the people it's meant for don't use it. The rain barrels typically used in North American systems too often remain full during storms; have inadequate filters that allow barrels to fill up with mud; and are too small, not durable enough, or difficult to monitor and maintain. Understandably, such systems fall into underuse or even disuse. By contrast, the ARB system draws users in to engage with it. And it compensates when they don't.

The summer of 2016 was unusually dry,[5] the participants were just learning how to use their barrels, and the systems experienced some glitches and unforeseen problems,[6] but even so, the average minimum verified amount of rainwater redirected from sewers, stored, and used by participants was more than 1,000 L per month.



At the end of the season, we gathered the dashboard data to see how much water had been green-diverted, captured, and used, and when.

> *My new automated rain barrel helps keep my local Don River clean and provides free water to use on my garden. Best of all I control it all, from the convenience of my phone.*
>
> *A.S.*

Testing the Solution: the 2016 ARB Pilot Project

In the spring of 2016 the residents of fifteen households in one Toronto neighbourhood, who were interested in environmentally friendly solutions, signed on to our ARB system pilot project.

The participants agreed to have an ARB installed on their property, to learn how to use it optimally, and to give us feedback. We installed each system with a view to the unique requirements of each house and yard and with the goal of transforming stormwater from negative potential to positive results. We responded to participants' needs as they learned how much they could benefit, and as we learned how to find solutions that pointed to the substantial potential of the system. Even in its first prototype, the ARB was a huge hit!

THE RESULT:

Despite an exceptionally dry summer, each well-installed, fully operational ARB system was still able to capture and store 1,000 to 2,000 L of water per month. This means that, for a ten-month collection season, each barrel can capture 10,000 to 20,000 L. Even with the short duration of the pilot project, we still transformed

OVER 50,000 L FROM WASTE WATER TO FREE WATER.

PROJECTIONS BY THE BARREL

# OF 500 L ARBs	MIN RAIN CAPTURE (L/YR)	MAX RAIN CAPTURE (L/YR)
1	10K	20K
100	1M	2M
500	5M	10M
1.5K	15M	30M
5K	50M	100M
15K	150M	300M

K = thousand
M = million
B = billion
(2.5 million L = 1 Olympic-sized swimming pool)

Imagine this System Growing Across Your City

PROJECTIONS OVER TIME

# OF ARBs	MIN–MAX VOL (L)	MIN–MAX VOL (L)	MIN–MAX VOL (L)
	3 YEARS	5 YEARS	10 YEARS
1	30–60K	50–100K	100–200K
50	1.5–3M	2.5–5M	5–10M
500	15–30M	25–50M	50–100M
1K	30–60M	50–100M	100–200M
5K	150–300M	250–500M	500M–1B
15K	450–900M	750M–1.5B	1.5–3B

Benefits

For Municipality

- reduces costs for stormwater storage and treatment
- reduces risk of municipal property damage and residential-damage liability
- reduces costs for transporting and treating water for gardens
- increases ecosystem health, especially green infrastructure
- helps city adapt to climate change on a scalable, residential level
- builds community-based, urban, residential water-storage capacity
- supports and integrates with green infrastructure
- reduces greywater infrastructure investment and associated wastewater pumping and treatment costs
- tracks water collection and redirection
- has attracted householder-citizen enthusiasm and support

For Householders

- reduces at-taps costs
- reduces potential municipal stormwater surcharges
- offers convenience of remote monitoring of rainfall and remaining barrel capacity and emptying of barrel
- pilot results show that the majority of our participants used 80% or more of the total water collected on their property for gardens and trees over a full season[7]
- protects against basement flooding and water damage to building foundation
- offers stormwater and drought resiliency in the face of increasing climate-derived extreme weather events

For Local Environment

- reduces combined-sewer overflows (CSOs) to local water bodies[8]
- reduces toxins and bacterial-loading to aquatic ecosystem from untreated runoff
- increases recharge of local streams, groundwater, soil moisture, and clean available water
- increases drought-resiliency and health of green infrastructure
- improves air quality
- takes advantage of climate change's extension of the rainfall collection season

> *My automated rain barrel helps make Toronto climate change–resilient. In exchange for helping the environment and my city, I get free water for my garden.*
>
> *L.W.*

Exciting Potential

With such enthusiastic response to a first-of-its-kind basic prototype, it is hard not to be excited about the potential for ARB systems to help solve the issues resulting from increased threats of urban stormwater.

As the RiverSides 2016 Pilot Project showed, even during an unusually dry summer and with a prototype that proved to have room for further development, one well-placed ARB system will collect a minimum of 10,000 L of water a year.[9] The feedback from participants was invaluable. It helped us envision how we can maximize the functionality of the ARB and envision the even-greater potential for it to relieve the stress and costs of stormwater on people, cities, and the environment.

For a municipality, the ARB offers these future potentials:

- savings in water storage through additional above-ground storage capacity to relieve already overburdened municipal underground storage and stormwater ponds
- real-time monitoring and opportunities for extensive data collection
- centralized management
- targeting of flood-susceptible areas
- at-meter studies of water reduction to see how ARB-system users save the city money
- community-based viability for dense urban areas
- reduction of tapwater consumption during drought periods
- scalability, so the network can be expanded as needed
- prototype development to adapt to the different needs of communities from coast to coast, and even globally

> *My automated rain barrel transforms stormwater runoff from being a source of pollution and residential flooding into a free way to water my garden. I call that a win-win scenario!*
>
> *D.O.*

Next Steps

RiverSides believes the time has come for householders, communities, municipalities, insurance companies, real-estate developers, architects, and urban planners to consider how this preventive stormwater infrastructure can be tested, refined, and incorporated into the "toolbox" of options designed to meet the challenge of urban climate change adaptation.

Here are some things you can do:

- Visit www.riversides.org to see our full report ("Ground Testing Automated Rain Barrels") and virtual tour to consider how an ARB could be used on your property.
- Begin with the installation of a standard rain barrel. Once it is installed, conversion to an automated system is the next step.
- Ask your local and municipal political representatives if they support or consider ARB technology in their stormwater planning.

This work was carried out with the aid of a grant from the Commission for Environmental Cooperation

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NOTES

1 Each year combined sewer overflows (CSOs) dump 19–49 million litres of untreated water back into the lakes and rivers of Toronto. (Based on numbers obtained from GLEAM [Great Lakes Environmental Assessment and Mapping] Project, 2012: http://greatlakesmapping.org/great_lake_stressors/7/combined-sewer-overflows.)

2 For more on the enthusiastic feedback offered by those 2016 pilot project householders who filled in surveys, wrote personal correspondence, and participated in focus groups, see the RiverSides Final Report, "Ground Testing Automated Rain Barrels: The Potential of Community-Based, Residential Stormwater Storage," at www.riversides.org.

3 For the potential of the ARB system, see page 10 of this summary report.

4 For an online tour of the pilot project installation, go to www.riversides.org/automated-rain-barrels/.

5 With its total precipitation of 631.90 mm, 2016 was Toronto's fourth driest year since 1992 (see table entitled "Total Precipitation — Annual data [25 years] for Toronto": http://toronto.weatherstats.ca/metrics/precipitation.html). Toronto had a total of 517 mm of rainfall over the 2016 year and only 269 mm over the five-month collection period (1 July to 1 December; see http://toronto.weatherstats.ca/charts/rain-1year.html).

6 For more details on the challenges and how they were overcome, see the RiverSides Final Report, "Ground Testing Automated Rain Barrels."

7 From participant feedback and surveys.

8 See note 1, above.

9 For further details about the data collected, see the RiverSides Final Report, "Ground Testing Automated Rain Barrels."

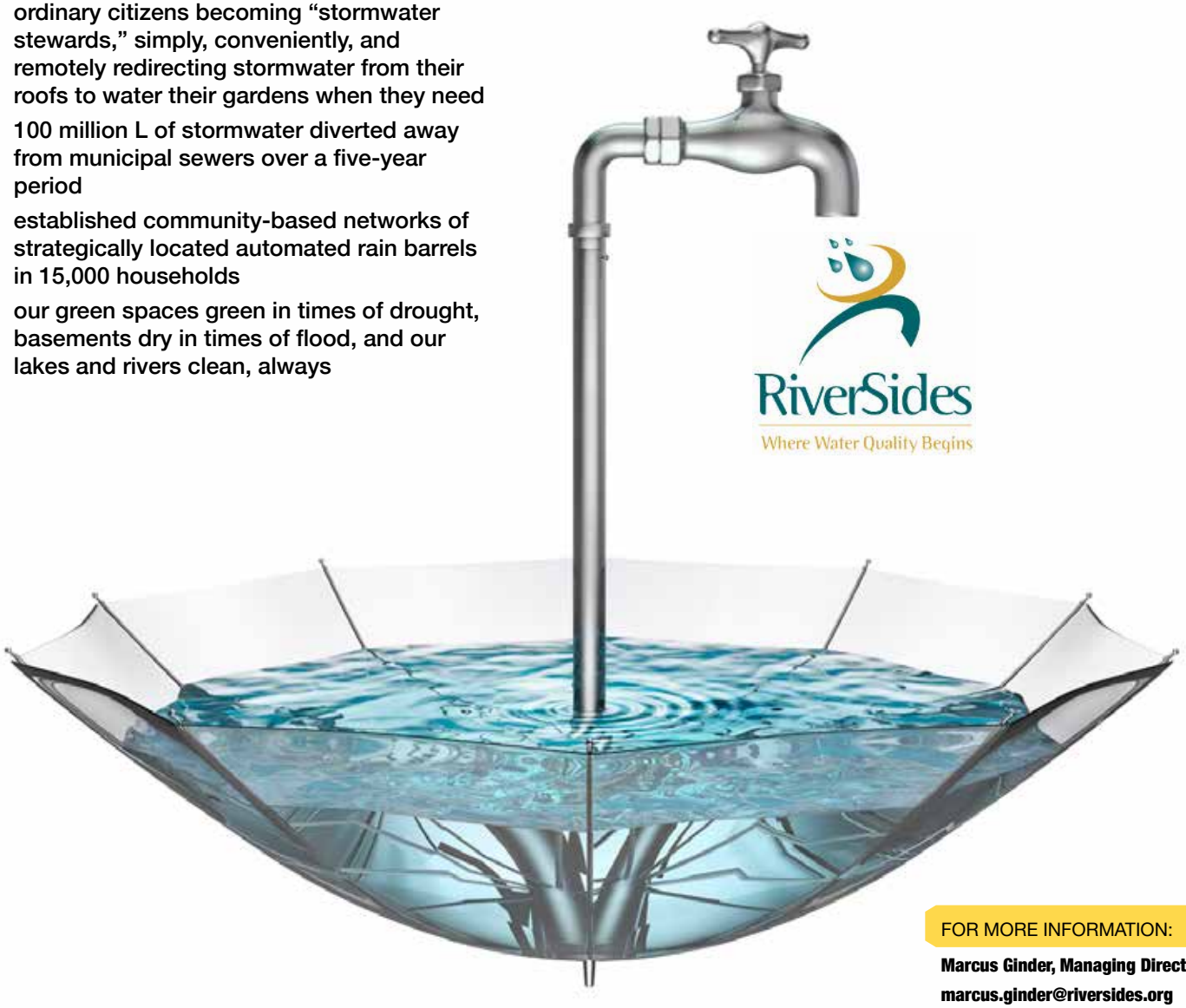
RiverSides supports the healthy relationship between householders and the urban river valleys on which they depend.

We engage local communities in innovative and climate-resilient residential stormwater projects; make partnerships with householders, planners, and businesses around stormwater management; and offer policy advice to all levels of government on appropriate development and preventive solutions to costly stormwater problems.

We aim to build a new model of urban climate resiliency for city-dwellers by redirecting the stormwater from their roofs away from storm sewers. We want to save homeowners from the damages of flooding and provide them with free water for their gardens, while alleviating local watershed degradation and significantly reducing municipal sewer treatment costs.

With increased storms on the horizon due to climate-change, RiverSides would like to see:

- ordinary citizens becoming "stormwater stewards," simply, conveniently, and remotely redirecting stormwater from their roofs to water their gardens when they need
- 100 million L of stormwater diverted away from municipal sewers over a five-year period
- established community-based networks of strategically located automated rain barrels in 15,000 households
- our green spaces green in times of drought, basements dry in times of flood, and our lakes and rivers clean, always



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