



## DISCLAIMER

This project was conducted with financial assistance from a grant from the Metropolitan Water District of Southern California (Metropolitan), the U.S. Bureau of Reclamation, the Central Arizona Project, the Southern Nevada Water Authority, the Southern California Gas Company, and the Western Resource Advocates through Metropolitan's Innovative Conservation Program (ICP). The ICP provides funding for research to help document water savings and reliability of innovative water savings devices, technologies, and strategies. The findings of this project, summarized in this report, are solely from the project proponent.

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# 2018 Innovative Conservation Program FINAL REPORT

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FLO TECHNOLOGIES, INC.

In partnership with:



Prepared for:



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## **Flo Technologies**

Flo Technologies, Inc. ("Flo") is a Los Angeles based technology company, and the makers of the award-winning Flo by Moen Smart Water Shutoff, a first-of-its-kind, real-time water use monitoring and water shut-off system, to single family homes. Flo was awarded a grant from the ICP to perform the tests described herein, in partnership with the LADWP.

## **I. EXECUTIVE SUMMARY**

Flo Technologies, Inc. (“Flo”) partnered with LADWP to identify up to 100 participants and track the water consumption of program participants in LADWP’s service area over a 10-month period. Flo sought to evaluate how water consumption and usage habits in homes with a Flo by Moen Smart Water Shutoff (“Flo by Moen device”) were impacted, as compared to a control group of LADWP customers that did not have the Flo by Moen device. Ninety-seven (97) participants originally opted in as part of the test group (“Test Group”), and LADWP selected approximately 20 homes for every single Test Group participant (i.e. approximately 1,920 homes total) to act as a control group (“Control Group”). Flo then used statistical methodologies described herein to analyze any correlation and causation of changes in water consumption and the existence of a Flo by Moen device.

The initial results of the study contained in this Report show promising trends toward water consumption savings using the Flo by Moen device, including but not limited to substantial decreases in water waste due to leaks, and positive trends in the plumbing health by eliminating small leaks. Overall, the Test Group did identify a number of leaks (big and small), and actually fixed them during the test period. The three findings are described in the Results section in more detail. An overview of the findings include:

### **1. Health Test Pass Rate Increases**

Test Group homes increased their pass-rate of Health Tests during the course of the study (Figure 5, in the Results section, p. 28). This demonstrates a proactive approach homeowners took to resolve leaks in their homes when alerted by the Flo by Moen device. Assuming the average leak results in 17 gallons of water lost per day, the improved health test results during the course of the Study resulted in water savings of **41.82 gallons/day**<sup>1</sup>.

### **2. High Water Waste Event Savings**

During the course of the study, specific Test Group homes saw water savings due to the Flo by Moen system detecting a water loss event and automatically shutting off the water. The Flo by Moen Smart Water Shutoff detected hundreds of critical alerts over the study, however, of the 10 critical alerts that were reported by 9 different devices, the Flo by Moen device automatically shut-off 6/10 critical incidents, preventing catastrophic damage to those respective homes.<sup>2</sup> The resulting 6 automatic

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<sup>1</sup>Kiefer, J., Dziegielewski, B., Mayer, P., DeOreo, W.B., (2016). “Residential End Uses of Water, Version 2 Executive Report”. Indoor Household Use by Fixture. pg. 5

<sup>2</sup> Flo determined that all 10 critical incidents were true positive events (i.e., critical alert = irregular flow rate detected). The Flo by Moen Smart Water Shutoff alerted the homeowner for the remaining 4/10 critical incidents, and in those instances, the homeowner took necessary measures to stop the critical flow event before the device automatically shut off the valve. 1 critical incident was the result of a leaking toilet flapper, and the remaining 3 critical incidents’ were the result of fixtures that were left on by the homeowner.

shut-offs from 6 different devices came from 8% of the Test Group participants. All 10 critical incidents are broken down in Table 4 Results section, p. 29)

### 3. Consumption and Pressure Decreases among all Flo Customers

The charts in Figure 6 (Results section, p. 32) illustrate consumption and pressure levels among all Flo customers over the first 90 days they installed their Flo device. After 45 days of device installation, average daily usage **decreased ~35 gallons** and average daily pressure **decreased ~2 PSI**. These findings indicate that homeowners took proactive measures to fix leaks, adjust behavior and other damages in their infrastructure that may have been causing pressure abnormalities and increased consumption levels. The results could also indicate that homeowners with Flo by Moen Smart Water Shutoffs are more likely to use less water over time because they are proactively using the app to monitor water usage.

## II. INTRODUCTION: FLO BY MOEN



### A. About Flo by Moen

Flo's mission is to "prevent loss, one drip at a time."<sup>3</sup> Flo is attempting to stop preventable water damage and unnecessary water waste in homes, not only in this country, but around the world. US homeowners' insurance companies estimate the water damage problem at around \$9 billion per year,<sup>3</sup> and show the problem is getting worse year-over-year. The EPA reports shows that minor water leaks in homes account for more than 1 trillion gallons of wasted water each year, equal to the annual household water use in 11 million homes.<sup>4</sup> Flo is focused on applying our first-of-its-kind and proactive system to tackle and solve these global problems.

Based on decades of plumbing and fluid dynamics expertise, Flo's foundation has been built on solid plumbing DNA. Henry Halimi, Flo's Inventor and co-founder, has been in the plumbing industry for over 25 years as a mechanical engineer, inventor and expert witness for plumbing equipment companies in litigation. He spent over 10 years analyzing all of the ways that plumbing can fail in homes. The Flo by Moen device is the answer to proactively protecting the home from such failures. Historically, utility rebates have been focused on adopting low flow fixtures, and curbing other active or intentional uses of water. The future of water conservation rebating is through the adoption of devices such as the Flo by Moen Smart Water Shutoff.

<sup>3</sup> Montgomery, Lisa "A Smart Home That Pays You Back for Water Problems?" Electronic House, 18 June 2018, <https://www.electronichouse.com/home-security/a-smart-home-that-pays-you-back-for-water-problems/>.

<sup>4</sup> Visit [epa.gov/watersense](http://epa.gov/watersense)

Since being founded in 2015, Flo has raised over \$40 million in venture funding, including funding from two top US insurance companies. In 2018, Flo formed a strategic partnership with Moen, one of the world's leading plumbing fixture brands. This unique partnership leverages core strengths of both Flo and Moen, while capitalizing on our shared commitment to offer the best user experience and modernizing how people interact with water in their homes. As part of the partnership, Flo re-branded its products as "Flo by Moen."

## **B. Leak Detection Technology**

The Flo by Moen device proactively monitors the entire home water supply line from leaks as big as a burst pipe, to as small as a drop per minute. It measures all factors of a home's water health such as flow rate, pressure, and temperature. After about a week of "learning," the Smart Water Shutoff begins to constantly analyze telemetry in real-time to determine if each home's water conditions are consistent or anomalous, resulting in alerts and automatic shut-off if needed. The Flo by Moen App allows homeowners to track their water usage data, set conservation goals, remotely shut off/on the home's water if needed, and more.

Historical leak detection and water monitoring devices have not been able to proactively alert homeowners of plumbing issues that can cause leaks in the supply line, including irrigation. Additionally, traditional solutions may have been effective at reactively shutting off the water supply to mitigate water loss and damage, but they weren't intelligent enough to adapt to the usage in the home and relied on manual configuration for protection. Homeowners who choose to monitor irrigation with the Flo device should consider the various device installations. In Los Angeles, landscape irrigation is usually downstream from the device, but may vary depending on device installation location. Some homeowners prefer for the Flo device to monitor the home *and* irrigation, and therefore, can have the device installed before the water supply line splits for irrigation, and the Flo device can detect its water flow. Other homeowners who have backyard irrigation and pools connected to the home plumbing line, may install the device after the irrigation valve splits from the water supply line -- in this case, the irrigation is downstream. There is not a definite "always downstream" or "never downstream" scenario, it all depends on how the Flo device is installed.

Of the Test Group cohort, 80.5% had irrigation of the following types:

1. Drip only - 1.39%
2. Drip and sprinkler - 5.56%
3. Sprinkler only - 73.61%

Of those that have irrigation only, 3.4% are not being monitored by the Flo device.

The Flo by Moen Shutoff is installed after the water meter, and after the home's shutoff valve. This is well beyond the meter, and therefore will not be installed in the valve box. Installation in a valve box is not recommended for the following reasons: The shutoff is outdoor rated, but cannot be submerged. Installation in a valve box can cause water accumulation from rain, and heavy condensation, which can, over time, result in water damage within the device. Additionally, WiFi and power may be challenging to deliver to the shutoff were it to be in a valve box next to the meter.

The Flo by Moen Smart Water Shutoff focuses on water loss in the home infrastructure, often behind walls, underneath slabs, or leaks too small or hidden to be identified by homeowners or utilities. In 2011, the EPA and Water Research Foundation published a study of accuracy of in-service water meters at low flow rates that did not accurately detect small water loss events.<sup>5</sup> Flo identifies these small, even microscopic, leaks that occur downstream from the device every day. Flo gives homeowners and utilities definitive insight into whether or not leaks exist, being able to designate homes as “leak free,” everyday.

<sup>6</sup>

### C. Flo by Moen Smart Water Shutoff: Detailed Device Functionality

The Flo by Moen device is installed on the water supply line to the home after the pre-existing manual shutoff, and right before the water enters the home. The Flo by Moen Smart Water Shutoff proactively monitors the entire water supply system downstream of the device, within the home, and detects any abnormal water events, such as small drips, high water pressure, freezing temperatures, and abnormal water usage. This system is distinguishable from legacy leak detection technologies, which used sensors downstream from the product’s installation. Rather, there are no point sensors needed around the property to communicate leak information to the customer with the Flo by Moen device. The Flo by Moen device is installed inline and capable of shutting off the water supply to the property, further distinguishing it from single sensor devices that are only able to beep when water hits them in the area they’re placed (i.e. under a sink, or near a water heater).

The Flo by Moen Smart Water Shutoff is not limited in its ability to monitor water flow rates. It is also capable of monitoring real-time pressure in the property’s water supply. The benefit of monitoring real-time water pressure is to alert the property owner of pressure increases that can cause bursts in pipes, fixtures and appliances. Flo by Moen monitors pressure in real-time, and alerts homeowners when things aren’t looking right, allowing immediate action to decrease the risks of leaks that high water pressure can cause. More about water pressure monitoring can be found here: <https://www.youtube.com/watch?v=Fs02lcMahQ>. An engaged homeowner will take steps to reduce water pressure when alerted of high water pressure. By doing so, the homeowner significantly reduces the likelihood of causing leaks.

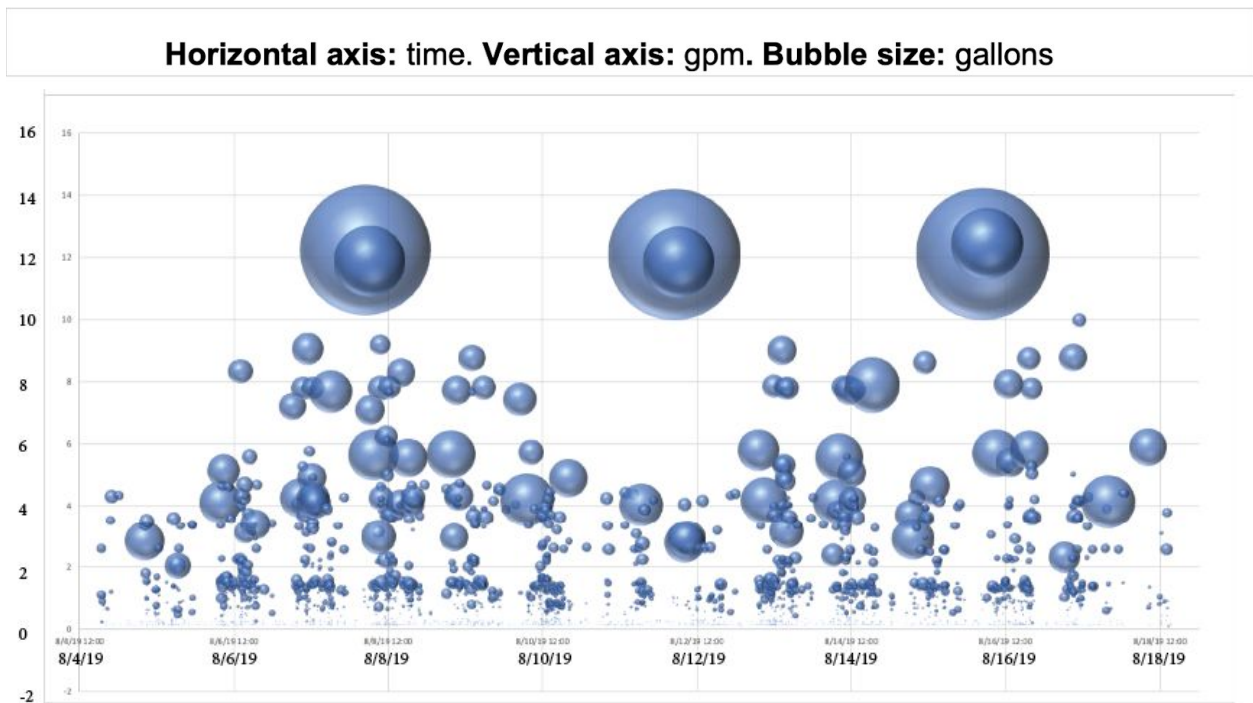
In the event that the Flo by Moen device detects a critical leak in the home’s plumbing system, it can automatically shut off the home’s water supply line to protect the home from damage and conserve water that would otherwise be lost through leak events, which occur downstream from the installation location. Demonstrations of how the Flo by Moen Smart Water Shutoff visualizes water usage using

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<sup>5</sup> “Accuracy of In-service Water Meters at Low and High Flow Rates.” *The Water Research Foundation*, <https://www.waterrf.org/research/projects/accuracy-service-water-meters-low-and-high-flow-rates>.

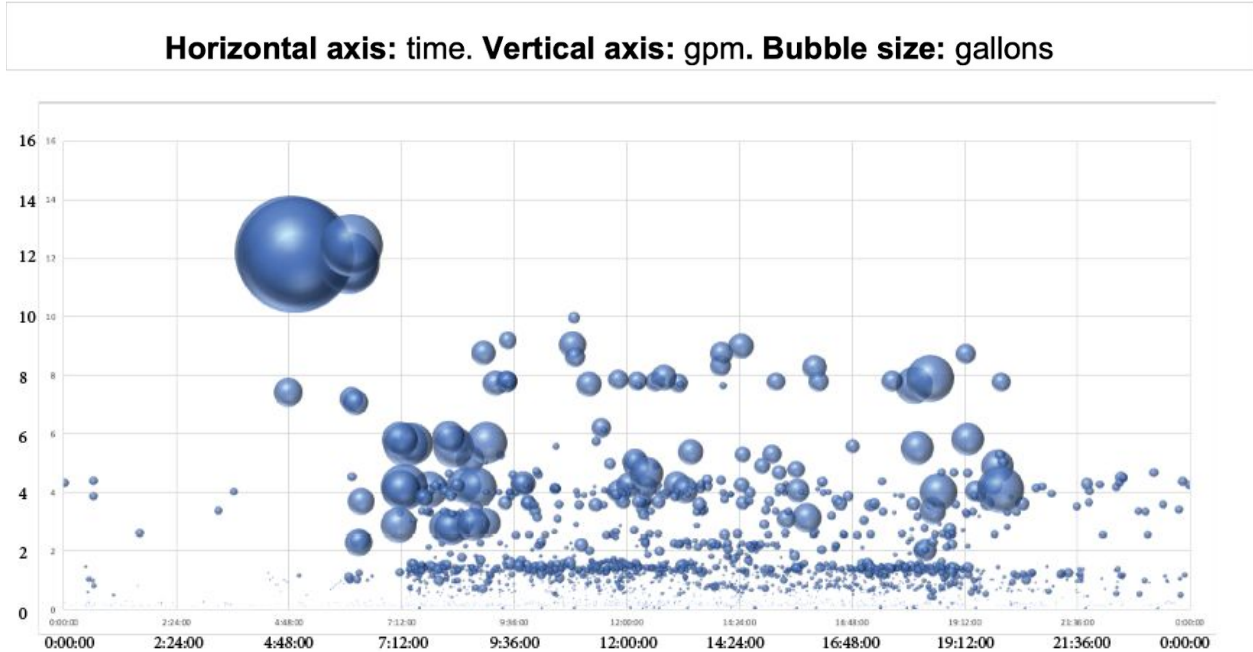
<sup>6</sup> See page 33 to learn how the Flo by Moen Smart Water Shutoff runs daily health tests to proactively protect homes from water damage and limit water waste.

gallons per minute, total gallons consumed, time of consumption, duration of consumption and a combination of those factors in a home can be seen in **Figure 1** and **Figure 2** below.



**Figure 1: Example of a Test Group Homeowner's 2 Week Water Usage**  
*(To best illustrate water usage in this figure, fixture data was captured at 12:00pm PDT, however the Flo by Moen Shutoff captures water usage every second)*





**Figure 2: Example of a Test Group Homeowner's 2 Week Water Usage from Figure 1 (overlaid over 24 hour period)**

#### **D. Flo by Moen Features**

##### **1. The Flo by Moen Smart Water Shutoff Valve**

Once the Flo by Moen Smart Water Shutoff is installed on the home's water supply line, users can:

- Proactively monitor pressure, temperature, and flow rate of the home's water.
- Learn the water usage patterns of the home so it knows the difference between typical water use and a leak event.
- Run daily health tests to routinely check for leaks and potential vulnerabilities in the home's plumbing system
- In the event of catastrophic failure, automatically shut off the water in order to protect the home
- Alert users of issues via text, email, phone call, or push notifications
- Contact Flo Support with any questions or for help troubleshooting an alert

##### **2. The Mobile App**

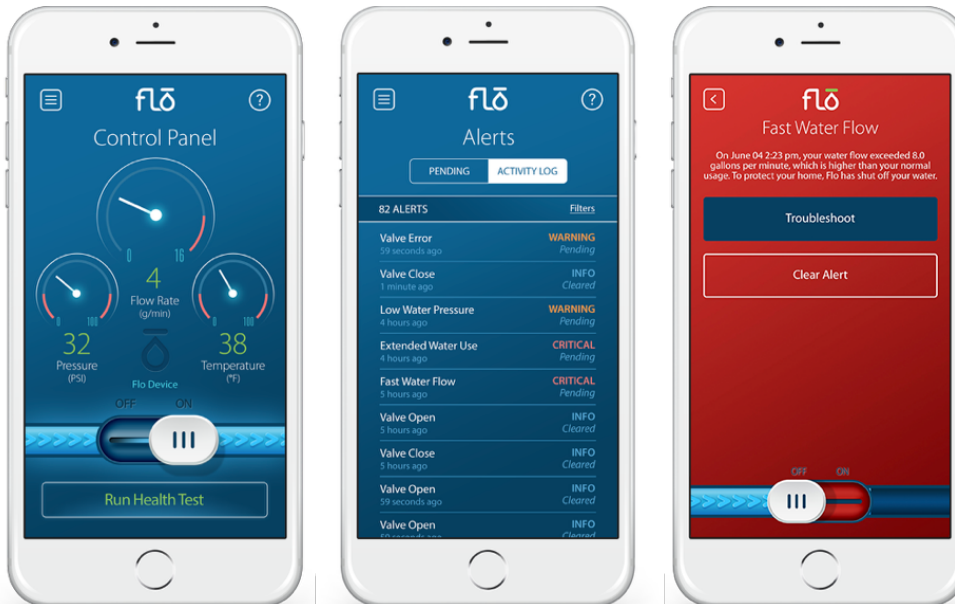
The mobile app contains multiple interfaces to allow users to monitor water usage and any vulnerabilities in the home's plumbing system **(see Image 1 below)**.

- Control Panel: The control panel allows users to see real-time water usage, and manually shut off the water valve.
- Dashboard: The dashboard allows users to see how much water they have consumed on a daily or weekly basis. If the user is monitoring daily consumption, they can also have access to the hourly consumption bar charts, illustrating peak consumption. The user can also switch between the 3 system modes in the dashboard.
  - a. Home mode - if the device is in home mode, it will send the homeowner an alert, and if it does not hear from the homeowner within a defined time, it will automatically shut off the valve.
  - b. Away mode - if the device is in away mode, it will send the homeowner an alert, and if it does not hear from the homeowner within 10 seconds, it will automatically shut off the valve.
  - c. Sleep mode - if the device is in sleep mode, it will *not* send the homeowner any alerts in the event of a catastrophic leak (note: homeowners may choose to put the device in sleep mode when they know they will be purposefully increasing their water use (filling a pool, car wash, guests visiting the home, etc.)) The device can remain in sleep mode for up to 72 hours, and after 72 hours, it will revert to the mode it was in before it was placed in sleep mode.



Menu

Dashboard



Control Panel

Alert History

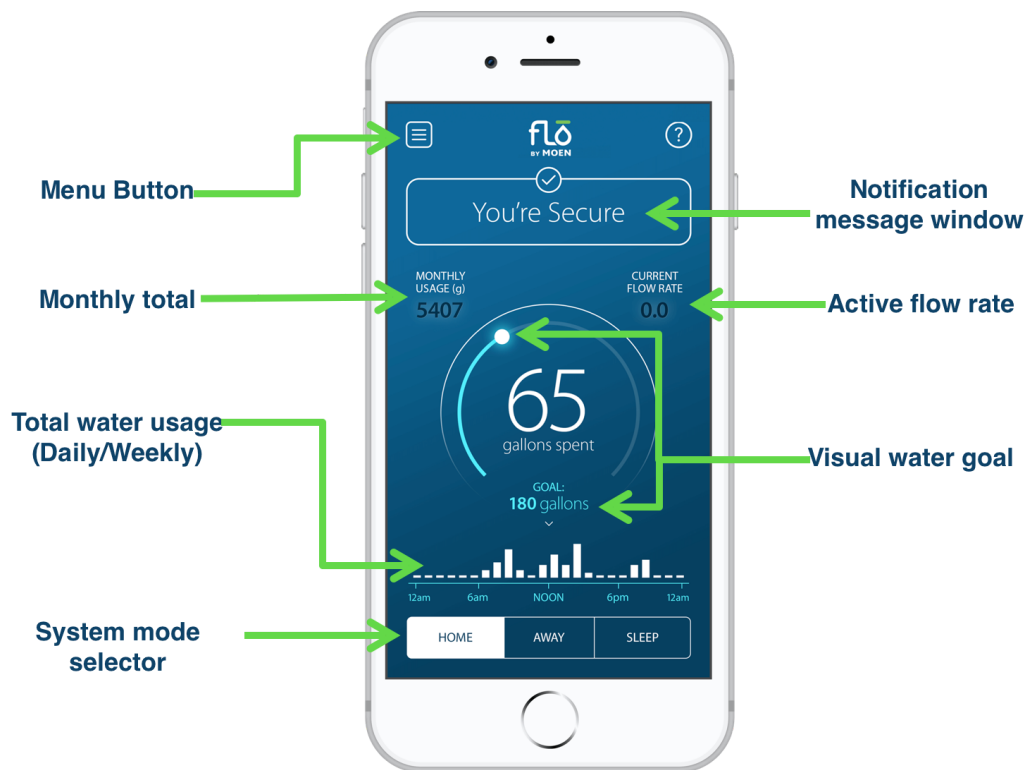
Sample Critical Alert

**Image 1: Flo by Moen Control Panel, Dashboard, and Alerts**

- Alerts

The system will send 3 different types of alerts if it detects abnormalities in usage.

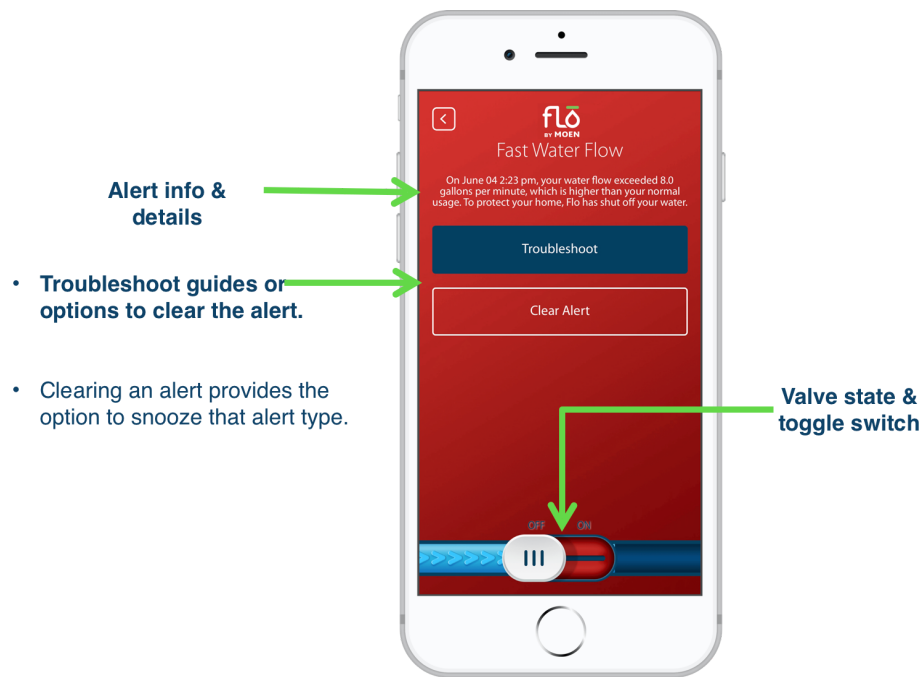
- d. Warning alerts – In the event of pressure irregularities (i.e., pressure increasing over 80 PSI, etc.) and temperature irregularities (i.e., freezing temperatures), a warning alert will be sent to the homeowner's mobile device.
- e. Informative alerts- The results of the daily health test will be sent to the homeowner's mobile device in the form of an informative alert. The daily health test runs daily at 03:00, or at a time when it knows there is no water usage in the home.
  - A. If the homeowner passes their health test, an alert will be sent to their mobile device titled 'Auto Health Test Successful'.
  - B. If the homeowner fails their health test, an email will be sent titled 'Small drip detected', and 2 options will be presented to the homeowner: (1) troubleshoot the alert; or (2) Ignore the alert.
- f. Critical alerts - In the event of flow rate irregularities (i.e., extended shower use, leaky toilet flappers, water heater pipe burst, etc.), the Flo by Moen system will send the homeowner a critical alert directly to the mobile device (phone call, in app push notification, text message, email).



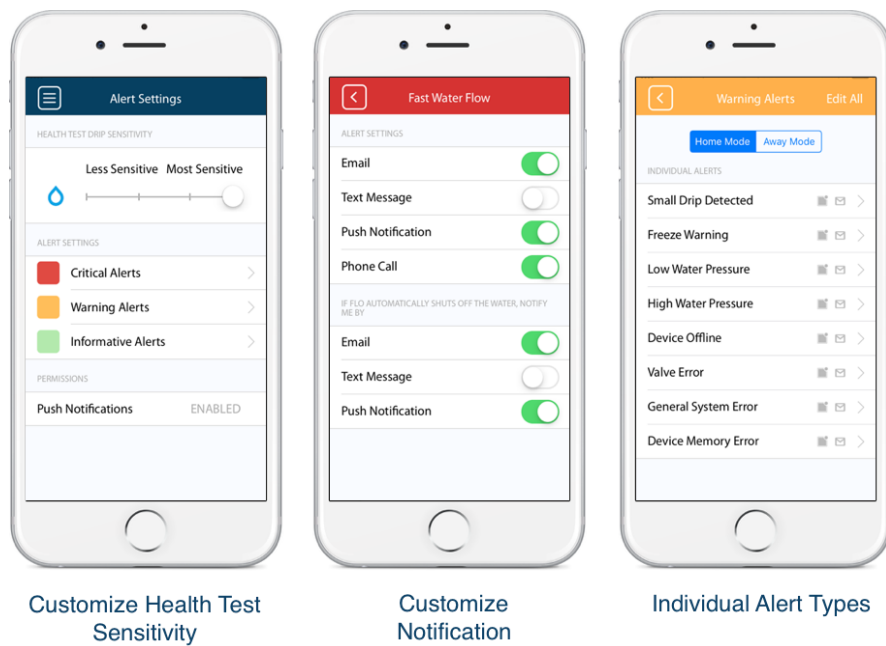
**Image 2: Flo by Moen Detailed Dashboard View**

Once the Flo by Moen system learns the homeowner's water usage behavior (the learning period for the device can range anywhere from 2 to 7 days, it will also learn *irregular* usage and consumption. The Flo by Moen system categorizes *irregular* events into 3 buckets:

- g. Excess flow rate (gallons)
- h. Extended duration of flow (minutes)
- i. Totalization (gpm)



**Image 3: Critical Alert, Fast Water Flow**

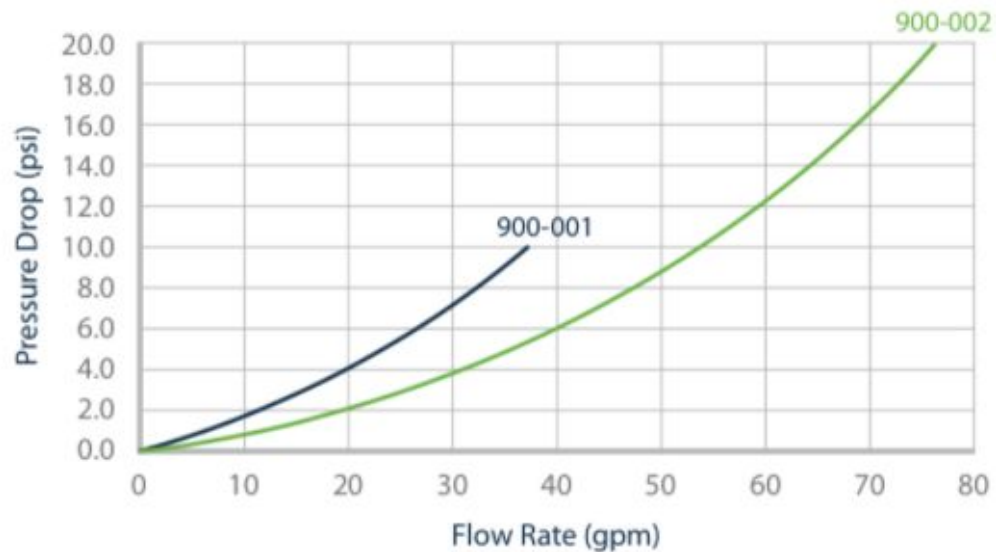


**Image 4: Alert Settings & Customizations**

- Flow Performance - IAPMO results
  - The chart below depicts the maximum flow rates at each given static supply pressure level (PSI).
  - Ex: At 80 PSI, the ¾" (900-001) the maximum throughput is 37.6 gpm.

### PERFORMANCE

Static Supply Pressure	Max Flow Rate (gpm)	
	¾" (900-001)	1.25" (900-002)
30	24.5	88.3
45	28.5	108.3
60	32.6	122.0
80	37.6	137.7



**Figure 3: Flow Rate and Pressure Drop Results from 3rd Party Testing at IAPMO**

- Live Support

Flo by Moen provides customers with access to live support in the event of a catastrophic leak, or for any questions or concerns on the device or mobile application.

- Proactive 24/7 monitoring with preventive alerts to avoid catastrophic damage.
- Our water damage prevention experts help customers troubleshoot and quickly resolve any issues the Flo by Moen system detects, and they're

available to recommend Flo-verified professional installers and plumbing resources across the United States.

- Optional Feature - FloProtect

FloProtect is an *optional* \$5 per month add on guaranteeing home safety from water damage.<sup>7</sup> It is available for free to customers for 1 month when they first sign up for the system. FloProtect features include:

- A water damage reimbursement guarantee up to \$2,500 in the unlikely event the system fails to protect against catastrophic damage
- Installation verification letter to help save money on home insurance
- In-app access to live chat with Support
- Enhanced water usage data to help users reduce their water use. With FloProtect, users can learn how much water their appliances are using with Fixture Detection. Note, this feature is only available with FloProtect.
- 3-year extended product warranty<sup>8</sup>

### **III. INTRODUCTION TO LADWP**

The Los Angeles Department of Water and Power (LADWP) is the largest municipal water and power utility in the nation, established more than 100 years ago to deliver reliable, safe water and electricity to more than 4 million residents and many businesses in Los Angeles. LADWP provides over 680,000 water customers with quality service at competitive prices.

### **IV. FLO'S PROPOSAL**

On March 22, 2018, Flo submitted a proposal with Metropolitan's ICP to conduct a "Pilot Program" and study water usage habits with LADWP. Such Proposal included two parts:

#### **A. Proactive Leak Detection and "low hanging fruit"**

According to the Water Research Foundation, approximately 13% of indoor water use is lost due to leaks (approximately 18 gallons per home per day)<sup>9</sup>. According to the EPA, this is over a trillion gallons per year nationwide<sup>10</sup>. According to the USEPA, average household's leaks can account for more than 10,000 gallons of water wasted per home every year, and ten percent of homes have leaks that waste 90 gallons or more per day.<sup>11</sup> Unlike any other leak detection system on the market, Flo's proprietary technology identifies all leaks, leaks as small as a single

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<sup>7</sup> FloProtect was provided to the Test Group at no charge

<sup>8</sup> The Flo by Moen device ships with a one-year manufacturer warranty included with the standard purchase of the product.

<sup>9</sup> [Water Research Foundation, 2016](#) ; [Residential End Uses of Water V2, 2016](#)

<sup>10</sup> [EPA, 2017](#)

<sup>11</sup> [EPA, 2017](#)



drop of water per minute behind a wall, or as large as a pipe burst or major slab leak. The system empowers customers to repair those leaks and daily designates homes as "leak free". If a leak is detected, Flo helps residents identify the underlying leak or vulnerability, and fix the problem. In the event of a pipe burst or water left running, Flo can notify homeowners (via text, push notification, email and phone call) and can automatically shut off the water without the homeowner taking action. Common types of leaks found in the home are faulty toilet flappers, dripping faucets, and other leaking valves. These types of leaks are often easy to repair yet go undetected.

### 1. Behavioral Change Water Savings

Results of a 2014 National Academy of Sciences study showed that participants underestimated water use by a factor of 2 on average, with large underestimates for high water-use activities.<sup>12</sup> The Flo System's real-time data reporting feature is unique. Flo will implement and monitor behavioral cause and effect strategies, using real-time information and customer communication methods to promote water savings. Flo provides homeowners with real-time data on water usage, pressure, and temperature of their homes water system without the need for a smart meter from their utility. Note that while the Flo device does detect water usage from the supply line, the Flo device did not replace the utility meter and was not used for billing purposes for LADWP.

Not only does Flo prevent water damage, leaks and unnecessary water waste in homes across the country with its smart leak prevention system, but the Flo by Moen Smart Water Shutoff has helped homeowners save over **23 million gallons** since launching in 2018. Flo's first-of-its-kind water monitoring and shut-off device proactively detects micro-leaks and other vulnerabilities anywhere in the home's water supply, preventing costly damage before it happens. In addition to preventing water damage, Flo aims to promote the conservation of our depleting freshwater supply by informing customers of their water usage trends, daily leak reports, and behavioral adaptations to catastrophic leaks.

As part of the Proposal, Flo agreed to submit this Report to "validate the outcome of water monitoring/leak detection and automatic shut-off valve smart home devices against the hypothesis of a 10% water use reduction in homes compared to the control group."

See below for Flo by Moen Smart Water Shutoff Device installation requirements and certain product details.

- Requirements for installation
  - a. An above ground and accessible home water supply line
    - A. SKU 900-001 fits all .75" or smaller water supply lines
    - B. SKU 900-006 fits all 1" or smaller water supply lines

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<sup>12</sup> [PNAS, 2014](#).


- C. SKU 900-002 fits all 1" - 1 1/2" or smaller water supply lines
- b. A standard power outlet within 10' of the device, and if power is not located within 10', the user may use Flo by Moen low voltage 25' extension cords for extended reach.
- c. Powered via plug-in AC to DC transformer
- d. Power Supply: 12 VDC via 100-240V – 50/60 Hz switching type
- e. A smartphone (iPhone or Android)
- f. Home Wi-Fi
  - A. WLAN Connectivity / IEEE 802.11bgn, 2.4 GHz frequency
  - B. Even though our product uses Wi-Fi to alert the homeowner of a leak and to share water use information, it does not require Wi-Fi to protect the home. (i.e., it does not need Wi-Fi to shut off valve in the event of a leak because our device stores its most recent parameters within itself, and makes its critical decisions without looking to the cloud.)

## ***V. DELIVERABLES AND DESCRIPTION OF WORK***

### **A. Deliverable 1: Identify and Qualify Homes**

Deliverable 1 of Flo's ICP Proposal was to identify and qualify homes to participate in a conservation study in LADWP's service area. To be part of the study, Flo devices would be installed on the pilot participants' homes. Flo determined the target number of homes to reach statistical significance with one year's worth of data to be 100 participating homes.

To execute this Deliverable, Flo worked with LADWP to send a series of emails to LADWP customers, which directed LADWP customers to a prequalification application landing page. The emails were sent by LADWP.


**Los Angeles  
Department of  
Water & Power**

## FREE Flo Smart Home Water Monitoring & Leak Protection System

As a valued LADWP customer, we want to let you know that you may qualify to participate in a pilot program for a leak detection product for home plumbing systems called "Flo." Flo is a smart home device that is installed on your main water supply line and monitors the water flowing into your home. This device may help protect your home from potential water damage and could potentially help you save money on your water bill. Participants can also monitor their entire home's water usage 24/7 using the Flo mobile app.

It's a simple concept: When a leak or any issue is detected, Flo sends an alert to your smartphone via a push notification, text, email or call. You can then shut off the water from the app, get troubleshooting tips, or contact a plumber – all to help protect your home from water damage, wherever you are.

LADWP is collaborating with Flo Technologies Inc. on a study of the potential water savings from using this Flo device. **The first 100 qualifying LADWP customers will receive a free, professionally-installed home water detection device through this unique offer.** Applicants for this offer must be a LADWP single-family residential homeowner with an active water account, have in-home Wi-Fi service, an electrical outlet near the home's water shut off valve, and an IOS or Android smartphone.


Applying takes less than a minute. There is no cost or commitment to apply. If you meet the minimum requirements, a Flo representative will contact you directly via the information you provide on your application.

**Interested?**

**Apply Now for FREE**

Deadline to apply is November 13, 2018

Learn more at [www.meetflo.com](http://www.meetflo.com)



Questions? Please call Flo Technologies, Inc. at (844) 633-8356 (9am to 5pm) or email [support@meetflo.com](mailto:support@meetflo.com).

**Image 5: Flo by Moen / LADWP Email Template**

The email described the pilot program, the fact that there was no financial commitment to join (free device and installation),<sup>13</sup> and how to apply. In total, 18,241 emails were sent by LADWP over the course of a 2-month period, in 3 email batches: 6,506; 2,691; 9,044.

<sup>13</sup> Based on qualitative findings from a number of other studies and pilots that Flo has conducted, Flo learned that having some financial commitment was important to attract engaged participants to provide more data to the study. We found that having no financial commitment was a detractor from getting 100 engaged participants for the study.

LADWP initially sent one email out to recruit Test Group participants for the study, but in order to increase the number of participants, they sent out an additional 2 batches of emails. See Table 1 below for the emails delivered, applications submitted, and total qualified participants. Flo fulfilled 40 devices from the first email batch, 15 devices from the second email batch, and 42 from the third email batch.

	<b>Total # of Contacts</b>	<b>Opened</b>	<b>Applications Submitted</b>	<b>Qualified &amp; Shipped Flo by Moen Smart Water Shutoffs</b>
Email Batch #1 (9/13/18)	6,506	2,047	196	40
Email Batch #2 (10/2/18)	2,691	749	140	15
Email Batch #3 (10/29/18)	9,044	N/A	387	42
Total	18,241	2,796+	723	97

**Table 1: Total Number of Emails Sent by LADWP & Qualified by Flo**

LADWP customers who opened the email and clicked on one of the five appropriate links were directed to a prequalification application, hosted by Flo, that asked them a variety of questions about their Home Wi-Fi/Wi-Fi, Smartphone access, etc. -- all of which were prerequisites to successfully use the Flo by Moen system. There were a total of 723 prequalified applications. After submitting the application, the potential pilot participants were told their application would be reviewed by Flo, and were then contacted directly by Flo. From the 97 'confirmed' participants, many people did not follow through, and in order to get as close to 100 participants as possible, Flo onboarded 29 participants via word of mouth referrals. When Flo received and reviewed the 100 treatment homes from the raw data (including the 29 word of mouth referrals), Flo cross-referenced them with the known installed devices, and reduced the count to 73 (i.e., of the 100 devices, 27 devices were not known to have been actually installed according to Flo data). Then, Flo eliminated 5 more devices because they lacked enough data. 3 of those 5 didn't have any control data, and 2 of the remaining 5 devices didn't have enough treatment data. The final treatment group = 68 participants.



**Thanks for your interest in participating in the Flo Pilot Program with Flo Technologies.**

Flo is collaborating with LADWP to provide qualifying customers a Flo Smart Home Water Monitoring and Leak Protection System. If you qualify and are selected, you'll receive a free Flo system and professional installation. **Together this is over \$800 of value for FREE!**  
Learn more about Flo at <https://meetflo.com>.

To see if Flo is compatible with your home, **please complete the 1-minute questionnaire** below. There is no cost or commitment to apply. If you meet the minimum requirements, a Flo representative will contact you shortly via the information you provide.

**Start** press ENTER

***Image 6: Screenshot of the Pilot Study application***

## **B. Deliverable 2: Description of Work**

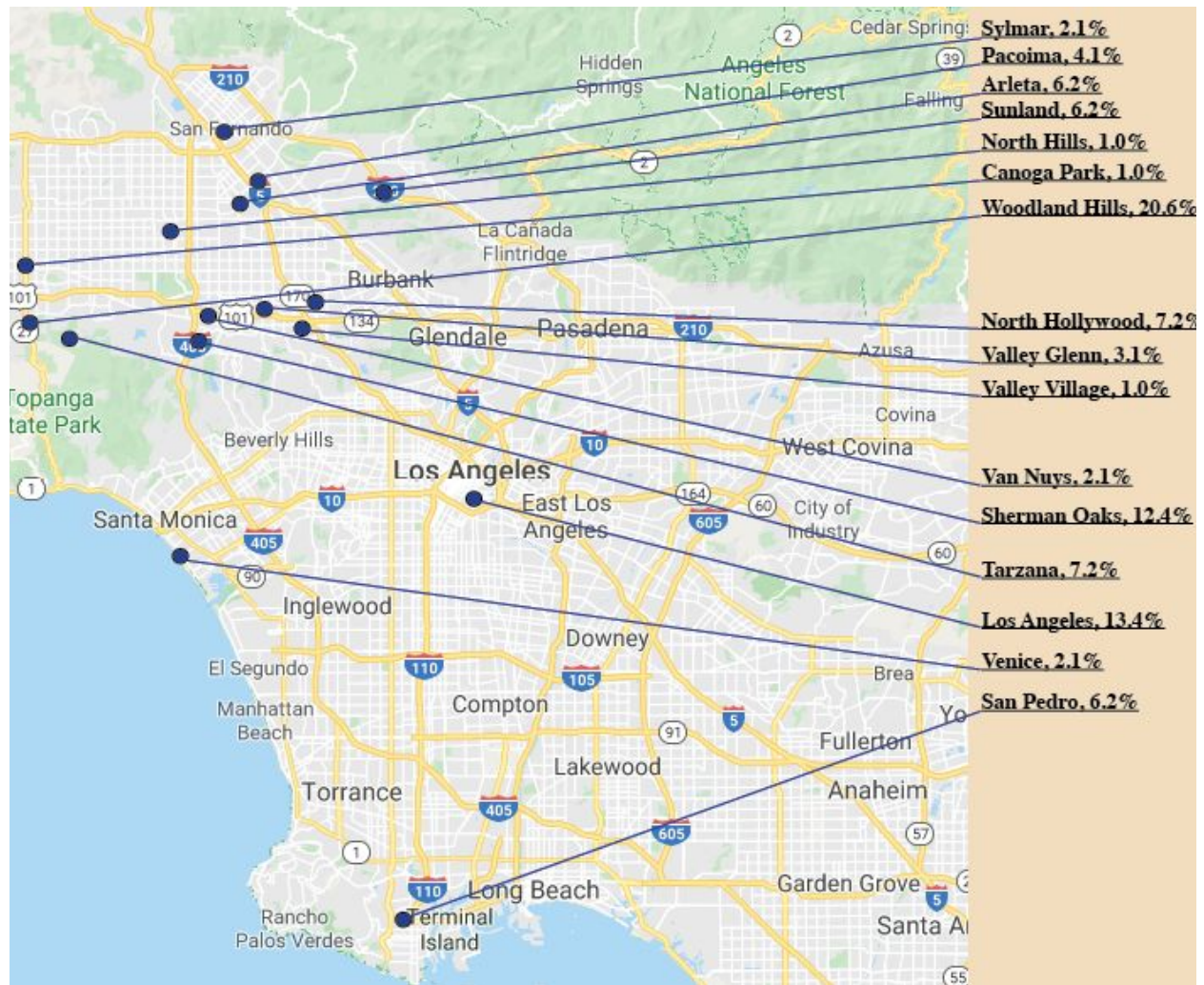
Deliverable 2 of the ICP program was for Flo to install the Smart Water Shutoff devices on the homes of participants qualified as part of Deliverable 1. As Flo was able to make contact with the homeowners and confirm their interest in participating in the study (and qualifications and requirements thereof), Flo by Moen devices were shipped on a rolling basis to qualified homeowners.

When the qualified homeowner received the Smart Water Shutoffs in the mail, they were asked by Flo Support to 'pair' their device with their home's Wi-Fi and the Flo by Moen smartphone app. To do this, the homeowner had to create a Flo account and follow the step-by-step pairing flow in the Flo by Moen smartphone app. Flo required this step prior to installation to optimize the plumber's time on-site and to ensure the home's Wi-Fi and user's smartphone was compatible for the System. During this process, several emails were sent out to the homeowners that reminded them to pair their Flo device if they had not<sup>14</sup>.

When pairing was complete, Flo's plumber reached out to the homeowner to schedule a time for them to install the Flo device on the home's water supply line and ensure power was supplied to the Flo device. As set forth above, Flo ultimately installed 100 devices on LADWP service area homes. The 100 homes on which the Flo by Moen device was installed and the homeowner participated in the study comprised the "Test Group."

<sup>14</sup> Because there was no financial commitment by the Test Group, many of the participants either stopped replying after they received the device, or significantly delayed the setup and installation process; this was a detractor from getting 100 timely and engaged participants for the study.





**Figure 4: Breakdown of qualified participants**

### C. Deliverable 3: Data Collection/Cloud Services

Deliverable 3 required Flo to “expend resources for staff time, data collection and cloud services, engineering, analysis, messaging, and reporting. In addition to customer content accessible on Flo’s phone app and web-based customer portal, Flo and LADWP worked on deploying conservation messaging to a subset of participants. Communication channels that Flo offers include weekly email reports, texts, push notifications, and automated calls. The customized messaging may have real-time demand side management messages, offers for other water efficiency incentives, and general information on water savings and the importance of having a leak free home.”

Flo completed this deliverable by completing the following initiatives:

- LADWP collected data from homes in the test cohort and sent this data to Flo. (Appendix E)

- Flo collected data from homes in the test cohort from the Flo devices. (Appendix F)
- LADWP collected data from homes in the control cohort and sent this data to Flo. (Appendix E)
- Flo is reviewing and analyzing data from the control and test cohorts to evaluate the consumption savings. (Appendix G)
- Flo is reviewing and analyzing data from the control and test cohorts to evaluate other potential relevant correlations between the cohorts. (Appendix H)
- Flo's cloud data storage, analysis and infrastructure allow Flo to do the following:
  - i. Build custom and proprietary algorithms to alert the test cohort of leaks and potentially shut off the customer's water supply depending upon the size of the leak. This leak detection and automatic shutoff provide a framework to decrease water consumption in the test cohort due to a decrease of water lost due to leaks; and
  - ii. Compare the test cohort water consumption and other metrics described herein to the control cohort's consumption metrics provided by LADWP.
  - iii. Assumptions on presumed decreases in consumption as a result of leak identification include:
    - 1. Metric - The average of the maximum daily water usage in gallons, since the measure used for all devices was *installation*.
    - 2. Duration - 75 day duration - Flo selected a duration that would include all devices without any gaps while still being long enough to provide insight.
    - 3. Seasonality - Seasonality concerns were mitigated somewhat by the variance in date of installation. A larger data set would provide more conclusive results, but Flo feels this is acceptable for a study of this size.
- Flo messages the test cohort with information about their consumption through the Flo mobile application. (Appendix I)
- Flo messages the test cohort with information about their consumption through email as it compares it with their prior consumption and consumption of homes in their region. (Appendix J)
- Flo messages to the test cohort information on water efficiency, water savings and the importance of a leak free home. (Appendix K)

#### **D. Deliverable 4: The Current Final Report & Data Collection**

## **VI. OBJECTIVES**

### **A. Experimental Goal and Setup**

This Report's goal was to analyze the impact of using the Flo by Moen Smart Water Shutoff device on water savings for single-family homes in Los Angeles. In order to estimate the impact, the Flo by Moen Water Shutoffs were installed on 100 pre-qualified homes in LADWP's service area.

## **VII. METHODOLOGY**

### **A. Selecting Test Groups and Control Groups**

LADWP provided utility meter data that was collected and aggregated for multiple years before the installation and a year after the installation, both for the 100 participants in the Test Group, and the approximately 1,940 total in the Control Group.<sup>15</sup> For the Test Group, LADWP selected a sampling of zip codes to represent different demographics and areas within the Los Angeles Metropolitan area. Then, LADWP filtered out homes that had missed readings and those that did not have consistent residence in the same home for the time period (2013-2018). From the filtered group, Flo was then able to qualify 100 participants as the Test Group, which included 29 word of mouth referrals.<sup>16</sup>

When Flo received and reviewed the 100 treatment homes from the raw data (including the 29 word of mouth referrals), Flo cross-referenced them with the known installed devices, and reduced the count to 73 (i.e., of the 100 devices, 27 devices were not known to have been actually installed according to Flo data). Then Flo eliminated 5 more devices because they lacked enough data. 3 of those 5 didn't have any control data, and 2 of the remaining 5 devices didn't have enough treatment data. The final treatment group = 68 participants.

LADWP selected approximately 20 homes for each single Test Group participant to act as a Control Group for each of those 100 Test Group homes. Each "Control Group" home was selected by (1) being in the same zip code of that specific Test Group home, and (2) being within +/- 15% in usage per month on average for the years 2015-2017. Because LADWP was not able to get a sufficient number of homes for certain Control Groups, in two instances, LADWP supplied Control Group homes with +/- 20% in usage per month.<sup>17</sup> The final study included 68 participants with <20% missing daily usage date.<sup>18</sup>

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<sup>15</sup> The Test Group suffers from a selection bias because those individuals opted into the study. Unfortunately, the Control Group does not have a matching bias because they were selected randomly from the LADWP data without each customer opting in. A better method would have been to ask a large pool of individuals to opt into the study, and then randomly assign them to the Control Group or Test Group.

<sup>16</sup> Because the process of soliciting qualified participants through LADWP's email campaign did not get the study enough qualified participants, several homes in the Test Group included former stakeholders of LADWP, and employees and family members of Flo.

<sup>17</sup> Unfortunately, widening the Control Group range for water usage negatively impacts the statistical significance of the data.

<sup>18</sup> After the data from the 100 installed Smart Water Shutoffs were cleaned, and after a number of homes were excluded (see previous footnote), 73 participants qualified for participation. However, after the Smart Water Shutoffs were installed, 5 devices did not have sufficient water usage data resulting in 68 total test group devices for the study. Note that because this



## B. Differences-in-Differences Method

Flo used the difference-in-differences method to estimate the causal effect of installing the Flo by Moen Smart Water Shutoff on the Test Group.<sup>19</sup> We represent the average water use in a home as  $w$ , and subscript this usage with  $T$  for the test group or  $C$  for control. We also denote the time period of the measurement with either  $B$  for before the device was installed, or  $A$  for after the device was installed. Finally, we denote the counterfactual with a tilde, so  $\tilde{w}_{TA}$  denotes what the average water usage *would have been* for the test group in the test period if the device *had not been installed*.

**Flo makes a key assumption: the change for the Test Group in the test period would have been the same as for the Control Group if the device had not been installed for the Test Group.**

$$\text{Equation 1} \quad \tilde{w}_{TA} - w_{TB} = w_{CA} - w_{CB} \quad (\text{Eq 1})$$

Then, we seek to find the change  $w_{TA} - \tilde{w}_{TA}$  caused by installing the device. By substituting Eq. 1 we find

$$\text{Equation 2} \quad w_{TA} - \tilde{w}_{TA} = (w_{TA} - w_{TB}) - (w_{CA} - w_{CB}) \quad (\text{Eq 2})$$

The r.h.s. of Eq. 2 contains no tildes, so that we can compute it from the observed data.

We express the final result as a percent difference because it is convenient for comparing across cohorts. To do so, we may normalize by the average water use in the treatment group without the treatment. Thus the percent difference we seek is

$$\text{Equation 3} \quad \frac{w_{TA} - \tilde{w}_{TA}}{\tilde{w}_{TA}} = \frac{(w_{TA} - w_{TB}) - (w_{CA} - w_{CB})}{w_{TB} + (w_{CA} - w_{CB})} \quad (\text{Eq 3})$$

## C. Implementation Details

In order to compute the percent difference across all the cohorts of the data set, we must extract the relevant water-use statistics. This requires careful accounting of time periods for two distinct reasons. First, LADWP's water meter was read approximately bi-monthly (every 2 months) at each home, but on different dates. Second, the Smart Water Shutoff was installed on a different date in each of the homes in the Test Group. Thus, the test period began at a different point in time for each cohort. When Flo received and reviewed the 100 treatment homes from the raw data (including the 29 word of mouth referrals), Flo cross-referenced them with the known installed devices, and reduced the count to 73 (i.e., of the 100 devices, 27 devices were not known to have been actually installed according to Flo data). Another complication is that we are missing data for some homes because LADWP's water meter was presumably broken (as it was not reporting data) or because different residents were living in those respective homes during the study (2013-2019), Flo eliminated 5 devices because they lacked enough

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was an unpaid study, several participants might've disconnected their device or chose to no longer participate in the study after they were selected as treatment group participants. This affected the active devices throughout the study, and therefore the varied number of devices available throughout the study.

<sup>19</sup> Varian, Hal R. "Causal inference in economics and marketing." *Proceedings of the National Academy of Sciences* 113.27 (2016): 7310-7315.

data. 3 of those 5 didn't have any control data, and 2 of the remaining 5 devices didn't have enough treatment data. The final treatment group = 68 participants.

So, we must eliminate some homes from the study (32 homes).

As mentioned previously, each test home where a Flo by Moen Smart Water Shutoff was installed was assigned to a corresponding cohort of control homes. Rather than try to align the difference-in-differences analysis across all of these cohorts, we instead compute a separate causal effect for each cohort, and then perform a statistical analysis of the collections of cohort results. This helps make the assumption of Eq. 1 more reasonable because we are only assuming similar trends within each cohort. Effectively we are mitigating issues stemming from mis-aligned seasonality between the cohorts because we allow a separate shared trend for each cohort. More importantly, by computing the difference-in-differences on each cohort separately, we are able to produce a collection of results that facilitate use of the bootstrap algorithm for computing the variability in our causal estimate. In other words, we are able to compute confidence intervals for our result.

Each cohort is a set of one test home and approximately twenty control homes. We perform the following steps for each cohort. First, we split the data into a period before test (denoted B) and a period after test (denoted A). We split the data according to the known installation date for the Flo device in the test home. We look back for a period of 540 days prior to installation in order to extract period B, and look forward for as much data as is available for period A. We check for missing records and require that at least 3 records exist in period B and period A for every home in the cohort in order to keep the cohort in our analysis.

Next, we compute the average water usage for both periods and for the test homes and the control homes. In order to account for the varied utility meter-reading times, we use known dates of the readings on a per-home basis for computing the average. For each home, we determine the number of days between the last reading of the period and first reading of the period. Then we sum the amount of water used in that period (leaving off the utility meter reading from the first date in the list because it corresponded to water that was used before the reading period).<sup>20</sup> For the test home, we simply compute the average water use by dividing the total use in the period by the total number of days in the period. For the control homes, we construct a weighted average by summing the total water use in the period over all homes and dividing by the total time across all homes.

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<sup>20</sup> Excluding the first sample has the side benefit of excluding the short period of time during which the Flo device was installed between utility meter readings, which is an ambiguous period because it includes both pre-test (B period) and post-test (A period) data.

Performing the steps above for every cohort produces a list of values for  $w_{TB}$ ,  $w_{TA}$ ,  $w_{CB}$ , and  $w_{CA}$

from which we may evaluate Eq. 3 for each cohort. Next we perform a bootstrap sampling<sup>21</sup> in order to acquire statistics on the variability of our estimate. We sample the results 5,000 times with replacement. From this list of 5,000 values, we compute the average and also the 95% confidence interval by extracting the fifth and ninety-fifth percentile value from the 5,000 values.

#### **D. Proving Causality**

Due to various factors, such as seasonality emergence in 2019 from a five year drought from 2014 - 2017, and other external factors, we cannot simply compare historical consumption data to consumption data following the installation of the Flo by Moen Smart Water Shutoff device on the Test Homes in the study. Some examples may include variability in the number of residents in the home over time due to residents having kids, kids moving into and out of the residences, divorce, and other factors that may affect consumption which were not able to be tracked in the Test Group. For this reason, we have created the aforementioned Test and Control Groups in an attempt to best analyze any causal link between the existence of a Flo by Moen Smart Water Shutoff device and a change in water consumption. In order to prove this causal link, we deploy rigorous statistical analysis as described herein.

#### **E. Quantitative Methodology**

Flo analyzes three phases of data for both Test and Control Groups:

1. Six months prior to Service installation – assessing steady-state for both Test and Control Groups.
2. Period following Device installation where Test Group water consumption changes.
3. Period when Test Group reaches new steady-state.

Throughout each phase, we use a difference-in-differences analysis to estimate the causal effect of installing the Flo by Moen Smart Water Shutoff device.

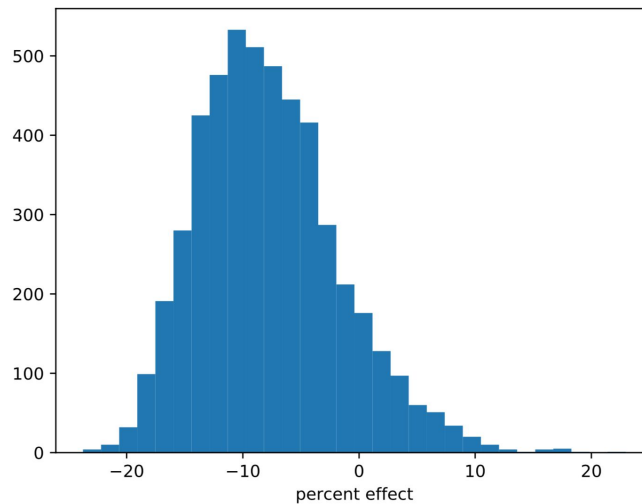
### **VIII. RESULTS**

Unfortunately, the variability is extremely wide, indicating that we do not have sufficient statistics to draw any firm conclusions from the data to validate any water use reduction in Test Group homes compared to the Control Group homes. As a result of insufficient data (and a number of other issues

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<sup>21</sup> Bootstrap sampling is a method that allows us to compute a confidence interval. We are simulating 5,000 different versions of the dataset and looking at the variability across all these simulations. The "replacement" refers to the fact that we reuse the original data in each of these simulations in a way that might make multiple copies of the same customer's data. Efron, B. (1979). "Bootstrap methods: Another look at the jackknife". The Annals of Statistics. 7 (1): 1–26.

highlighted throughout this report), our result findings are inconclusive. That said, the average test effect is approximately -5%. At a 95% confidence interval, that indicates the effect is somewhere between -16% and +3%.<sup>22</sup> The results are illustrated in Fig. 4.



**Figure 4: Histogram of 5,000 bootstraps sampled from the list of percent-difference causal-effects obtained from aggregating Eq. 3 across all cohorts.**

In summary, there were a number of factors that contributed to inconclusive results of the Control Group vs. Test Group analysis. However, there are a number of meaningful results that did transpire, and further testing for a longer duration is encouraged and should result in promising results.

#### **A. Specific Wins During this Study**

By looking at the results from the Test Group, Flo is able to point toward significant savings and promising results. Overall, the Test Group did identify a number of leaks (big and small), and actually fixed them during the test period.

##### **1. Health Test Pass Rate Increases**

For context, Flo's Health Test consists of daily pressure decay tests on the home water supply line to identify any leaks in the supply line. Many such leaks are smaller than a standard utility water meter can accurately identify, so though the results of fixing these identified leaks may or may not be reflected in

<sup>22</sup> Based on all the data we observed, Flo by Moen is 95% confident that the average impact to water savings is somewhere between -16% and +3%.

the water bill, the savings can be significant.<sup>23</sup> For example, one pipe that drips every few seconds equates to almost 700 gallons of water per year.<sup>24</sup>

Test Group homes increased their pass-rate of Health Tests during the course of the study (Figure 5, below). This demonstrates a proactive approach homeowners took to resolve leaks in their homes when alerted by the Flo by Moen device. This can include fixing leaking fixtures (ie., toilets, sinks) and/or updating connecting valves or other aspects of the home's plumbing infrastructure. Furthermore, in 90 days of usage, there was a 4.1% decrease in failed health tests from a test group of 60 devices. Note that there are several reasons why we cannot get conclusive results on water reduction after pass rate increases: (a) the number of participants was too low to provide conclusive statistics, and (b) the duration of time (amount of data collected) after the pass rate increases is too short. Assuming the average leak results in 17 gallons of water lost per day, the improved health test results during the course of the Study resulted in water savings of **41.82 gallons/day**.<sup>25</sup>

## 2. High Water Waste Event Savings

During the course of the study, specific Test Group homes saw water savings due to the Flo by Moen system detecting a water loss event and automatically shutting off the water. The Flo by Moen Smart Water Shutoff detected hundreds of critical alerts over the study, however, of the 10 critical alerts that were reported by 9 different devices, the Flo by Moen device automatically shut-off 6/10 critical incidents, preventing catastrophic damage to those respective homes.<sup>26</sup> The resulting 6 automatic shut-offs from 6 different devices came from 8% of the Test Group participants. All 10 critical incidents are broken down in Table 4 below.

The table below (Table 4) indicates catastrophic water flow incidents from LADWP test group participants. In each incident, the Flo by Moen Smart Water Shutoff automatically shut off the valve when the device detected high water usage and/or extended water use. The table highlights incidents from 10 devices and their usage 24 hours before the alarm incident, and 24 hours after the alarm incident. Not only did the Flo by Moen Smart Water Shutoff prevent catastrophic damage to the home, but in 83% of the incidents in which the Flo by Moen device automatically shut off the valve, water consumption decreased 24 hours after the abnormal water usage was detected.

Even though the device stopped the extended water flow and prevented catastrophic damage to these homes, Flo still requires more information from these events to be able to credit the decrease in

<sup>23</sup> "Accuracy of In-service Water Meters at Low and High Flow Rates." *The Water Research Foundation*, <https://www.waterrf.org/research/projects/accuracy-service-water-meters-low-and-high-flow-rates>.

<sup>24</sup> See [www.water.usgs.gov](http://www.water.usgs.gov)

<sup>25</sup> Kiefer, J., Dziegielewski, B., Mayer, P., DeOreo, W.B., (2016). "Residential End Uses of Water, Version 2 Executive Report". Indoor Household Use by Fixture. pg. 5

<sup>26</sup> Flo determined that all 10 critical incidents were true positive events (i.e., critical alert = irregular flow rate detected). The Flo by Moen Smart Water Shutoff alerted the homeowner for the remaining 4/10 critical incidents, and in those instances, the homeowner took necessary measures to stop the critical flow event before the device automatically shut off the valve. 1 critical incident was the result of a leaking toilet flapper, and the remaining 3 critical incidents' were the result of fixtures that were left on by the homeowner.

consumption either to the specific leak, or to a reduction in water usage from other fixtures. Flo Technologies is continuing to analyze these incidents and how the cause of the leak and the volume of water loss compares to each specific homeowner's water usage during that specific time.

Device ID	Alarm Name	Customer Feedback	Did Flo Shut Off Water	Device's Water Usage the 24 hours BEFORE the Incident	Device's Water Usage the 24 hours After the Incident	Water Consumption Difference
XXXXXXXX8f0	High Water Usage	Fixture Left On	YES	532.76	307.69	-42.2%
XXXXXXXX449	High Water Usage	Plumbing Failure	YES	478	490	2.5%
XXXXXXXX5f3	High Water Usage	Toilet Flapper	NO	162.92	164.59	1.0%
XXXXXXXX73d	Extended Water Use	Fixture Left On	YES	84.23	73.94	-12.2%
XXXXXXXXaba	Extended Water Use	Fixture Left On	NO	86.40	139.91	61.9%
XXXXXXXXaba	High Water Usage	Fixture Left On	NO	71.39	38.85	-45.6%
XXXXXXXX7ae	Extended Water Use	Fixture Left On	NO	271.29	134.97	-50.2%
XXXXXXXX85b	Extended Water Use	Toilet Flapper	YES	679.80	113.84	-83.3%
XXXXXXXX9f3	Extended Water Use	Fixture Left On	YES	209.79	107.36	-48.8%
XXXXXXXe73	Extended Water Use	Toilet Flapper	YES	284.14	169.78	-40.2%

**Table 4: Flo by Moen Smart Water Shutoff, Critical Incidents**

### 3. Consumption and Pressure Decreases among all Flo Customers

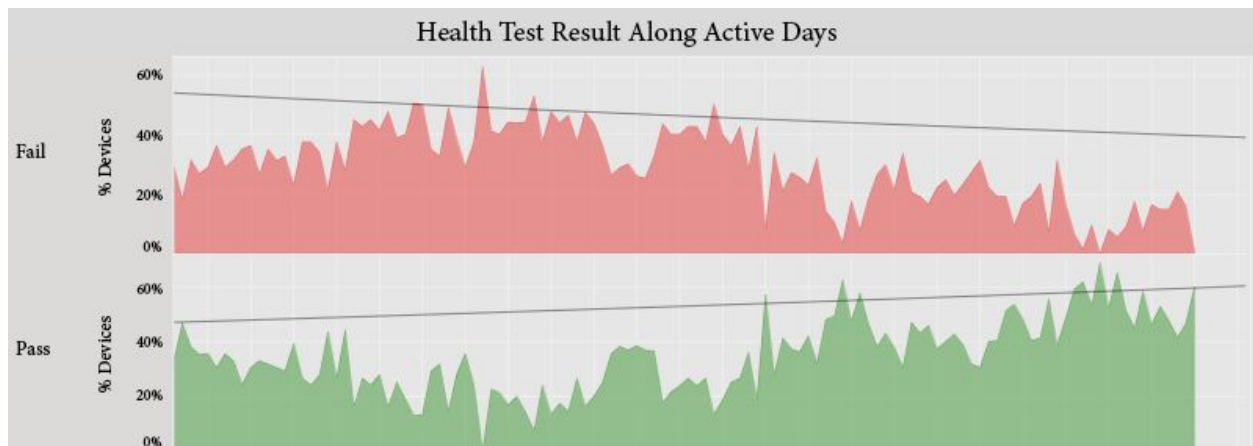
The charts in Figure 6 below illustrate consumption and pressure levels among all Flo customers over the first 90 days they installed their Flo device. On Day 1 of the device installation, average daily usage was ~179 gallons and average daily pressure was ~62 PSI. However, after 45 days of device installation, average daily usage decreased to ~144 gallons and average daily pressure decreased to ~60 PSI. These findings indicate that homeowners took proactive measures to fix leaks, adjust behavior and other damages in their infrastructure that may have been causing pressure abnormalities and increased consumption levels. The results could also indicate that homeowners with Flo by Moen Smart Water Shutoffs are more likely to use less water over time because they are proactively using the app to monitor water usage.

#### B. Savings Summary

The health test results in Figure 5 below illustrate the following:

*The Fail chart:* Among the 68 participants in the test group, the number of failed health tests decreased over 90 days. A decrease in the number of failed health tests indicate that homeowners have taken proactive measures to fix issues within the plumbing infrastructure to mitigate the number of microleaks detected.

*The Pass chart:* The inverse of the Fail chart is the pass chart. Among the 68 participants in the test group, the number of successful health tests increased over 90 days. An increase in the number of successful health tests indicate that homeowners have taken proactive measures to fix issues within the plumbing infrastructure to mitigate the number of microleaks detected.

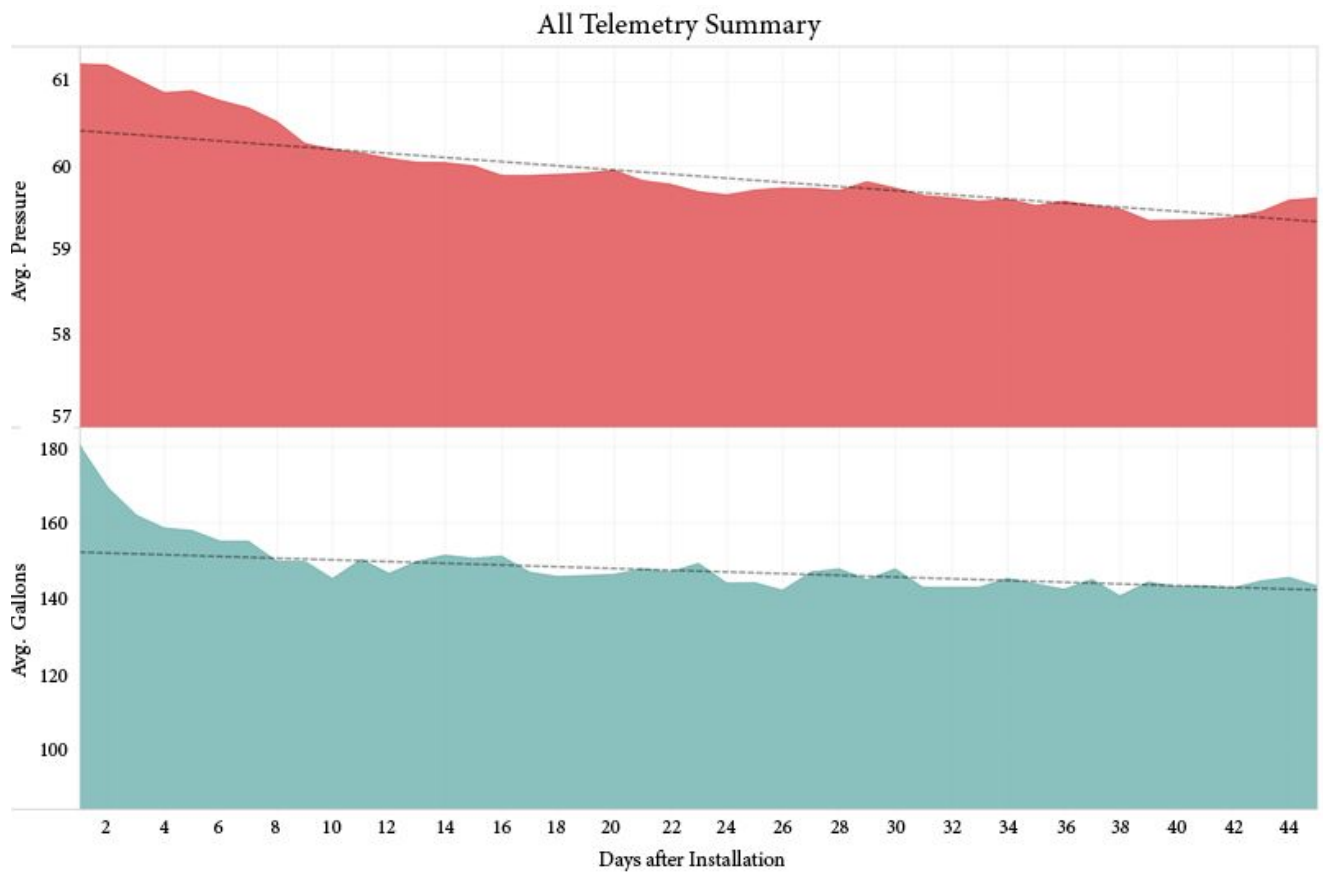


**Figure 5: Health Test Results along Active Days (Test Group)**

Device Count	Installation Time Period (Month)
--------------	----------------------------------

14	October 2018
9	November 2018
8	December 2018
13	January 2019
14	February 2019
5	March 2019
3	April 2019
1	May 2019
2	June 2019

**Table 5: Installation Range throughout LADWP Study**



**Figure 6: Average Consumption and Pressure Telemetry Summary over 45 days**



***IX. LIMITATIONS: STUDY CHANGES AND COMPLICATIONS***

At the onset of the study, Flo selected 100 participants to participate in the Test Group, and LADWP selected 20 Control homes for each participant in the Test Group that lived in the same zip code of that respective “Test Group”, and had within +/- 15% in usage to +/- 20% in usage per month on average for the years 2015-2018.

After cleaning the data, Flo had to exclude a number of homes from the Test Group (when Flo received and reviewed the 100 treatment homes from the raw data [including the 29 word of mouth referrals], Flo cross-referenced them with the known installed devices, and reduced the count to 73 (i.e., of the 100 devices, 27 devices were not known to have been actually installed according to Flo data). Then Flo eliminated 5 more devices because they lacked enough data. 3 of those 5 didn't have any control data, and 2 of the remaining 5 devices didn't have enough treatment data. The final treatment group = 68 participants).

Furthermore, 20% of the test group participants were concentrated in Woodland Hills, CA, not a likely representative sample of Los Angeles. While the results are promising, the size of the test group was not sufficient enough to draw significant conclusions that can affect the potential for utility incentives or to determine how the reduction in leaks in the test group encouraged decreased water usage over time. The reader must draw their conclusions on the study based on the fact that not all 68 devices were paired and installed for the entirety of the study, as devices were installed during different times between 2018-2019. Though promising, Flo believes more data through an increase in test group participants and duration of study time (for example, 2-3 years) would lend to more significant results relating to test group water consumption.

***X. CONCLUSION AND RECOMMENDATIONS***

The Report demonstrates positive results on water consumption savings in specific instances when the service responded to a potentially critical leak event, and demonstrates positive results in the number of Test Group homes decreasing the prevalence of leaks over time. With these promising trends, Flo recommends more service installations and a larger time for evaluation of the Test Group take place to statistically prove the efficacy of the service on homeowner water consumption behavior.

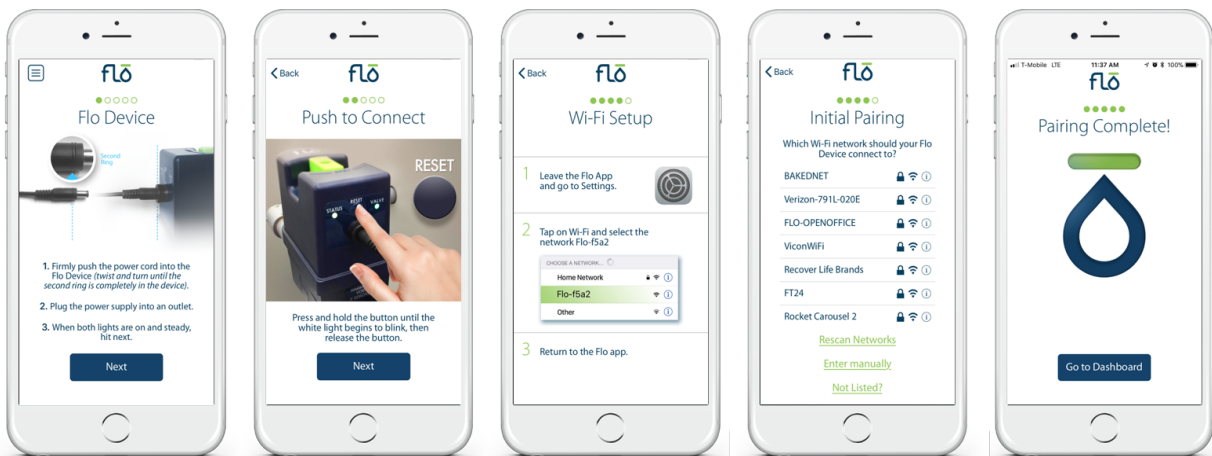
## ***XI. APPENDIX***

### Appendix A.

#### **The Flo by Moen Smart Water Shutoff**

- A. Requirements for installation
  1. An above ground and accessible water supply line
    - SKU 900-001 fits all .75" or smaller water supply lines
    - SKU 900-006 fits all 1" or smaller water supply lines
    - SKU 900-002 fits all 1" - 1 1/2" or smaller water supply lines
  2. A standard power outlet within 10' of the device, and if power is not located within 10', the user may use Flo by Moen low voltage 25' extension cords for extended reach.
    - Powered via plug-in AC to DC transformer
    - Power Supply: 12 VDC via 100-240V – 50/60 Hz switching type
  3. A smartphone (iPhone or Android)
  4. Home Wi-Fi
    - WLAN Connectivity / IEEE 802.11bgn, 2.4 GHz frequency
    - Even though our product uses Wi-Fi to alert the homeowner of a leak and to share water use information, it does not require Wi-Fi to protect the home. (i.e., it does not need Wi-Fi to shut off valve in the event of a leak because our device stores its most recent parameters within itself, and makes its critical decisions without looking to the cloud.)
- B. Included in the Flo by Moen device package
  1. Flo by Moen Smart Water Shutoff device
  2. Threaded brass tailpieces
  3. Power supply (10 ft)
  4. Hex key to assist in manual shutoff
  5. Spare O-rings
  6. Installation spacer
- C. Pairing the Flo by Moen Smart Water Shutoff Device
  1. Users take the following steps to make sure their device is paired to their Wi-Fi before installation

- Make sure that the home's Wi-Fi is connected prior to moving forward with the initial pairing of the Flo by Moen Smart Water Shutoff device on the Flo by Moen app.
- Download the 'Flo by Moen' app
- Create an account in the app
- Plug the device into a power outlet
- Follow 'Add Device' steps in the app
- Connect the device to the home Wi-Fi
- Once the user sees the 2 solid LED indicator lights on the Flo by Moen Smart Water Shutoff device, they should press and hold the Reset button until the status light is a blinking white color and press 'Next'
- The user will then be asked to scan the QR code on their Flo by Moen device, scan the QR code, and follow the steps on the Flo by Moen app and complete the initial pairing instructions
- After the device is paired and installed, it will default to 'Learning Mode'



**Image 1: Pairing the Flo by Moen Smart Water Shutoff**

#### D. Learning Mode

1. The Flo by Moen device takes about 2 days on average to learn the homeowner's consumption behavior.
2. The device learns the behavior based on analysis of water using 'events'.

- An 'event' is defined as usage increasing from 0gpm - an undefined range - and then back down to 0gpm (i.e., turning a sink on/off)
- The more events completed by the homeowner(s), the more quickly the Flo by Moen Smart Water Shutoff can build a parameter profile for the home.

#### E. The Health Test

1. Flo by Moen's MicroLeak™ technology runs daily proactive tests to identify and notify users of tiny leaks that often go undetected.
  2. Micro-leaks, as small as a single drop per minute, are often early indicators of vulnerabilities in pipes, fixtures or appliances.
    - These vulnerabilities can be exacerbated by high water pressure and lead to catastrophic leaks, damage and corresponding water loss.
    - They can also catalyze the formation of dangerous black mold.
  3. With its MicroLeak technology, FloSense, and an experienced customer support team, the Flo by Moen Smart Water Shutoff gives homeowners the information and tools they need to proactively protect their home from water damage and limit water waste. Health test runs for approximately 5 minutes total. Less if a drip is found. The system will automatically cancel and open the valve if a fixture is activated during the health test. The user can tap the back button (top left) to return to the dashboard.
  4. This is the same test that is run automatically once per day, at a time when water is least likely to be used.
- F. Automatic test will cancel, or delay if water usage is detected, and will automatically retry up to 3 times.



***Image 2: The Flo by Moen Daily Health Test***

1. Flo by Moen's MicroLeak™ technology runs daily proactive tests to identify and notify users of tiny leaks that often go undetected.
2. Micro-leaks, as small as a single drop per minute, are often early indicators of vulnerabilities in pipes, fixtures or appliances.
  - These vulnerabilities can be exacerbated by high water pressure and lead to catastrophic leaks, damage and corresponding water loss.
  - They can also catalyze the formation of dangerous black mold.
  - With its MicroLeak technology, FloSense, and an experienced customer support team, the Flo by Moen Smart Water Shutoff gives homeowners the information and tools they need to proactively protect their home from water damage and limit water waste.
3. Health test runs for approximately 5 minutes total. Less if a drip is found. The system will automatically cancel and open the valve if a fixture is activated during the health test. The user can tap the back button (top left) to return to the dashboard.

4. This is the same test that is run automatically once per day, at a time when water is least likely to be used.
- G. Automatic test will cancel, or delay if water usage is detected, and will automatically retry up to 3 times.

Images 3 and 4 (on pg. 12) illustrate how the Flo by Moen system views water in the Test Group's homes. Using this type of visualization, we can determine normal and abnormal water usage to prevent water loss. Image 3 indicates water events (faucet on/off, shower on/off, toilet 'on/off' (fill valve filling the tank after a flush), etc., and the time in which the events occurred in a 2 week period. Image 4 indicates water events overlapped over a 2 week period, illustrating the Flo by Moen device's ability to monitor and detect water irregularities across multiple events at the same time.

#### H. Sensors

1. The Flo by Moen device uses 3 sensors to determine if a home's plumbing is healthy: water pressure, water temperature, and water flow rate.
2. The device is certified for use on cold water service lines only.

#### I. Operating conditions

1. The device is outdoor rated with International Protection Marking IPx5 (i.e. the device has protection from spray jets in any direction).<sup>27</sup>
2. Minimum operating temperature is 0°C / 32°F.
3. Maximum operating temperature is 50°C / 122°F.
4. Maximum ambient temperature is 140°F.
5. Maximum continuous pressure is 175 PSI.

#### J. Integrations

1. The Flo by Moen Smart Water Shutoff device is integrated with the following partners:
  - Amazon Alexa
  - Google Assistant
  - Control4
  - IFTTT

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<sup>27</sup> The Flo by Moen Shutoff is installed after the water meter, and after the home's shutoff valve. This is well beyond the meter, and therefore will not be installed in the valve box. Installation in a valve box is not recommended for the following reasons: The shutoff is outdoor rated, but cannot be submerged. Installation in a valve box can cause water accumulation from rain, and heavy condensation, which can, over time, result in water damage within the device. Additionally, WiFi and power may be challenging to deliver to the shutoff were it to be in a valve box next to the meter.

## Appendix B. - Deliverable 1 - Letter Sent to Homeowners to Identify & Qualify Participants

Dear Homeowner:

As a Los Angeles Department of Water and Power (“**LADWP**”) customer, you have been invited to participate in a water usage monitoring study (“**Pilot Program**”) conducted by Flo Technologies, Inc. (“**Flo**”, the “**Company**”, “**We**”, “**us**”, “**our**”) and sponsored by LADWP.

Flo is a Los Angeles area company that has developed an innovative way to assist property owners in monitoring water usage and detecting leaks, enabling owners to proactively address plumbing issues. We have created a proprietary water monitoring device that attaches to your existing plumbing (a “**Flo Device**”) which then communicates with our software to keep you informed about your plumbing via an application installed on your phone and/or connected device. You can learn more about our Company on our website, <https://meetflo.com>.

In order to participate in the Pilot Program, you must:

- Own your own home;
- Have a secure password-protected Wi-Fi connection at your home;
- Have an above-ground and accessible water supply line which is 1 ¼ inch or smaller;
- Have a standard power outlet; and
- Have a smartphone.

If you satisfy the above and subject to our approval, we’ll provide you with a Flo Device, have a Flo Device installed in accordance with those requirements, and provide related monitoring services via our mobile software application, all at no cost to you for the duration of the Pilot Program (currently set for 12 months). Our Flo HomeProtect™ Program (<https://meetflo.com/homeprotect/>) is included as part of the Pilot Program. At the conclusion of the Pilot Program, you may keep the Flo Device. You may then elect to subscribe to the Flo HomeProtect™ Program (<https://meetflo.com/homeprotect/>) to continue receiving our water monitoring services.

In exchange, all you’ll need to do throughout the Pilot Program is to allow us to have access to the Flo Device by periodic visits to your property, which may include photos and videography. We’ll provide you with reasonable notice before we plan to come to visit.

Please complete the attached Participation Agreement, and we will then schedule a time to install a Flo Device at your home to get started.

We look forward to your participation!

Sincerely,

Gabriel Halimi  
Founder and CEO  
Appendix C.

**Flo Technologies, Inc.**  
**LADWP PILOT PROGRAM PARTICIPATION AGREEMENT**

Flo Technologies, Inc., 3750 Robertson Blvd., Suite 202, Culver City, CA 90232 (“**Flo**”, the “**Company**”, “**We**”, “**us**”, “**our**”) is pleased to offer you, the undersigned (the “**Homeowner**”, “**you**”, “**your**”) this Pilot Program Participation Agreement (together with the exhibits attached hereto, the “**Participation Agreement**”) effective July 2018 (the “**Effective Date**”) in connection with the a water usage monitoring study (“**Pilot Program**”) conducted by us and sponsored by the Los Angeles Department of Water and Power (“**LADWP**”). Flo will conduct the Pilot Program via the installation of our Company’s water monitoring and leak detection product (each a “**Flo Device**”) in 100 Los Angeles area homes, including at the home address designated on the signature page of this Participation Agreement (your “**Home**”).

Use of each Flo Device is subject to our Terms and Conditions, attached as Exhibit A (“**Standard T&Cs**”). Except as modified by this Participation Agreement, the Standard T&Cs shall govern your use of the Flo Device. Capitalized terms have the meanings set forth in the Standard T&Cs, unless otherwise defined in this Participation Agreement. The Standard T&Cs are incorporated into this Participation Agreement by reference. In the event of a conflict between the Standard T&Cs and this Participation Agreement, the Participation Agreement shall govern and control.

1. Program Requirements. In order to participate in the Program, Homeowner agrees that as of the Effective Date and at all times throughout the Term, Homeowner: (a) owns the Home, (b) has a secure password-protected wireless Internet connection (Wi-Fi) at the Home; (c) has an above-ground accessible main water supply line which is 1 ¼ inch or smaller; (d) has a standard power outlet; and (e) has a smartphone.
2. Flo Device. You will be the Owner of the Flo Device installed at your Home. You will also be the “**Account Holder**” for each Flo Device. Company shall communicate with Account Holder to obtain relevant credentials (email address, mobile phone number) to access and use the mobile application and related content therein (the “**Service**”).
  - (a) Accessibility. Each Account Holder will be able to access the data concerning the Flo Device at your Home via a mobile device (IOS, Android) and/or via a web application.
  - (b) Usage. The Account Holder will have the right to use the Service for so long as he/she is the owner of the Home.
  - (c) Notifications. The Company will provide notifications to the Account Holder via the Services. Such notifications may include push notifications, texts, emails, and automatic phone calls for the Flo Device.



- (d) Reporting. The Company will provide weekly email reports to the Account Holder for the applicable Flo Device.
  - (e) HomeProtect™. Throughout the Pilot Program, Flo will provide you with access to its premium Flo HomeProtect™ Program (<https://meetflo.com/homeprotect/>), as may be modified or updated from time to time (“**HomeProtect**”). Upon termination of the Pilot Program, Owner may, within 30 days of such termination, sign up for HomeProtect to continue receiving such service the Flo HomeProtect Program (<https://meetflo.com/homeprotect/>), as may be modified or updated from time to time (“**HomeProtect**”). In the event Owner elects to sign up for HomeProtect, Owner will then be responsible for payments to Flo pursuant to the HomeProtect fee schedule then in effect.
  - (f) Account Transfer. In the event an existing Account Holder sells his/her Home, the Flo Device installed and assigned to that Home shall, at the election of the new owner of the Home, either
    - (i) remain on the Property and the new owner of the Home shall become the replacement Account Holder, removing the prior Account Holder concurrently with the closing of the sale of the Home, or
    - (ii) be removed by the selling Home owner.
3. Permissions. Throughout the Term, Homeowner shall grant Flo, upon reasonable notice, access to the Home for the purposes of monitoring the Flo Device. Homeowner acknowledges that Flo may take photographs (“**Photos**”) and videos (“**Videos**”), each in either film or digital format (Photos and Videos collectively, “**Pictures**”) of the Home and the Flo Device for Flo’s commercial purposes. Flo retains all right, title, and interest, including all intellectual property and proprietary information rights (including all copyrights, rights of authorship, and moral rights), in and to such Pictures.
  4. Designated Plumbing Partner. Owner expressly acknowledges that Company is not a plumber, does not repair damaged or leaking pipes, and does not install Flo Devices. Company shall engage a contracted authorized installer (“**Designated Plumbing Partner**”) to install the Flo Devices, connect the Flo Devices to Wi-Fi, set up notification settings for each Flo Device, conduct annual inspections and quality assessments of the Flo Devices, and maintain the Flo Devices. In all instances, Owner consents to communications by and between the Designated Plumbing Partner and Company concerning the status of any and all of the foregoing. Owner shall remain solely responsible for any plumbing costs incurred.
  5. Software Application. The Company shall provide the Owner with a password-accessible cloud-based software application to enable the Owner to monitor the water usage in the Home.
  6. Support; Customer Service. After installation of the Flo Devices is completed, Company shall provide comprehensive monitoring (24 hours per day, 7 days per week) of the Flo Device, subject to your compliance with your obligations herein. Company shall provide a phone number available to Account Holder to answer customer service questions regarding a Flo Device. Owner agrees to promptly provide Company with sufficient documentation, data and assistance with respect to any

reported errors, and to reasonably cooperate with Company, in order for Company to comply with its support obligations hereunder. In no event shall Company or LADWP be responsible or liable for any errors, bugs or other problems contained in or originating from hardware or software not provided by Company, or for incidents resulting from Owner's failure to fulfill its obligations.

7. Owner Obligations. Throughout this Participation Agreement, Owner shall be solely responsible and obligated to:
  - (a) Maintain electricity and an active Wi-Fi connection to support all Flo Devices in service, and ensure that the Flo Devices are not tampered with;
  - (b) Alert Company to any changes in Wi-Fi passwords, and ensure that the Flo Device is paired properly with an active secure authorized Wi-Fi network;
  - (c) Maintain complete and accurate contact information, and promptly notifying us of any changes to such information; and
  - (d) Provide the Company with access to the Property as necessary to perform services hereunder.
8. Data. Throughout the Agreement, Company shall collect and store data related to each Flo Device ("**Client Data**"). Company shall maintain appropriate safeguards for the protection of Client Data. Company owns the aggregated and statistical data ("**Aggregated Data**") derived from the operation of each Flo Device, and nothing herein shall be construed as prohibiting Company from utilizing the Aggregated Data for business and/or operating purposes, provided that Company does not share with any third party (other than its Designated Plumbing Partner and LADWP) Aggregated Data which reveals the identity of Owner.
9. Device Warranty. The Warranty Period for each Flo Device shall be as stated in the Limited Warranty, attached as Exhibit B hereto.
10. Confidentiality. Each of the parties agrees: (i) not to disclose any Confidential Information to any third parties except (A) as mandated by law and except to those subcontractors of Company providing Services hereunder who agree to be bound by confidentiality obligations no less stringent than those set forth in this Agreement; (ii) not to use any Confidential Information for any purposes except carrying out such party's rights and responsibilities under this Agreement; and (iii) to keep the Confidential Information confidential using the same degree of care such party uses to protect its own confidential information; provided, however, that such party shall use at least reasonable care. These obligations shall survive for three (3) years after termination of this Agreement.
  - (a) Definition. "**Confidential Information**" means non-public information of Company or Owner disclosed by either party to the other party, either directly or indirectly, in writing, orally or by inspection of tangible objects, or to which the other party may have access, including, but not

limited to, engineering information, formulas, hardware configuration information, know-how, ideas, inventions, processes, specifications, software, source code, trade secrets, the terms of this Agreement or any other information which a reasonable person would consider confidential and/or which is marked “confidential” or “proprietary” or some similar designation by the disclosing party or which is of a confidential nature even though not specifically so designated.

- (b) Exclusions. Confidential Information shall not, however, include any information which the recipient can establish: (i) was or has become generally known or available or a part of the public domain without direct or indirect fault, action, or omission of the recipient; (ii) was known by the recipient prior to the time of disclosure, according to the recipient’s prior written documentation; (iii) was received by the recipient from a source other than the discloser, rightfully having possession of and the right to disclose such information; or (iv) was independently developed by the recipient, where such independent development has been documented by the recipient.
- (c) Compelled Disclosure. If receiving party is compelled to disclose any such information by judicial or administrative process or by other requirements of law, such party shall (i) promptly notify the other party, (ii) reasonably cooperate with the other party in such party’s efforts to prevent or limit such compelled disclosure and/or obtain confidential treatment of the items requested to be disclosed, and (iii) shall disclose only that portion of such information which each party is advised by its counsel in writing is legally required to be disclosed.
- (d) Remedies. If either party breaches any of its obligations with respect to confidentiality or the unauthorized use of Confidential Information hereunder, the other party shall be entitled to seek equitable relief to protect its interest therein, including but not limited to, injunctive relief, as well as money damages.

11. Mutual Representations and Warranties. Each party represents and warrants to the other party that, as of the date hereof: (i) it has full power and authority to execute and deliver this Agreement; (ii) this Agreement has been duly authorized and executed by an appropriate employee of such party; (iii) this Agreement is a legally valid and binding obligation of such party; and (iv) its execution, delivery and/or performance of this Agreement does not conflict with any agreement, understanding or document to which it is a party.

## 12. Term; Termination.

- (a) Term. The term of this Agreement commences upon the Effective Date and expires on the first anniversary of the Effective Date (the “**Pilot Term**”). The Agreement then may renew upon mutual written agreement of the Parties (each a “**Renewal Term**” and together with the Initial Term, the “**Term**”), unless renewed for a different duration by mutual agreement or earlier terminated by a party due to a material breach.

- (b) Material Breach. Without limiting any other rights or remedies that either party may have at law or in equity, either party may immediately terminate this Agreement if the other party materially breaches its obligations hereunder, and, where capable of remedy, such breach has not been materially cured within forty-five (45) days of the breaching party's receipt of written notice describing the breach in reasonable detail.
- (c) Bankruptcy Events. Either party may immediately terminate this Agreement if the other party:
- (i) has a receiver appointed over it or over any part of its undertakings or assets; (ii) passes a resolution for winding up (other than for a bona fide scheme of solvent amalgamation or reconstruction), or a court of competent jurisdiction makes an order to that effect and such order is not discharged or stayed within ninety (90) days; or (iii) makes a general assignment for the benefit of its creditors.
13. Payments. Throughout the Pilot Term, no fees are due from Owner to Company for usage of the Flo Device and Services, provided, however, in the event Owner elects to purchase HomeProtect, Owner shall be responsible for payment of such fees.
14. Public Agencies. Homeowner acknowledges that the Pilot Program is sponsored via an innovative conservation program grant from Public Agencies (as defined herein). Owner hereby waives any and all claims arising out of, related to, or in connection with this Participation Agreement from and against LADWP, the Metropolitan Water District of Southern California (MWD), Bureau of Reclamation, Western Resource Advocates, Southern Nevada Water Authority, Central Arizona Project, and Southern California Gas Company (each a "**Public Agency**" and collectively, the "**Public Agencies**"). For the purposes of this Participation Agreement, the provisions of Section 7 (Indemnity), 8 (Warranty Disclaimers), and 9 (Limitation of Liability) of the Standard T&Cs are hereby amended such that where such sections read "Flo and its licensors and suppliers" or reference Flo, such reference shall be expanded to include "Flo and its licensors and suppliers, and the Public Agencies" or "Flo and the Public Agencies", as applicable.
15. Miscellaneous. This Agreement may be executed in any number of counterparts and electronically, each of which shall be an original but all of which together shall constitute one and the same instrument. Any modification, amendment, or addendum to this Agreement must be in writing and signed by both parties. No failure or delay on the part of either party in exercising any right, power or remedy under this Agreement shall operate as a waiver, nor shall any single or partial exercise of any such right, power or remedy preclude any other or further exercise or the exercise of any other right, power or remedy.

## Appendix D.

**Program requirements**

Homeowners in the surrounding Los Angeles neighborhoods were invited to participate in a water usage monitoring study (“**Pilot Program**”) conducted by Flo Technologies, Inc. (“**Flo**”, the “**Company**”, “**We**”, “**us**”, “**our**”) and sponsored by LADWP. In order to participate in the program, participants must have:

1. Owned their own home;
2. Had a secure password-protected Wi-Fi connection at their home;
3. Had an above-ground and accessible home water supply line which is 1 ¼ inch or smaller;
4. Had a standard power outlet; and
5. Had a smartphone.

If the participants satisfied the above and were approved by Flo, Flo provided each participant with a Flo Device, installed a device in accordance with those requirements, and provided related monitoring services via our mobile software application, all at no cost to the participant for the duration of the Pilot Program (currently set for 12 months). The Flo HomeProtect™ Program (<https://meetflo.com/homeprotect/>) was included as part of the Pilot Program. At the conclusion of the Pilot Program, participants were allowed to keep the Flo Device. They then had the option to elect to subscribe to the Flo HomeProtect™ Program (<https://meetflo.com/homeprotect/>) to continue receiving our water monitoring services. In exchange, all the participants had to do throughout the Pilot Program is to allow us to have access to the Flo Device by periodic visits to their property, which may include photos and videography. We provided participants with reasonable notice before we visited their home. We asked participants to complete the Participation Agreement (see Addendum B), and began the process to install a Flo Device in their home.

**Flo by Moen Smartwater Shutoff Device**

- *Participation*

By participating in the pilot program, participants would be the owner and “Account Holder” of the Flo Device installed at their Home. Flo communicated with the Account Holder to obtain relevant credentials (email address, mobile phone number) to access and use the mobile application and related content therein (the “**Service**”).

1. Accessibility. Each Account Holder had access the data concerning the Flo Device at their Home via a mobile device (IOS, Android) and/or via a web application.
2. Usage. The Account Holder had the right to use the Service for so long as he/she is the owner of the Home.

3. Notifications. Flo provided notifications to the Account Holder via push notifications, texts, emails, and automatic phone calls for the Flo Device.
4. Reporting. Flo also provided weekly email reports to the Account Holder for the applicable Flo Device.

### **FloProtect**

Throughout the Pilot Program, Flo provided participants with access to its premium FloProtect(r) Program (<https://meetflo.com/homeprotect/>). Upon termination of the Pilot Program, the homeowner may, within 30 days of such termination, sign up for FloProtect to continue receiving such services. In the event the homeowner elects to sign up for FloProtect, homeowner will then be responsible for payments to Flo pursuant to the HomeProtect fee schedule then in effect.

Account Transfer. In the event an existing Account Holder sells his/her Home, the Flo Device installed and assigned to that Home shall, at the election of the new owner of the Home, either (i) remain on the Property and the new owner of the Home shall become the replacement Account Holder, removing the prior Account Holder concurrently with the closing of the sale of the Home, or (ii) be removed by the selling Home owner.

## Appendix E.

- Data file from LADWP showing one test subject and multiple control subjects for that test subject

	A	B	C	D	E	F	G	H	I	J	K	L
1	id	new_id	monthavg13	monthavg14	monthavg15	monthavg16	monthavg17	monthavg18	monthavg19	monthavg151617	lowval	highval
2	1	1	11.333	10.167	9.600	8.167	8.500	9.500	15.000	8.756	7.442	10.069
3		1	6.000	10.000	10.333	9.000	8.167	5.333	4.800	9.167	7.442	10.069
4		1	27.800	10.429	9.500	10.833	7.667	6.167	8.600	9.333	7.442	10.069
5		1	13.600	14.429	10.000	7.667	10.167	10.833	41.200	9.278	7.442	10.069
6		1	18.500	23.667	6.000	8.333	10.667	11.833	11.833	8.333	7.442	10.069
7		1	9.500	10.167	11.500	8.833	6.667	9.833	11.000	9.000	7.442	10.069
8		1	10.600	9.429	9.500	7.167	8.333	9.833	14.000	8.333	7.442	10.069
9		1	12.400	10.000	9.000	7.333	11.333	11.667	14.200	9.222	7.442	10.069
10		1	11.000	11.000	6.667	10.667	9.500	7.000	6.400	8.944	7.442	10.069
11		1	9.400	11.000	9.333	8.333	7.167	6.333	6.400	8.278	7.442	10.069
12		1	18.000	14.714	7.667	8.500	12.167	11.667	15.200	9.444	7.442	10.069
13		1	15.400	12.571	10.667	7.833	8.000	8.500	9.200	8.833	7.442	10.069
14		1	9.167	8.667	8.000	8.667	10.167	9.833	10.600	8.944	7.442	10.069
15		1	5.200	8.286	8.500	11.500	4.667	5.667	7.800	8.222	7.442	10.069
16		1	11.800	14.000	12.500	6.000	6.667	7.333	8.000	8.389	7.442	10.069
17		1	15.800	12.143	10.333	9.167	6.167	10.833	6.000	8.556	7.442	10.069
18		1	12.000	12.833	10.000	8.833	6.333	5.000	24.400	8.389	7.442	10.069
19		1	8.400	8.857	9.000	9.500	9.167	8.500	7.600	9.222	7.442	10.069
20		1	12.000	10.429	9.333	8.500	8.500	8.500	7.800	8.778	7.442	10.069
21		1	9.400	11.143	9.167	8.167	7.000	4.500	3.600	8.111	7.442	10.069
22		1	10.200	11.000	9.667	8.000	8.000	7.667	7.800	8.556	7.442	10.069
23	2	2	11.833	11.167	9.333	10.000	10.500	13.333	10.600	9.944	8.453	11.436
24		2	13.500	11.667	8.833	9.500	11.167	9.333	6.800	9.833	8.453	11.436

## Appendix F.

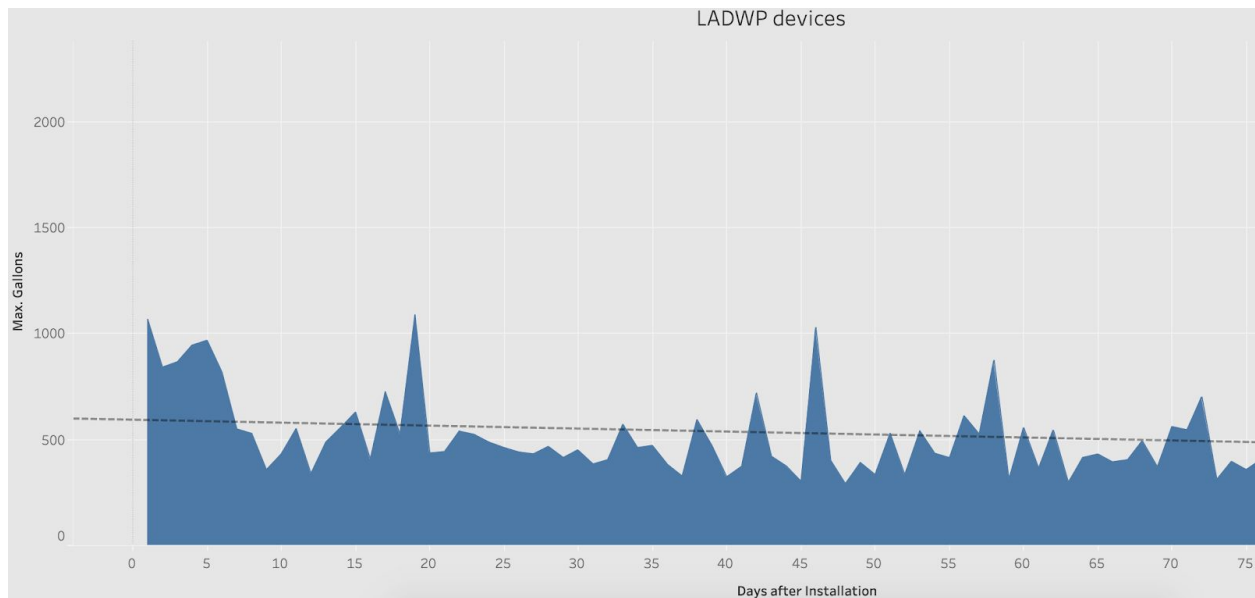
- Example of telemetric data captured from the Flo device for multiple test subjects

## LADWP Monthly Partner Report - December 2019

DEVICE ID	MIN PRESSURE	MAX PRESSURE	AVG PRESSURE	MIN TEMPERATURE	MAX TEMPERATURE	AVG TEMPERATURE	MAX FLOW RATE GPM	TOTAL GALLONS
if70	1.209748483	123.062056744	66.3	44	77	62	18.614	3,799.961
if01	40.940474822	64.183043479	55.7	54	72	61	7.529	2,149.963
5fc	14.414518316	102.900000863	43.7	42	100	60	7.295	2,119.989
is49	1.309092642	87.262604064	69.7	45	73	58	19.537	3,716.882
14ba	0.386695451	105.921289569	49.4	42	99	63	9.111	6,895.406
82b	0.400000003	129.029149947	83.5	46	77	62	8.935	4,829.328
831	48.464444201	94.500000078	89.3	47	68	58	6.918	2,134.157
eb4	11.254443347	96.499520877	70.1	42	82	59	7.165	1,906.863
b1c	27.561588157	154.89813841	64.3	52	99	68	7.482	3,078.322
30a	0	66.700000553	53.6	46	81	62	11.169	2,256.586
c7c	6.712879643e-08	56.1561137	53.9	47	72	62	38.390	4,177.064
b7c	37.819198389	52.600000436	51.1	47	80	62	4.605	212.190
d81	2.698790101e-15	118.679267798	99.4	45	82	63	9.074	612.885
aba	0.100060001	150.169121682	73.8	46	89	63	8.115	3,422.892
ebd	2.82643531	111.577241495	51.4	40	77	59	11.697	4,888.997

## Appendix G.

- Example of consumption over time of test subjects that is being evaluated in relation to LADWP control subjects (graphic depicts maximum consumption over time, days post installation)



## Appendix H.

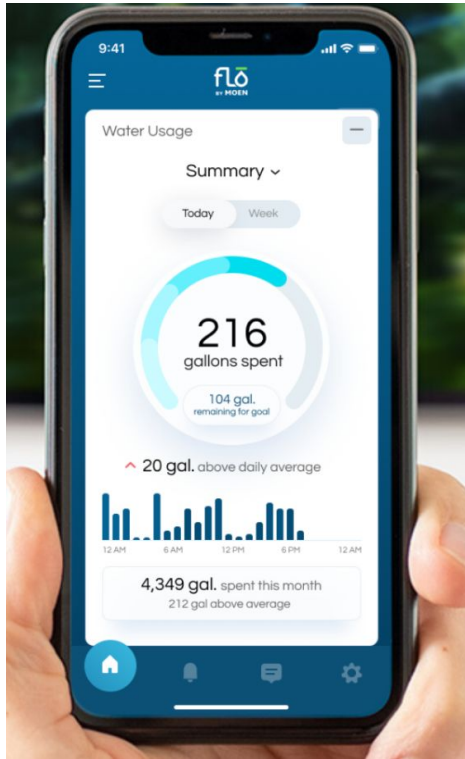
- Depiction of test cohort users with higher than average overnight water usage showing duration of usage (minutes) and consumption (gallons) during that usage

DEVICE_ID	Duration (mins)	Water Usage
le84	20.6	75.1
.d10	18.2	100.1
i390	13.8	59.4
l15b	10.5	29.0
eb4	9.4	26.4
l216	8.4	28.3
lc7c	8.4	23.8
:6d2	7.5	21.8
l9f3	6.9	18.8
l5b7	6.8	15.1
5ab	6.4	16.4



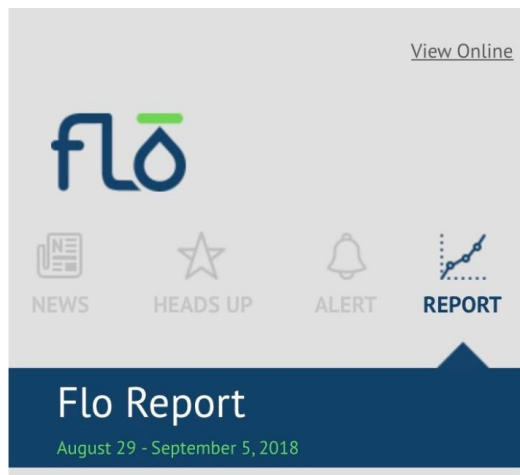
## Appendix I.

- Flo by Moen mobile application consumption tracking



## Appendix J.

- Examples of weekly consumption email sent to test cohort users



Henry, last week you consumed

**723** gallons of  
water

(That's about **15** bath tubs)

Great work! You met your  
**conservation goal** of **2100** gallons,  
using **65.6% less** water than your  
goal.

You consumed **35** less gallons  
(**4.6%**) than last week.

Last Week 723 gal

Two Weeks Ago 758 gal

Here's a breakdown of how many gallons of  
water you used each day.

Wed	Thu	Fri	Sat	Sun	Mon	Tue
8/29	8/30	8/31	9/1	9/2	9/3	9/4
68	247	137	93	66	16	93
+8%	+144%	-20%	-33%	-18%	-78%	-24%
Wed	Thu	Fri	Sat	Sun	Mon	Tue
8/22	8/23	8/24	8/25	8/26	8/27	8/28
63	100	171	141	81	75	123

## Appendix K.

- Examples of Flo content messaged to test cohort users

● Fix | December 20, 2019



## What To Do About Roots In Your Pipes (Without Killing the Tree)

Whenever our pipes get backed up, we usually assume it's something we did. Maybe we flushed the wrong thing down the toilet or let too much hair get into the shower drain. But sometimes, obstructions actually occur outside of our homes underground. One of the most common plumbing obstructions homeowners face is tree [...]

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## 5 Ways To Extend The Life of Your Water Heater

In many ways, your water heater is the heart of your home's plumbing system. It gives you hot water on demand. But when a water heater fails, it's an emergency that requires immediate attention. And just like with a heart, the best way to keep your water heater happy and healthy for years to come [...]

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