Important Information About this Document

The accompanying study was commissioned by the Southern Nevada Water Authority (SNWA) and conducted by Utah State University (USU). The primary purpose of the study was to determine the relative accuracy of consumer leak detection devices which purport to provide water use information. The USU evaluation is part of a larger undertaking by the SNWA to determine the water conservation and efficiency potential of consumer leak detection devices.

This report does not constitute an endorsement or recommendation for any product by either the SNWA or USU and the information herein shall not be used to imply endorsement by these organizations.

The SNWA advises the following information be considered in reviewing the study or referencing the results.

1. Table 1 should reflect that Phyn does provide pressure monitoring.
2. Streamlabs does not recommend use of their device on PVC pipe. Accuracy ratings for this product on PVC are informational and should not be used as a measure of the product’s accuracy.
3. One of the Flo devices (SN 295375850012) was a first-generation device. Flo states that improvements in metering capabilities at low flow rates have been implemented in their second-generation devices.

For additional information about the study, please contact:

Toby Bickmore  
Conservation Services Administrator  
Southern Nevada Water Authority, MS110  
Box 99956  
Las Vegas, NV 89193-9956  
toby.bickmore@snwa.com  
702-862-3759

Doug Bennett  
Conservation Manager  
Southern Nevada Water Authority, MS110  
Box 99956  
Las Vegas, NV 89193  
doug.bennett@snwa.com  
702-862-3777
PERFORMANCE EVALUATION OF FIVE DIFFERENT FLOW MONITORING DEVICES

Prepared for

SNWA

June 2019

UTAH WATER RESEARCH LABORATORY

Utah State University
Logan, Utah
PERFORMANCE EVALUATION OF FIVE DIFFERENT FLOW MONITORING DEVICES

Submitted to:

Southern Nevada Water Authority
P.O. Box 99956
Las Vegas, Nevada 89193-9956

By:

Steven L. Barfuss, P.E.
Research Professor

and

Tyler Ashby
Adam Pack
Research Assistants

Utah Water Research Laboratory
8200 Old Main Hill
Logan, UT 84322-8200

June 2019

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INTRODUCTION
Utah State University was contracted by Southern Nevada Water Authority (SNWA) to perform a performance evaluation at the Utah Water Research Laboratory (UWRL) in Logan, Utah on five water smart devices (Streamlabs Water Monitor, Buoy by Buoy Labs, Phyn by Phyn LLC, Flo by Moen, Flume by Flume Inc.). Table 1 provides a summary of the capabilities of each device, and although the capabilities of each device do vary, the ability to monitor total flow rate is common to all. Specifically, this study included cold-water tests performed to determine each device’s flow measurement accuracy over a wide range of flow rates.

Table 1. Comparative summary of flow monitoring device capabilities

<table>
<thead>
<tr>
<th>Feature</th>
<th>Device</th>
<th>Flo*</th>
<th>Buoy</th>
<th>Flume</th>
<th>Phyn</th>
<th>Streamlabs (Water Monitor)</th>
<th>Streamlabs (Water Control)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Subscription req’d</td>
<td>X*</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X**</td>
<td>X**</td>
</tr>
<tr>
<td>Flow Monitoring</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>Pressure Monitoring</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>Temperature Monitoring</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>Humidity Monitoring</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>Single unit</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>In-line installation</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>Alexa/Nest/Google Home pairing</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>Plumber recommended/req’d</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>Manual shut-off</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>Usage goals</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>Leak alarm</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>Freeze detection/alerts</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>Water usage by fixture</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>24/7 Live support</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>Battery-powered</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>Multiple units from single device</td>
<td>X (Unlimited)</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>Warranty</td>
<td>1-year [3-year*]</td>
<td>1-year</td>
<td>1-year</td>
<td>2-year</td>
<td>2-year</td>
<td>2 or 5**-year [7-year brass]</td>
<td>2 or 5**-year [7-year brass]</td>
</tr>
</tbody>
</table>

Notes:
* Only with FloProtect
** Only with StreamPlus Enhanced

EXPERIMENT SETUP AND PROCEDURE
The various water assistants were installed and tested in series (see Figure 1). The Streamlabs Water Monitors were first mounted to a ¾-inch PVC pipe with 3 to 4 inches between each Monitor. The pipe was first wiped clean with a wet cloth and allowed to dry. The Monitor was then placed on the pipe and zip-tied firmly on both ends of the device.
Figure 1. Installation of flow monitoring devices

The Buoy, Phyn, and Flo devices were all installed in-line with 4-inch couplings between each device. The couplings consisted of two brass couplers connected by a PVC nipple. Badger Model 35 meters were installed downstream of the Flo devices with the same 4-inch couplings between meters. The Flume water sensors were strapped onto the side of the Model 35 meter heads using the rubber strap provided. Note: It is important to note that placement of the water sensor had a significant impact on the Flume’s accuracy. During the first test after setup, one Flume registered over 500% of actual flow, another registered over
300%, and the third registered nearly 100%. The Flumes appeared to be similarly placed on their respective meters.

After preliminary tests were performed, the calibrators made slight adjustments to the two Flumes with poor registries, and all Flume devices registered accurately since that adjustment. After working more with the various devices, though, the calibrators decided that there could have been other sources of error besides water sensor placement. Regardless, homeowners should always be attentive to water sensor placement during installation.

Since PVC is not considered a compatible pipe material for the Streamlabs Water Monitor, the Monitors were tested in a second setup independent from the other devices (Figure 2). The devices were placed on ¾-inch type L Copper pipe for the second setup. The contact pads were replaced on each Water Monitor between the PVC and Copper tests.

Figure 2. Streamlabs copper pipe installation
For each flow rate, a control valve was used to set the flow rate. Then an
isolation valve was closed to stop flow. The total throughput was recorded after
at least five minutes with no flow to ensure that the throughput shown in each
app was completely updated before calibration. Once the daily throughput for
each device was recorded, the isolation valve was opened, and a stopwatch was
started. Water temperatures were measured at the beginning, midpoint, and end
of each test.

Once at least 100 gallons had been collected in the weight tank, the isolation
valve was closed and the stopwatch was stopped. The actual throughput was
calculated using the weight of water collected and the test time. After at least
five minutes, the total daily throughput was again recorded for each device. The
percent registry was then calculated using Equation 1.

\[
R = \frac{V_m - V_a}{V_a} \times 100\%
\]

Where R is percent registry, \( V_m \) is volume measured in gallons, and \( V_a \) is actual
volume in gallons.

Additional photographs of the five devices are shown in Appendix A.

**RESULTS**
The following tables summarize the test results for the devices. The accuracy
data is presented in certificate format.

The last certificate is for the Badger 35 meters to which the Flume water sensors
were mounted. These calibrations were necessary so that a clearer picture of the
Flume’s accuracy could be noted.

As indicated by the test results, the Buoy, Phyn and Flume devices were the most
accurate over the range of flow rates that were tested.
Meter Accuracy Certificate

This is to certify that Buoy devices were tested at the Utah Water Research Laboratory from May 16, 2019, to May 23, 2019, by calibrators Tyler Ashby and Adam Pack, using a gravimetric test bench. The laboratory weight tanks are traceable to the National Institute of Standards and technology (NIST) by weight. Test procedures are in accordance with AWWA M6 testing requirements. The devices listed below were tested at 15 gpm, 2 gpm, 0.50 gpm, and 0.25 gpm.

### Device Accuracy

<table>
<thead>
<tr>
<th>Device Type</th>
<th>Serial Number</th>
<th>15 gpm</th>
<th>2 gpm</th>
<th>0.50 gpm</th>
<th>0.25 gpm</th>
</tr>
</thead>
<tbody>
<tr>
<td>Buoy</td>
<td>00500742</td>
<td>110.98%</td>
<td>99.65%</td>
<td>100.56%</td>
<td>99.79%</td>
</tr>
<tr>
<td>Buoy</td>
<td>00500175</td>
<td>106.76%</td>
<td>98.67%</td>
<td>100.56%</td>
<td>90.02%</td>
</tr>
<tr>
<td>Buoy</td>
<td>00500154</td>
<td>112.94%</td>
<td>101.12%</td>
<td>99.60%</td>
<td>98.93%</td>
</tr>
</tbody>
</table>

Steven L. Barfuss, Research Professor
Utah Water Research Laboratory
1600 Canyon Road
Logan, Utah 84321
Meter Accuracy Certificate

This is to certify that Phyn devices were tested at the Utah Water Research Laboratory from May 16, 2019, to May 23, 2019, by calibrators Tyler Ashby and Adam Pack, using a gravimetric test bench. The laboratory weight tanks are traceable to the National Institute of Standards and technology (NIST) by weight. Test procedures are in accordance with AWWA M6 testing requirements. The devices listed below were tested at 15 gpm, 2 gpm, 0.50 gpm, and 0.25 gpm.

<table>
<thead>
<tr>
<th>Device Type</th>
<th>Serial Number</th>
<th>15 gpm</th>
<th>2 gpm</th>
<th>0.50 gpm</th>
<th>0.25 gpm</th>
</tr>
</thead>
<tbody>
<tr>
<td>Phyn</td>
<td>221746PP100C8E</td>
<td>100.98%</td>
<td>99.75%</td>
<td>100.66%</td>
<td>101.04%</td>
</tr>
<tr>
<td>Phyn</td>
<td>221817PP10038B</td>
<td>100.00%</td>
<td>98.77%</td>
<td>100.66%</td>
<td>99.12%</td>
</tr>
<tr>
<td>Phyn</td>
<td>221805PP100019</td>
<td>100.00%</td>
<td>98.77%</td>
<td>100.66%</td>
<td>97.19%</td>
</tr>
</tbody>
</table>

Steven L. Barfuss, Research Professor
Utah Water Research Laboratory
1600 Canyon Road
Logan, Utah 84321
This is to certify that Flume devices were tested at the Utah Water Research Laboratory from May 16, 2019, to May 23, 2019, by calibrators Tyler Ashby and Adam Pack, using a gravimetric test bench. The laboratory weight tanks are traceable to the National Institute of Standards and technology (NIST) by weight. Test procedures are in accordance with AWWA M6 testing requirements. The devices listed below were tested at 15 gpm, 2 gpm, 0.50 gpm, and 0.25 gpm.

### Device Accuracy

<table>
<thead>
<tr>
<th>Device Type</th>
<th>Serial Number</th>
<th>15 gpm</th>
<th>2 gpm</th>
<th>0.50 gpm</th>
<th>0.25 gpm</th>
</tr>
</thead>
<tbody>
<tr>
<td>Flume</td>
<td>30NLECSUDP4IL</td>
<td>99.90%</td>
<td>99.75%</td>
<td>96.79%</td>
<td>98.17%</td>
</tr>
<tr>
<td>Flume</td>
<td>30FXJ9RS3L41J</td>
<td>99.02%</td>
<td>101.31%</td>
<td>99.50%</td>
<td>99.42%</td>
</tr>
<tr>
<td>Flume</td>
<td>30GNN24XH3NVE</td>
<td>99.90%</td>
<td>100.82%</td>
<td>98.24%</td>
<td>98.65%</td>
</tr>
</tbody>
</table>

Steven L. Barfuss, Research Professor
Utah Water Research Laboratory
1600 Canyon Road
Logan, Utah 84321
Meter Accuracy Certificate

This is to certify that Flo by Moen devices were tested at the Utah Water Research Laboratory from May 16, 2019, to May 23, 2019, by calibrators Tyler Ashby and Adam Pack, using a gravimetric test bench. The laboratory weight tanks are traceable to the National Institute of Standards and technology (NIST) by weight. Test procedures are in accordance with AWWA M6 testing requirements. The devices listed below were tested at 15 gpm, 2 gpm, 0.50 gpm, and 0.25 gpm.

Device Accuracy

<table>
<thead>
<tr>
<th>Device Type</th>
<th>Serial Number</th>
<th>15 gpm</th>
<th>2 gpm</th>
<th>0.50 gpm</th>
<th>0.25 gpm</th>
</tr>
</thead>
<tbody>
<tr>
<td>Flo</td>
<td>295375850012</td>
<td>99.02%</td>
<td>100.73%</td>
<td>89.05%</td>
<td>0.00%</td>
</tr>
<tr>
<td>Flo</td>
<td>312911790038</td>
<td>101.96%</td>
<td>102.68%</td>
<td>114.21%</td>
<td>123.05%</td>
</tr>
<tr>
<td>Flo</td>
<td>312911790034</td>
<td>98.04%</td>
<td>96.81%</td>
<td>95.82%</td>
<td>87.57%</td>
</tr>
</tbody>
</table>

Steven L. Barfuss, Research Professor
Utah Water Research Laboratory
1600 Canyon Road
Logan, Utah 84321
Meter Accuracy Certificate

This is to certify that Streamlabs Water Monitor devices were tested at the Utah Water Research Laboratory from May 16, 2019, to May 23, 2019, by calibrators Tyler Ashby and Adam Pack, using a gravimetric test bench. The laboratory weight tanks are traceable to the National Institute of Standards and technology (NIST) by weight. Test procedures are in accordance with AWWA M6 testing requirements. The devices listed below were tested on 3/4 in. PVC Schedule 40 and Copper Type L pipes at 15 gpm, 2 gpm, 0.50 gpm, and 0.25 gpm.

Device Accuracy

PVC Results

<table>
<thead>
<tr>
<th>Device Type</th>
<th>Serial Number</th>
<th>15 gpm</th>
<th>2 gpm</th>
<th>0.50 gpm</th>
<th>0.25 gpm</th>
</tr>
</thead>
<tbody>
<tr>
<td>Water Monitor</td>
<td>182000829WZU5</td>
<td>93.13%</td>
<td>95.84%</td>
<td>109.37%</td>
<td>102.97%</td>
</tr>
<tr>
<td>Water Monitor</td>
<td>182000930WZU5</td>
<td>91.17%</td>
<td>92.90%</td>
<td>97.76%</td>
<td>53.89%</td>
</tr>
<tr>
<td>Water Monitor</td>
<td>182000945WZU5</td>
<td>90.19%</td>
<td>91.92%</td>
<td>92.92%</td>
<td>47.15%</td>
</tr>
</tbody>
</table>

Copper Results

<table>
<thead>
<tr>
<th>Device Type</th>
<th>Serial Number</th>
<th>15 gpm</th>
<th>2 gpm</th>
<th>0.50 gpm</th>
<th>0.25 gpm</th>
</tr>
</thead>
<tbody>
<tr>
<td>Water Monitor</td>
<td>182000829WZU5</td>
<td>116.39%</td>
<td>125.15%</td>
<td>126.32%</td>
<td>90.26%</td>
</tr>
<tr>
<td>Water Monitor</td>
<td>182000930WZU5</td>
<td>124.15%</td>
<td>137.66%</td>
<td>181.03%</td>
<td>283.83%</td>
</tr>
<tr>
<td>Water Monitor</td>
<td>182000945WZU5</td>
<td>116.39%</td>
<td>110.71%</td>
<td>147.21%</td>
<td>0.00%</td>
</tr>
</tbody>
</table>

Steven L. Barfuss, Research Professor
Utah Water Research Laboratory
1600 Canyon Road
Logan, Utah 84321
This is to certify that Badger 35 cold water meters devices were tested at the Utah Water Research Laboratory from May 16, 2019, to May 23, 2019, by calibrators Tyler Ashby and Adam Pack, using a gravimetric test bench. The laboratory weight tanks are traceable to the National Institute of Standards and technology (NIST) by weight. Test procedures are in accordance with AWWA M6 testing requirements. The devices listed below were tested at 15 gpm, 2 gpm, 0.50 gpm, and 0.25 gpm.

### Device Accuracy

<table>
<thead>
<tr>
<th>Device Type</th>
<th>Serial Number</th>
<th>15 gpm</th>
<th>2 gpm</th>
<th>0.50 gpm</th>
<th>0.25 gpm</th>
</tr>
</thead>
<tbody>
<tr>
<td>Badger 35</td>
<td>1069527</td>
<td>99.75%</td>
<td>100.60%</td>
<td>98.11%</td>
<td>98.85%</td>
</tr>
<tr>
<td>Badger 35</td>
<td>1069526</td>
<td>99.71%</td>
<td>99.56%</td>
<td>95.71%</td>
<td>98.29%</td>
</tr>
<tr>
<td>Badger 35</td>
<td>1069522</td>
<td>99.87%</td>
<td>101.04%</td>
<td>99.37%</td>
<td>99.77%</td>
</tr>
</tbody>
</table>

Steven L. Barfuss, Research Professor
Utah Water Research Laboratory
1600 Canyon Road
Logan, Utah 84321
Streamlabs Water Monitor on PVC pipe
Streamlabs Water Monitor on copper pipe
Buoy by Buoy Labs
Flo by Moen