**July 19, 2018**

# Sienna Living: Measurement & Verification Findings

## *Summary Findings*

The following Measurement and Verification (M&V) analysis demonstrates mixed results for the 3 Sienna facilities (2005 Lawrence Ave., 1800 O'Connor Fountain View and Harmony Hill) in which the H2minusO Flow Management Device (FMD) was installed. The results are mixed because, in both the O'Connor buildings, during the post-installation measurement period, we discovered that there were unaccounted for and unexpected variables that caused an increase in water consumption. When this variable data is normalized, the FMD demonstrates positive results, exceeding our original projections.

## *Key Project Metrics*

| Address | One time Project Investment | Projected Consumption (m3) | Cost (m3) | Install Date |
|---|---|---|---|---|
| 2005 Lawrence | $13,855 | 46,861 | 3.61 | 2018-05-09 |
| 1800 O'connor F**ountain** V**iew** | $13,855 | 36,427 | 3.61 | 2018-05-08 |
| 1800 O'connor H**armony Hill** | $13,855 | 35,905 | 3.63 | 2018-05-08 |

## *Pre-Installation Projections*

| Address | Projected Savings ($) | Projected Savings (%) | Projected ROI (yrs) |
|---|---|---|---|
| 2005 Lawrence | $8,425 | 5.00% | 1.45 |
| 1800 O'connor F**ountain** V**iew** | $6,568 | 5.00% | 1.93 |
| 1800 O'connor H**armony Hill** | $6,519 | 5.00% | 1.87 |

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***Post-Installation Measurements***

| Address | Measured Savings ($) | Measured Savings (%) | Measured ROI (yrs) |
|---|---|---|---|
| 2005 Lawrence | $7,683 | 4.56% | 1.8 |
| 1800 O'connor Fountain View | $28,110 | 21.40% | .49 |
| 1800 O'connor Harmony Hill | $15,007 | 11.51% | .92 |

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## ***Detail Findings: 2005 Lawrence Ave.***

Table 1 details the consumption pattern for the pre and post-installation periods from March 14, 2018 - June 28, 2018. Column 6 shows the total daily consumption (m3) based on the start and end period as indicated in columns 3 and 4. Rows 1 and 2, column 8 shows the measured change in consumption between the pre-installation period and the post-installation period. Note – irrigation started in the post-installation period, but we have insufficient data that would allow us to normalize the measured consumption. Nevertheless, even in the absence of this data, the results are positive.

The measured consumption was 132.43 m3/day (row-1 column-7) pre-installation compared to a non-normalized 126.39 m3/day (row-2 column-7) post-installation. So measured consumption decreased by 6.04 m3/day. This represents a non-normalizede measured savings of 4.56% (row-2 column-8) between these 2 periods. The results clearly confirm the improved meter reading efficiency post-installation of the FMD.

Table 1: M&V Results – 2005 Lawrence Ave.

| # | H2 Reference | Start Measurement Pd | End Measurement Pd | Days in Pd | Total Consumption/Pd (m3) | Average Consumption (m3/day) | Change in Consumption (%) |
|---|---|---|---|---|---|---|---|
| 1 | Pre-Install | 2018-03-14 | 2018-05-09 | 56 | 7,416 | 132.43 | N/A |
| 2 | Post-Install | 2018-05-09 | 2018-06-28 | 50 | 6,320 | 126.39 | 4.56% |

## ***Detail Findings: 1800 O'Connor Drive Fountain View***

Table-2 details the consumption pattern for the pre and post-installation periods from April 4, 2018 - June 27, 2018. During the post-installation readings, consumption unexpectedly spiked by a daily average of more than 8% during mid-May to June 7th. This was discovered when we conducted our meter reading On June 7th and asked questions pertaining to the increase in consumption. We were informed that the fountain was turned on and had been operational for at least 2-weeks (perhaps longer). Furthermore, as we were shown how the fountain filling and shut-off worked, it was discovered that the shut-off valve was, in fact, malfunctioning - water had been continuously running since the fountain was turned on. This was clearly demonstrated by the increase of 8% compared to the first 1-2 weeks of readings. Immediately after the situation was resolved the next 2-weeks saw the consumption return to post-installation numbers. Given the lack of details, with respect to the leak, we used similar metrics as those used at Harmony Hills to calculate consumption amounts in order to normalize the actual measured post-installation consumption.

During the first 30 days, meter reading efficiency showed an improvement of over 5% (table-2 row-3 column-11) in spite of the issues experienced by the fountain. And once the issue was uncovered and the appropriate steps were taken to mitigate the problem, measured consumption showed a significant improvement - dropping from 120.32 m3/day (table-2 row-1 column-9) to 94.2 m3/day (table-2 row-4 column-9).

The new information clearly demonstrated why consumption increased shortly after the FMD was installed. It is also important to note, that the improved meter reading efficiency, due to the FMD, is still delivering as expected. However, because of unexpected and unaccounted for changes in the water usage, the pre-installation baseline does not provide the appropriate metrics to compare the post-installation period too.

Table 2 also shows what the projected savings could be when the post-installation consumption is normalized based on the excess water used for filling the fountain. The following assumptions were made in order to calculate the additional water used.

1. Water pressure on ground-level = 60 psi (pounds per square inch)
2. Size of water hose = ½”
3. Number of hose(s) = 1 (100 feet)
4. Calculated flowrate = 7.5 (gpm) gallons per minute
5. Number of minutes in a day = 1440 (60 mins * 24 hours)
6. Number of days “fountain filling” left on = 14

With the above values, the calculated amount of water used to normalize the measured consumption post-installation was: (Line 3 * line 4 * line 5 * line 6 = 151,200 gpm) or 572 m3.

Table 2 column-12 shows the projected post-installation savings based on normalizing the measured consumption. Column-6 rows 2,3 and 4 shows the m3 that is used to normalize the actual measured consumption which is shown in column-8. Column-10 shows the adjusted average daily consumption when the actual measured consumption is normalized. When the data is normalized we can see that the FMD is, as expected, still working. However, the unexpected and unaccounted for variables mask the results.

Table 2: M&V Results – 1800 O'connor Drive

| # | H2 Reference | Start Measurement Pd | End Measurement Pd | Days in Pd | Unaccounted for Consumption | Total Consumption/Pd (m3) | Normalized Consumption | Average Consumption Unadjusted(m3/day) | Average Consumption Adjusted (m3/day) | Change in Consumption Unadjusted(%) | Change in Consumption Adjusted (%) |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | **Pre-Install** | **2018-04-04** | **2018-05-08** | **34** | **0** | **4,091** | **4,091** | **120.324** | **120.324** | **N/A** | **N/A** |
| 2 | **Post-Install** | **2018-05-08** | **2018-06-27** | **50** | **572** | **5,301** | **4,729** | **106.020** | **94.580** | **11.89%** | **21.40%** |
| 3 | **Post-Install** | **2018-05-08** | **2018-06-07** | **30** | **572** | **3,418** | **2,846** | **113.933** | **94.867** | **5.31%** | **21.16%** |
| 4 | **Post-Install** | **2018-06-07** | **2018-06-27** | **20** | **0** | **1,884** | **1,884** | **94.200** | **94.200** | **21.71%** | **21.71%** |

## ***Detail Findings: 1800 O'Connor Drive Harmony Hill***

Table 3 details the consumption pattern for the pre and post-installation periods from April 4, 2018 - June 27, 2018. During the post-installation readings consumption unexpectedly began to increase after the first 6 days. Prior to the increase, there was a decrease in the consumption 100.667 m3/day (row-3 column-9) compared to the pre-installation period of 107.397 m3/day (row-1 column-9 and savings were tracking at over 6% (row-3 column-11). However, during the next 42 days, the consumption showed a marked increase – going from 100.67/m3/day (row-3 column-9) to 123.28 m3/day (row-5 column-9) and savings went from 6.27% to -14.79%.

Given the unexpected change in consumption, we began to explore what changes may have occurred in the facility that caused the increase. In speaking to the facility manager, it was brought to our attention that on days that the outdoor temperature exceeded 25-degrees Celsius (or residents complained of the excessive heat), 2 garden hoses were opened and (in a continuous stream) sprayed onto the cooling tower for the duration of the day. This was necessary because the cooling tower is undersized for the building and so in order to prevent the unit from overheating the external water source was required. Furthermore, we were also informed that even though the temperature exceeded the 25-degree mark 13.8 days post-installation, it was very possible that the cooling tower may still have been hosed down on days where this was not the case because tenants may have complained that the heat was excessive. However, for the purposes of our analysis and normalizing the data, we have used the 13.8-day benchmark as the number of days to normalize.

The new information clearly demonstrated why consumption increased after the first 6-days. In the first 6 days post-installation, there were no days that the outdoor temperature exceeded 25 degrees Celsius and thus the FMD showed improved meter reading efficiency by more than 6%. This, unfortunately, was not the case for the next 42 days. It is also important to note, that the improved meter reading efficiency, due to the FMD, is still delivering as expected. However, because of unexpected and unaccounted for changes in the water usage, the pre-installation baseline does not provide the appropriate metrics to compare the post-installation period too.

Table 3 also shows what the projected savings could be when the post-installation consumption is normalized based on the water used on the cooling tower. The following assumptions were made in order to calculate the additional water used on the cooling tower.

1. Water pressure on top deck = 45 psi (pounds per square inch)
2. Size of water hose = ½”
3. Number of hose(s) = 2 (100 feet each)
4. Calculated flowrate = 6.5 (gpm) gallons per minute
5. Number of minutes in a day = 1440 (60 mins * 24 hours)
6. Number of Cooling Degree Days > 25º Celsius in post-installation period = 13.8
    a. Number of Cooling Degree Days > 25º Celsius post-installation period row-3 = 0
    b. Number of Cooling Degree Days > 25º Celsius post-installation period row-4 = 5.7
    c. Number of Cooling Degree Days > 25º Celsius post-installation period row-5 = 8.1

With the above values, the calculated amount of water used to normalize the measured consumption post-installation was: (Line 3 * line 4 * line 5 * line 6 = 258,336 gpm) or 978 m3.

Table 3 column-12 shows the projected post-installation savings based on normalizing the measured consumption. Column-6 rows 2,3,4 and 5 shows the m3 that is used to normalize the actual measured consumption which is shown in column-8. Column-10 shows the adjusted average daily consumption when the actual measured consumption is normalized. When the data is normalized we can see that the FMD is, as expected, still working. However, the unexpected and unaccounted for variables mask the results.

Table 3: M&V Results – 1800 O'connor Drive Harmony Hill

| # | H2 Reference | Start Measurement Pd | End Measurement Pd | Days in Pd | Unaccounted for Consumption | Total Consumption /Pd (m3) | Normalized Consumption | Average Consumption Unadjusted( m3/day) | Average Consumption Adjusted (m3/day) | Change in Consumption Unadjusted( %) | Change in Consumption Adjusted (%) |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | Pre-Install | 2018-04-04 | 2018-05-08 | 34 | 0 | 3,652 | 3,652 | 107.397 | 107.397 | N/A | N/A |
| 2 | Post-Install | 2018-05-08 | 2018-06-27 | 50 | 978 | 5,730 | 4,752 | 114.592 | 95.032 | -6.70% | 11.51% |
| 3 | Post-Install | 2018-05-08 | 2018-05-14 | 6 | 0 | 604 | 604 | 100.667 | 100.667 | 6.27% | 6.27% |
| 4 | Post-Install | 2018-05-14 | 2018-05-30 | 16 | 404 | 1,673 | 1,269 | 104.563 | 79.313 | 2.64% | 26.15% |
| 5 | Post-Install | 2018-05-30 | 2018-06-27 | 28 | 574 | 3,452 | 2,878 | 123.286 | 102.786 | -14.79% | 4.29% |