HARVESTING SUSTAINABLE WATER SOLUTIONS

RESEARCH REPORT | 2019 – 2020

RESEARCH & REPORT BY

KEEP GROWING DETROIT

DRUMMOND CARPENTER
engineering + research

Acknowledgments

Keep Growing Detroit would like to thank and acknowledge everyone who played a role in making this research project possible.

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We'd also like to thank our staff lead, Rick Blanchard and research partners from Drummond Carpenter, Don Carpenter and Chris Bragg for their hard work and diligence in setting up and communicating with research host sites, collecting and analyzing data, and advising the Water Research Learning Community.

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Finally, we would like to thank the Erb Family Foundation for funding this important work and for your long-time support of Detroit's urban agriculture community.

Executive Summary

Research conducted during the Harvesting Sustainable Water Solutions Project was based on the holistic question:

How can urban agricultural be an integral part of stormwater management in Detroit?

Research conducted by Drummond Carpenter and Keep Growing Detroit (KGD) determined that urban agriculture could be effective at managing stormwater through rainwater harvesting and thoughtful development of urban agricultural planting beds.

With regards to rainwater harvesting, it was determined that the six sites involved in this research could have harvested over 100,000 gallons of stormwater runoff per year, with five of the six sites theoretically harvesting all of the stormwater runoff during the 2019 and 2020 growing seasons. Based on extrapolation, the 29 rainwater harvesting systems developed by KGD or their partner organizations since 2016 could collect over 500,000 gallons of stormwater annually. However, this is predicated on the rainwater harvesting systems having enough capacity to store the runoff, which led to KGD analyzing practical challenges associated with citizen rainwater harvesting. In response to those challenges, KGD improved outreach tools including revised flyers and a text messaging system encouraging urban agriculturalists to drawdown their rainwater harvesting systems in advance of predicted rain.

With regards to the planting beds, the research demonstrates that urban agricultural soils are extremely efficient at storing water and could be used for stormwater management. Based on seasonal monitoring, the agricultural in-ground beds demonstrated practically no stormwater runoff from natural rainfall events. For simulated rainfall events, agricultural soil demonstrated infiltration rates of 2.3 to 5.4 inches per hour with little to no observed ponding and, overall, between 9 and 21 inches of "rain" was applied to at-grade beds with little to no runoff. This led to an approximation that urban agricultural soils are conservatively capable of storing three times more water than typical Detroit topsoil. In other words, an urban agricultural bed could capture and treat three times the amount of connected impervious surface when compared to typical turfgrass applications. The research also showed that raised planter beds captured up to 90% of the annual rainfall volume and 75% of the extreme simulated rainfall events. Therefore, raised planter beds could be paired with rainwater harvesting systems to serve as the equivalent of an above-ground rain garden for both volume and peak discharge control.

Finally, typical organic matter in topsoil ranges from 1% up to 5% for the richest organic topsoil blends. The average percentage of organic matter from 1,040 samples processed by Keep Growing Detroit on Detroit agricultural soils was 5.9%. If we assume typical topsoil in Detroit has an organic matter content of 3%, then this equates to an additional 2900 gallons of stormwater stored annually for each city lot converted to agriculture. In larger terms, each acre converted to agriculture will hold approximately 50,000 gallons more water than typical topsoil.

Research Introduction

There were three research questions posed by the Harvesting Sustainable Water Solutions Project:

1) How can urban agricultural be an integral part of stormwater management in Detroit?
2) How can we quantify rainwater harvesting as a stormwater management technique?
3) How can we quantify a local water balance (i.e. agricultural bed scale) and evaluate the amount of rainwater being captured/treated by urban agriculture?

The first question was a holistic question that guided project activities. The other two questions were the subject of research that is discussed in this report. To monitor rainwater harvesting, the team deployed water level sensors in cisterns around the city and tracked the amount of water collected and used by urban agriculturalists. To monitor stormwater runoff from urban agriculture, the team evaluated the amount of water captured and stored by urban planting beds using both natural rainfall and simulated storm events. Overall, research activities were conducted over two complete growing seasons (2019 and 2020) after pilot testing in 2018. At the end of each season, a presentation was assembled that highlighted the results from that year. Attachment A is the presentation of the 2019 results (and includes 2018 pilot testing) and Attachment B is a presentation of the 2020 results.

Rainwater Harvesting

KGD and Drummond Carpenter staff installed digital micro-divers (a specialized water level data logger) in six rainwater harvesting systems that varied from a single 300-gallon tote (Figure 1) to three large cisterns (5000 gallons combined) connected with pumps (Figure 2). The six locations were:

- Timbuktu Community Gardens
- CDC Urban Farms
- Knagg's Creek Community Garden
- Earthworks Urban Farms
- Making Shade Community Garden
- Parker Community Garden

A summary of all rainwater harvesting systems including dimensions and catchment areas can be found in Attachment A. The micro-divers track water level which is then used to compute rainwater volume collected and used for the various water collection systems. Installation and beta-testing of the system was completed in 2018 and water level data was collected for one growing season (2019). Data from the micro-divers was downloaded routinely and graphs of water level vs. rainfall for all systems is included in Attachment C. The collection and subsequent use of water is clearly visible in the data.

Figure 1: 300-gallon tote at Making Shade Community Garden

Figure 2: Two at-grade 1000 gallon cisterns and one 3000 gallon elevated cistern.

There were two components to the rainwater harvesting research: real-time recording of water level in the rainwater harvesting totes and citizen journaling of rainwater collected and used (see Attachment D for Citizen Journal). The goal was to establish water irrigation patterns and determine whether user recorded water level data and water use would match the monitoring data. Of the six rainwater harvesting and monitoring project locations, only three recorded data in journals and submitted for comparison against the automated water level collection. Of those three, two (CDC and Knagg's Creek) did a reliable job journaling and one (Timbuktu) showed intermittent journaling. Unfortunately, users at the other three sites did not submit journals for comparison, but the installation of the divers allowed the monitoring of stormwater collection and use.

For the three sites with rainwater harvesting journals, the journal summary tables are available in Attachment A. Timbuktu collected about 3100 gallons of water over the course of the growing season and utilized that water in some capacity on-site (either through irrigation, washing, or water release). However, the estimated runoff available for collection was much higher and over 10,000 gallons overflowed into the combined system during the year. This means the cisterns were undersized for potential harvesting volume. For CDC, over the course of the growing season, more than 13,000 gallons were collected and used for irrigation. At CDC, the rainwater harvesting system did not overflow into the combined system. For Knagg's Creek, approximately 1300 gallons of rainwater was collected and 900 used to irrigate, but approximately 6000 gallons overflowed into the combined system.

For the three sites without rainwater harvesting journals, the recorded water levels demonstrated they used the rainwater they harvested. Parker Community Gardens consistently had approximately 1200 gallons of rainwater in the system except between August 7 and August 22 when 800 gallons was used for irrigation. The rest of the 2019 growing season saw minimal use of harvested rainwater. Making Shade followed a similar pattern with 280 gallons consistently in the totes except for the period between August 7 and August 22 when all 280 gallons were used. Earthworks was a unique case in that there are three rainwater harvesting cisterns (two at grade and one elevated) that have a combined capacity of 5000 gallons. The automatic water level recording was in one of the at-grade cisterns and showed that as rainwater was harvested, it was pumped out and used.

With regards to rainwater harvesting, there are two general approaches for sizing rainwater harvesting systems: supply and demand. When sizing for supply, the amount of stormwater runoff from a catchment area for a given storm event is used to size the system. When sizing for demand, the amount of water needed for use over a set period determines the size the system. Ideally, the supply and demand of rainwater can be balanced over time. However, in many urban agricultural scenarios, the supply and demand of rainwater is unbalanced. Timbuktu Community Gardens is an example of an unbalanced system. Timbuktu has two 300-gallon totes which represent the amount of water necessary to water their community learning gardens. However, the catchment area from the school roof generates much more runoff than can be harvested. As an example, in August 2019, almost 7000 gallons of stormwater were generated by the roof, but only 380 gallons were collected by the totes. The rest of the rainwater overflowed into the combined sewer during rain events. As an example of a balanced system, CDC can capture up to 3200 gallons of rainfall runoff and displays mostly balanced water harvesting with water used over the course of most of the summer.

For rainwater harvesting to be used as a DWSD-recognized stormwater management technique, a use plan must show how supply and demand balance such that runoff to combined sewer system is managed. As a simple demonstration of how that could work for these six sites, the amount of runoff generated daily for each site's catchment area was calculated for the 2019 and 2020 growing seasons (May 1 – October 31). It is assumed that the beginning of each day, the rainwater harvesting cisterns are empty having been either used for agricultural watering or slowly released to adjacent grass areas in anticipation of the next days rainfall event. The cisterns would only overflow to the combined system if the runoff produced during that day's rainfall event exceeded capacity of the system. Summary results (Appendix E) from this analysis demonstrate that five of the six sites never discharge to the combined system during the rainfall event with only Timbuktu not having enough capacity to store the runoff. In total, from these six sites, the gallons of stormwater that could be harvested was 105,367 in 2019 and 110,864 in 2020.

Table 1: Potential Stormwater Runoff Volume Harvested per Growing Season

Site	**Volume Harvested – 2019 (gallons)**	**Volume Harvested – 2020 (gallons)**
Timbuktu	28273	21480
CDC	26841	31120
Knagg's Creek	2928	3395
Earthworks	41420	48023
Making Shade	781	905
Parker	5124	5941

Rainwater Harvesting Summary

A summary of the rainwater harvesting research is as follows:

- Only CDC and Earthworks balanced water harvested with water use over an entire growing season.
- At four locations (Timbuktu, Knagg's Creek, Making Shade, and Parker), the rainwater harvesting systems were routinely full and subsequently runoff overflowed into the combined system.
- At three of the six locations (Timbuktu, Knagg's Creek, and Parker), a significantly larger amount of runoff volume is available for collection (based on catchment area) than was collected.

- Citizen journaling was inconsistent in recording water use, but the pilot program showed how journals could be used to quantify rainwater harvesting as a stormwater management technique.
- Lessons learned during 2019 led to revision to the *Keep Growing Detroit Rainwater Catchment Safety and Use Flyer* (Appendix F) to incorporate information about the potential of rainwater harvesting in Detroit, the need to "right size" the system, and the importance of having a water use plan so that runoff is harvested instead of overflowing to the combined sewer during wet weather events.
- Rainwater harvesting is a viable stormwater management strategy, but water must be released in between rainfall events (need a formal utilization plan). In larger agricultural systems like Earthworks and CDC, all harvested water was used for agriculture. For small operations with less water demand, the collected rainwater should be released between events.
- With a proper utilization plan, these six sites could have harvested over 100,000 gallons of stormwater runoff per year. Since 2016, Keep Growing Detroit or their partner organizations has assisted in the development of 29 rainwater harvesting systems that are capable of collecting over 500,000 gallons of stormwater annually.

Urban Agricultural Runoff Monitoring and Simulation

For monitoring stormwater runoff from urban agriculture, the team evaluated the amount of water captured and stored by urban agricultural planting beds or plots using both natural rainfall and simulated storm events at three locations:

- Earthworks – one agriculture bed
- Oakland Avenue Urban Farm (OAUF) – two agriculture beds
- Keep Growing Detroit (KGD) – two agriculture beds

At all three locations, stormwater runoff was recorded by measuring water level in an underground tote (Figure 3) using a micro-diver. A summary of all runoff monitoring systems including dimensions and catchment areas can be found in Attachment A and construction specification plans for monitoring agricultural bed runoff are in Attachment D[1]. Stormwater runoff from the beds was measured during two growing seasons (2019 and 2020). In addition, a rainfall simulator (Figure 4) (developed by Lawrence Tech University for monitoring lot runoff as part of a previous project) was used at least twice at each location to estimate the water carrying capacity of an agricultural bed before CSO contributing runoff occurred. The rainfall simulator is modular, and the size of the simulator was adjusted to meet planting bed requirements (see Figure 5 for example deployment).

Figure 3: Water Collection Tote.

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[1] As built, dimensions varied slightly from specifications but overall plan and profile are as intended.

Figure 4: Rainfall Simulator in Use on Vacant Land (2017)

Figure 5: Rainfall Simulator on KGD Raised Beds (Left – prior to wind shield deployment; Right – during simulation)

Earthworks

Runoff monitoring at Earthworks was conducted on a single agricultural bed (Figure 6). The agricultural bed was sloped at approximately 1% towards a gutter that was buried in the ground to receive sheet flow and shallow groundwater flow from the beds (Figure 7). In addition, an impermeable barrier was installed around the edge of the bed and buried several inches deep. This was done to isolate this section of the planting bed from the adjacent agricultural fields.

From August 1 to October 31 (2019)[2], 10.5 gallons of rainfall runoff was recorded from the bed out of the estimated 875 gallons of rainfall that fell on the bed[3]. From May 1 to August 31 (2020), 132 gallons of runoff were recorded out of the estimated 1122 gallons of rainfall that fell on the bed. However, the gutter is open and receives rainfall as well, so recorded runoff also includes direct capture rainfall and not just stormwater runoff from the planting beds. If direct capture is removed, then there was no recorded runoff volume in 2019 and only 118 gallons of runoff in 2020 (approximately 10%).

Figure 6: Earthwork Planting Bed

[2] 2019 was unusually wet during spring and early summer which caused a delay in construction and planting.
[3] Rainfall volume estimated by nearest NOAA weather station gauge.

Figure 7: Earthworks Planting Bed with Runoff Collection Gutter in Background.

The Earthworks planting bed was also subjected to three simulated storm events (Table 2). In 2019, approximately 2.7 inches/hour was applied to the bed over a four-hour period with no ponding and minimal amounts of runoff recorded. In 2020, 5.4 inches/hour was applied to the bed over a four-hour period with approximately 1 inch of ponding after three hours and only 13 gallons of total runoff volume.

Table 2: Rainfall Simulation Results (Earthworks)

Simulation Date	Duration	Rainfall Depth Applied (inches)	Estimated Infiltration Rate (inches/hour)	Total Volume Applied (gallons)	Total Runoff Volume (gallons)	Runoff Ratio
07/13/2019	4	10.72	2.68	999.9	12.4	0.01
10/29/2019	4	11.03	2.75	1028.6	3.7	0.00
07/25/2020	4	21.60	5.40	2019.0	13.4	0.01

Oakland Avenue Urban Farms

At OAUF, runoff monitoring was conducted on two adjacent agricultural beds (identified by #1 and #2 in Report and Attachments). Similar to Earthworks, the agricultural bed was sloped at approximately 1% towards a gutter that was buried in the ground to capture runoff, and an impermeable barrier was installed around the edge to isolate the bed (Figure 8 & 9). The difference between the two beds was Bed #2 had underdrains installed 18” below the surface to measure what fraction of rainfall would be stored in the upper layer of soil (and be utilized by the plants) versus what would potentially migrate to deeper soil layers through infiltration.

Figure 8: OAUF Planting Bed #2 During Construction

Figure 9: OAUF Planting Bed #1 During Simulation

From August 1 to October 31 (2019)[4], an estimated 875 gallons of rainfall fell on the beds with essentially no runoff (Table 3). From May 1 to August 31 (2020), an estimated 1122 gallons of rainfall fell on the bed with less than 10% running off Bed #1 and less than 1% runoff off Bed #2. In 2019, there was no recorded runoff from the underdrain. In 2020, there was 17 gallons of runoff from a single rainfall event.

Table 3: OAUF Seasonal Rainfall Runoff (gallons)

	August 1 – October 31 (2019)	May 1 – August 31 (2020)
Rainfall Volume	875	1122
Bed #1 – Surface Runoff	0	92
Bed #2 – Surface Runoff	6	9
Bed #2 – Underdrain	0	17

This bed was also subjected to three simulated storm events (Table 4). In 2019, approximately 2.3 inches/hour was applied to the bed over a four-hour period with no ponding and minimal amounts of surface runoff recorded. In 2020, 3.9 inches/hour was applied to the bed over 3.75 hours with no ponding and no surface runoff. In 2019, the underdrain collected 40 gallons of water and in 2020 the underdrain collected 247 gallons of water.

Table 4: Rainfall Simulation Results (OAUF)

Date		Duration	Rainfall Depth Applied (inches)	Estimated Infiltration Rate (inches/hour)	Total Volume Applied (gallons)	Total Runoff Volume Recorded (gallons)	Runoff Ratio
10/18/19	Bed #1 - Surface	4	9.24	2.31	862.4	1.8	0.00
10/25/19	Bed #2 - Surface	4	9.37	2.34	874.2	0.0	0.00
10/25/19	Bed #2 – Underdrain	4	9.37	2.34	874.2	40.0	0.05
07/31/20	Bed #1 - Surface	4	15.73	3.93	1467	0.0	0.00
08/01/20	Bed #2 - Surface	3.75*	14.42	3.85	1345	0.2	0.00
08/01/20	Bed #2 – Underdrain	3.75*	14.42	3.85	1345	247.4	0.35

* - actual rainfall started with 15 minutes remaining in the simulation so the simulation was ended early

[4] 2019 was unusually wet during spring and early summer which caused a delay in construction and planting.

Keep Growing Detroit

Runoff monitoring was conducted on two adjacent raised planting beds (Figure 10). The difference between the two beds was Bed #2 was lined. In this location, there was no potential for surface water runoff, so the only runoff was from underdrains.

From August 1 to October 31 (2019)[5], an estimated 157.5 gallons of rainfall fell on the beds and from May 1 to August 31 (2020), an estimated 202 gallons of rainfall fell on the beds. The bed without a liner produced minimal runoff (10% or less) with most of the water either evapotranspirating (ET) or infiltrating (Table 5). The bed with a liner experienced 25 gallons of runoff in 2019 and 110 gallons in 2020 (Table 5). The only mechanism for water to be removed from Bed #1 is ET.

Table 5: KGD Seasonal Rainfall Runoff (gallons)

	August 1 – October 31 (2019)	May 1 – August 31 (2020)
Rainfall Volume	157.5	202
Bed #1 – Lined	25.1 *(15.9%)*	110.4 *(54.6%)*
Bed #2 – No Liner	9.7 *(6.1%)*	20.5 *(10.1%)*

Figure 10: KGD Planting Beds Prior to Filling with Soil (Lined Bed is in the Foreground)

[5] 2019 was unusually wet during spring and early summer which caused a delay in construction and planting.

Figure 11: KGD Planting Bed with Rainfall Simulator

These beds were also subjected to two simulated storm events (Table 6). For the lined bed, 52% of the applied water ran off during the 2020 simulation and 72% during the 2019 simulation. For the unlined bed, 25% of the applied water ran off during the 2020 simulation and 27% during the 2019 simulation.

Table 6: Rainfall Simulation Results (KGD)

Date		Duration	Rainfall Depth Applied (inches)	Estimated Infiltration Rate (inches/hour)	Total Volume Applied (gallons)	Total Runoff Volume Recorded (gallons)	Runoff Ratio
11/29/19	Bed #1 – Lined	1	13.92	13.92	233.8	167.8	0.72
11/29/19	Bed #2 – No Liner	1	14.83	14.83	249	67.85	0.27
8/22/20	Bed #1 – Lined	1	11.08	11.08	186	97.35	0.52
8/22/20	Bed #2 – No Liner	1	11.93	11.93	200	49.41	0.25

Agricultural Runoff Monitoring Summary

A summary of the urban agricultural runoff monitoring research is as follows:

- The research demonstrates that urban agricultural planting beds are extremely efficient at storing water and could be used for stormwater management.
- For at-grade beds, annual runoff varied from 0% to 10% of the total rainfall that fell on the beds.
- For simulated events on at-grade beds, agricultural soil demonstrated infiltration rates of 2.3 to 5.4 inches per hour with little to no ponding.
- Overall, between 9 and 21 inches of “rain” was applied to at-grade beds with little to no runoff.
- Under “typical” conditions (as measured during annual monitoring), the underdrains located 18 inches underneath the OAUF planting beds measured 0 gallons of runoff in 2019 and 17 gallons of runoff in 2020. Therefore, most of the rainfall that fell on the beds is stored in the agricultural planting soil for use by the plants. Even under extreme conditions, very little water drains through the underdrains (40 gallons from 9.37 inches of rain and 247 gallons from 14.42 inches of rain).
- The unlined raised beds captured up to 90% of the annual rainfall volume and 75% of the extreme simulated rainfall events, demonstrating they could serve as the equivalent of an above-ground rain garden for both volume and peak discharge control.
- The lined raised beds captured between 84% (2019) and 46% (2020) of the annual rainfall volume but less for the extreme simulated rainfall events. However, given that the beds were lined, a significant portion of the rainfall volume was stored in the agricultural soil for use by plants.

Overall, the agricultural soil is demonstrating higher amounts of water retention (i.e. effective soil porosity) than would be expected from typical topsoil. This is in part because of the higher amounts of organic matter in the agricultural soils. It has been shown that for each percent of organic matter in the top foot of soil, moisture-holding capacity increases by about 16,500 gallons per acre, roughly 1,000 gallons per standard city lot (UMass Extension, 2014). Typical organic matter in topsoil ranges from 1% up to 5% for the richest organic topsoil blends. The average % organic matter from 1,040 samples processed by Keep Growing Detroit on Detroit Agricultural soils was 5.9%. If we assume typical topsoil in Detroit has an organic matter content of 3%, then the sampled agricultural soils were on average 2.9% higher. This equates to an additional 2900 gallons of stormwater stored annually for each city lot converted to agriculture.

The water stored in the agricultural soil is available for plant uptake. Studies suggest ET can play a significant role in runoff reduction and should be accounted for in rain garden designs (Nocco et al. (2016), DelVecchio et al. (2016), Ebrahimiam et al. (2019) and Hess et al. (2017 and 2019)). Rates of ET have been found to range from 0.1 to 0.4 inches per day and represent between 19% and 84% of the total annual runoff volume reduction by rain gardens. Similar, if not higher, values should be expected from agricultural crops.

Attachment A – 2019 Summary Presentation

2019 Keep Growing Detroit

Urban Agricultural Water Learning Community Meeting

01/07/20

Table of Contents

Timbuktu Gardens

Site Name: Timbuktu
Site Address:
Contact:
Contact Phone #:

HOBO Diver S/N: 20370790

Launch Date: 9/14/2018

Volume of Reservoir: 300 gal.
Shape of Reservoir: Cube

	L	W	H
Dimesions (in.)	38	46	38.52
Dimensions (ft.)	3.17	3.83	3.21
Area, W x L, (sq.ft.)	12.14		

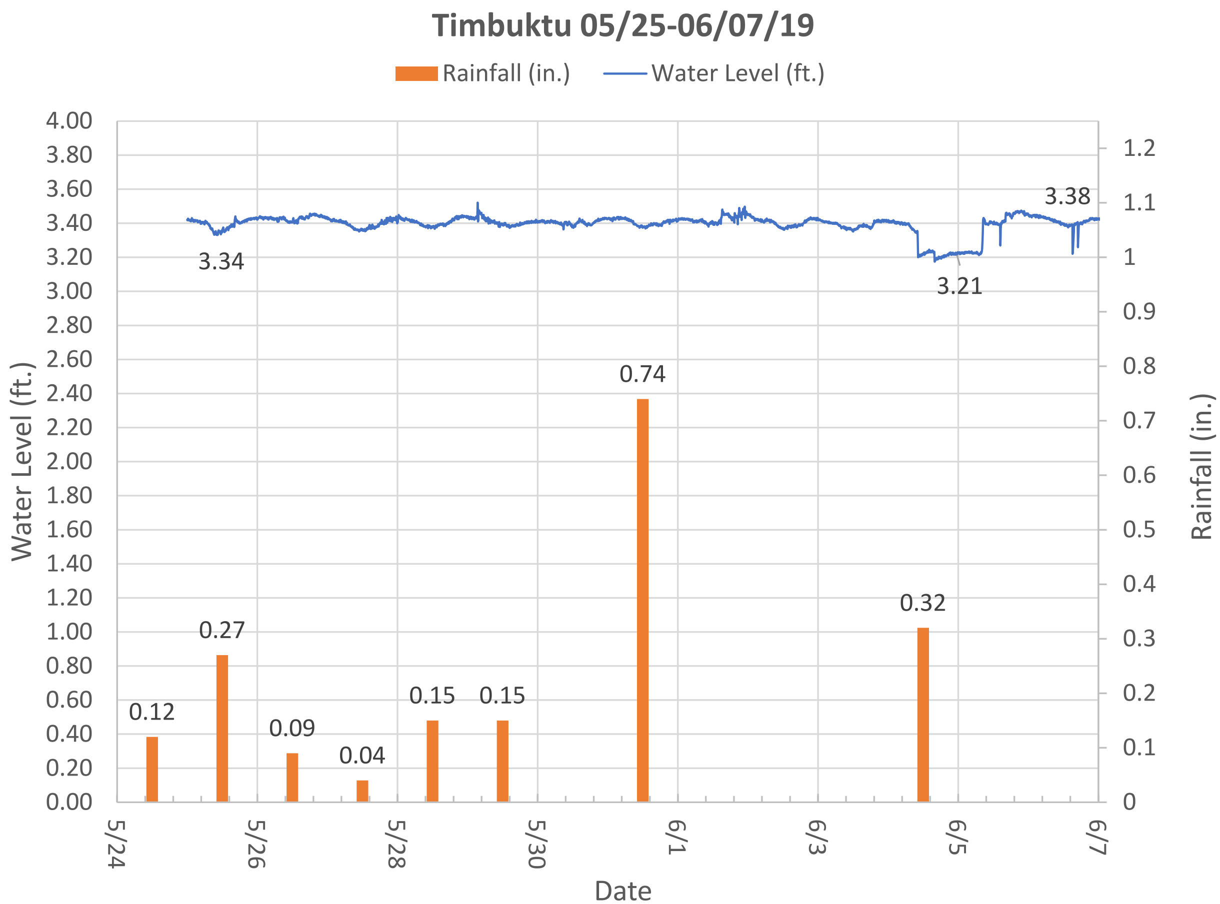
Site Notes: 2x 300 gal. totes connected in series
Location of Diver: Westernmost tote

E Canfield St
Montclair St
Timbuktu Academy of Science and Technology
Catchment Area
Cisterns
Lemay St
© 2019 Google

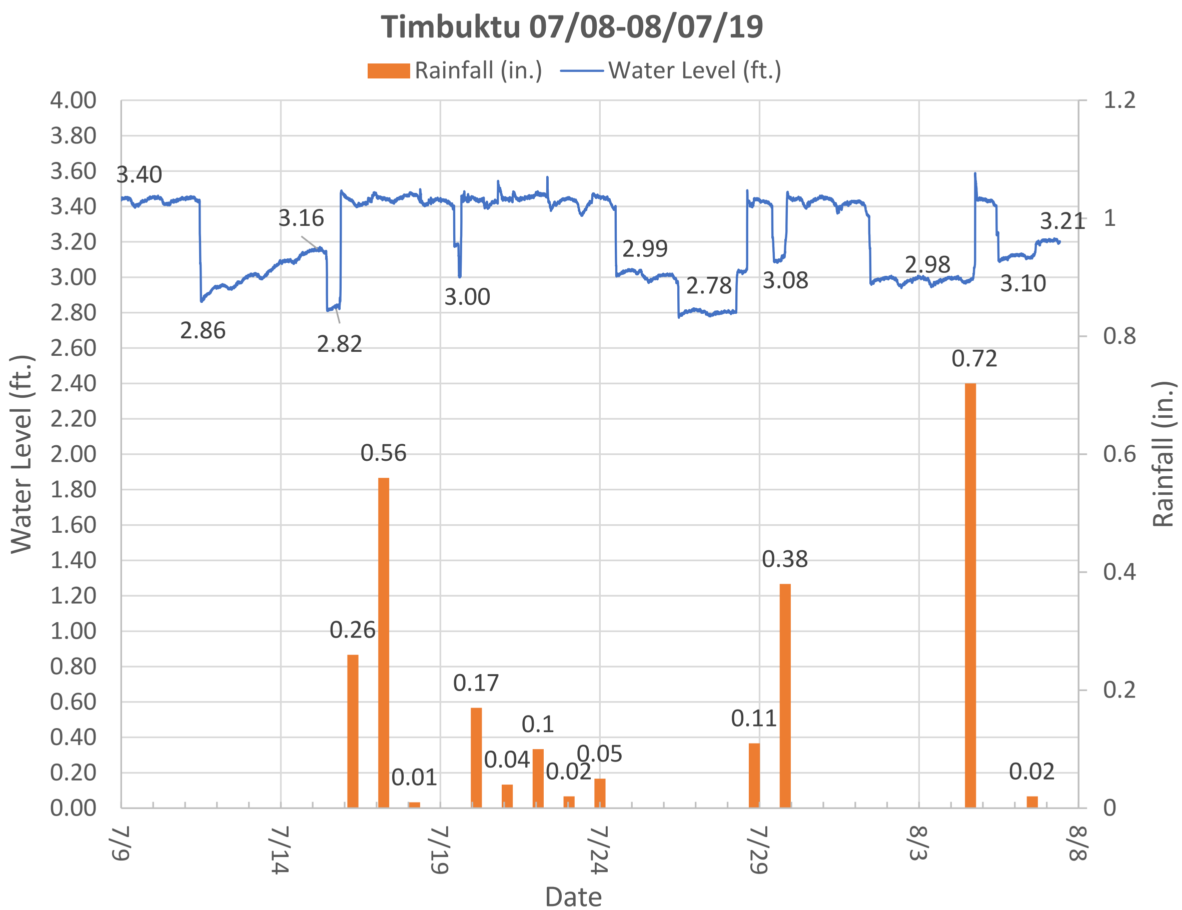
Field Sheet

Date	Time On Site	Time Off Site	Depth of Reservoir (ft.)	Depth from top of Res. to Water Surface (ft.)	Depth of Water (ft.)	Volume (gal.)	Notes
9/14/2018	1:00 PM	1:13 PM	3.40				Diver installed and set to start recording at 4pm.
10/3/2018	3:18 PM	3:35 PM	3.40	0.05	3.35	300+	Data downloaded and point of measurment marked.
[redacted]						304	Calculated based off area and depth measurments.
11/9/2018	10:55 AM	11:10 AM	3.40	0.00	3.40	309	Cisterns overflowing. Diver pulled at 11:03am.
5/10/2019	6:45 AM	7:15 AM	-	-	-	-	Diver installed and set to start recording at 2pm.
7/8/2019	11:20 AM	11:40 AM	3.40	0.00	3.40	309	Data upload. Diver set to start recording at 5pm.
8/7/2019	9:40 AM	9:55 AM	3.40	0.20	3.20	291	Data upload. Diver set to start recording at 2pm.
8/22/2019	9:12 AM	9:19 AM	3.40	0.00	3.45	313	Data upload. Diver set to start recording at 2pm.
9/6/2019	9:00 AM	9:14 AM	3.40	0.10	3.30	300	Data upload. Diver set to start recording at 2pm.
9/20/2019	10:40 AM	10:50 AM	3.40	0.26	3.14	285	Data upload. Diver set to start recording at 4pm.
10/18/2019	2:07 PM	2:21 PM	3.40	0.00	3.40	309	Data upload. Diver set to start recording at 8pm.
11/1/2019	10:10 AM	10:15 AM	3.40	0.00	3.40	309	Data upload. Diver pulled for winter storage.

Timbuktu Water Journal					
Data Source:	2019 KGD Water Journals				
Est. Catchment Area (sq.ft.):		3850			
Date	**Rainfall Recorded on Site (in.)**	**Rainfall Detroit City Airport (in.)**	**Estimated Runoff For Collection (gal.)**	**Volume of Water Used to Irrigate (gal.)**	**Notes:**
6/22/2019	-	0.00	-	-	Watered for 1 hour
6/26/2019	-	0.00	-	-	Watered for 2.5 hours (noted as 11/26/19 on June 2019 sheet)
7/1/2019	-	0.00	-	20	-
7/2/2019	-	0.76	-	14	-
7/3/2019	-	0.01	-	20	-
7/8/2019	-	0.00	-	20	-
7/16/2019	-	0.56	-	-	"Rain" noted on sheet
8/5/2019	1.50	0.00	3239.8	14	-
8/7/2019	-	0.00	-	8	-
8/12/2019	-	Trace	-	26	-
8/14/2019	-	0.00	-	30	-
8/20/2019	0.90	0.52	1943.9	-	-
8/21/2019	0.10	0.05	216.0	4	Previous evening
8/22/2019	0.10	0.00	216.0	-	Previous evening
8/26/2019	0.60	0.34	1295.9	22	-
8/28/2019	-	0.00	-	12	-
9/2/2019	-	0.22	-	-	"Rain" noted on sheet
9/3/2019	-	0.16	-	-	"Rain" noted on sheet
9/4/2019	0.30	0.12	648.0	0	-
9/6/2019	-	0.03	-	15	-
9/10/2019	-	0.00	-	30	-
9/13/2019	0.30	0.65	648.0	15	.3" from previous evening noted on sheet
9/16/2019	-	0.00	-	-	1.3" over weekend noted on sheet
9/24/2019	-	0.00	-	40	-
9/25/2019	-	0.00	-	15	-
9/30/2019	0.40	0.01	863.9	-	-



(3.38 ft.-3.21 ft.) x 12.14 sq.ft. x 7.48 gal./cu.ft. x 2 Totes = **30.8 gal. Harvested**



(3.16 ft.-2.86 ft.) x 12.14 sq.ft. x 7.48 gal./cu.ft. x 2 Totes = **54.4 gal. Harvested**
(3.40 ft.-2.82 ft.) x 12.14 sq.ft. x 7.48 gal./cu.ft. x 2 Totes = **105.4 gal. Harvested**
(3.40 ft.-3.00 ft.) x 12.14 sq.ft. x 7.48 gal./cu.ft. x 2 Totes = **72.6 gal. Harvested**
(3.40 ft.-2.78 ft.) x 12.14 sq.ft. x 7.48 gal./cu.ft. x 2 Totes = **112.6 gal. Harvested**
(3.40 ft.-3.08ft.) x 12.14 sq.ft. x 7.48 gal./cu.ft. x 2 Totes = **58.2 gal. Harvested**
(3.40 ft.-2.98 ft.) x 12.14 sq.ft. x 7.48 gal./cu.ft. x 2 Totes = **76.2 gal. Harvested**
(3.21 ft.-3.10ft.) x 12.14 sq.ft. x 7.48 gal./cu.ft. x 2 Totes = **20.0 gal. Harvested**

Timbuktu Water Journal Summary

Month	# of Days in the Month	# of Days With Journal Entries	# of Rain Days Recorded in Journal	Rainfall Recorded on Site (in.)	Estimated Runoff For Collection (gal.)	Estimated Volume of Water Collected (gal.)	Volume of Water Used to Irrigate (gal.)
May	31	0	-	-	-	223.4	-
June	30	2	-	-	-	501.2	*
July	31	5	1**		-	1895.8	74
August	31	9	5	3.2	6911.5	384.7	116
September	30	10	3***	1	2159.9	96.4	115
October	31	0	-	-	-	30.8	-
2019 Season Totals		26	9	4.2	9071.4	3132.3	305

*Watering noted for 6/22 and 6/26 with no volume value given.

**Rain noted on sheet with no depth value given.

**Rain values noted on sheet for 9/2 and 9/3 with no depth value given. 9/16/19 noted 1.3" fell over the weekend.

CDC Community Gardens

Site Name:	CDC	
Site Address:		
Contact:		
Contact Phone #:		
HOBO Diver S/N:	20370794	
Launch Date:	9/14/2018	
Volume of Reservoir:	350 gal.	
Shape of Reservoir:	Cube	
	L	W
Dimesions (in.)	38	46
Dimensions (ft.)	3.17	3.83
Area, W x L, (sq.ft.)	12.14	
Site Notes:	4x 350 gal. and 6x 300gal totes in series.	
Location of Diver:	NW Corner of Building	

Cisterns
Catchment Area
628 W Philadelphia St
2nd Ave
W Philadelphia St

Field Sheet

Date	Time On Site	Time Off Site	Depth of Reservoir (ft.)	Depth from top of Res. to Water Surface (ft.)	Depth of Water (ft.)	Volume (gal.)	Notes
09/14/18	1:00 PM	1:13 PM					Diver installed and set to start recording at 4pm.
10/03/18	1:13 PM	1:31 PM	3.89	0.35	3.54	~313	Data downloaded and point of measurment marked.
[redacted]						321	Calculated based off area and depth measurments.
11/09/18	10:56 AM	11:02 AM	3.89	0.03	3.86	350	Calculated based off area and depth measurments. Diver pulled at 10:59 AM.
05/10/19	8:30 AM	8:45 AM	-	-	-	-	Diver installed and set to start recording at 2pm.
07/08/19	12:30 PM	12:35 PM	3.89	0.48	3.41	310	Data upload. Diver set to start recording at 5pm.
08/07/19	10:40 AM	10:47 AM	3.89	0.27	3.62	329	Data upload. Diver set to start recording at 2pm.
08/22/19	10:05 AM	10:12 AM	3.89	0.30	3.59	326	Data upload. Diver set to start recording at 2pm.
09/06/19	10:52 AM	11:00 AM	3.89	0.29	3.60	327	Data upload. Diver set to start recording at 2pm.
09/20/19	12:54 PM	1:01 PM	3.89	0.30	3.59	326	Data upload. Diver set to start recording at 4pm.
10/18/19	1:27 PM	1:36 PM	3.89	0.85	3.04	276	Data upload. Diver set to start recording at 8pm.
11/01/19	1:14 PM	1:20 PM	3.89	0.32	3.58	325	Data upload. Diver pulled for winter storage.

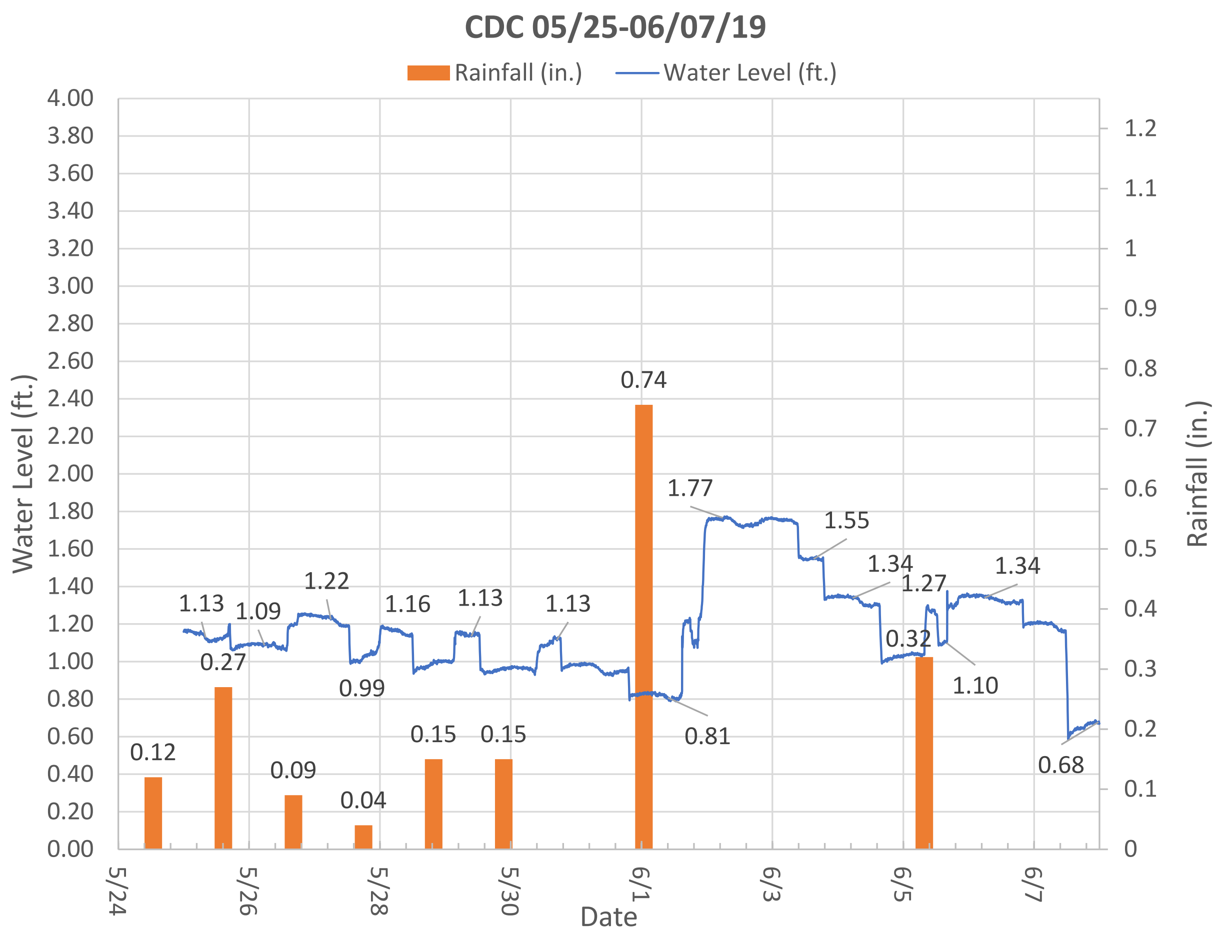
CDC Water Journal					
Data Source: 2019 KGD Water Journals					
Est. Catchment Area (sq.ft.): 2200					
Date	**Rainfall Recorded on Site (in.)**	**Rainfall Detroit City Airport (in.)**	**Estimated Runoff For Collection (gal.)**	**Volume of Water Used to Irrigate (gal.)**	**Notes:**
5/2/2019	-	0.09	-	-	Heavy rain noted on sheet
5/3/2019	-	0.05	-	-	Light rain noted on sheet
5/10/2019	-	0.03	-	-	Light rain noted on sheet
7/15/2019	0.43	0.26	530.7	-	-
7/16/2019	0.56	0.56	691.2	-	Watered for 29 minutes
7/19/2019	0.12	0.17	148.1	-	Watered for 20 minutes
7/20/2019	0.40	0.04	493.7	-	-
7/21/2019	0.27	0.10	333.2	-	-
7/22/2019	0.04	0.02	49.4	-	Watered for 24 minutes
7/23/2019	0.01	0.05	12.3	-	Watered for 25 minutes
7/24/2019	-	0.00	-	-	Watered for 30 minutes
7/25/2019	-	0.00	-	-	Watered for 30 minutes
7/26/2019	-	0.00	-	-	Watered for 30 minutes
7/29/2019	0.01	0.38	12.3	-	-
7/30/2019	-	0.00	-	-	Watered for 30 minutes
7/31/2019	-	0.00	-	-	Watered for 30 minutes
8/2/2019	-	0.00	-	-	Watered for 30 minutes
8/6/2019	-	0.02	-	-	Watered for 25 minutes
8/7/2019	-	0.00	-	-	Watered for 25 minutes
8/12/2019	-	Trace	-	-	Watered for 25 minutes
8/16/2019	0.06	0.01	74.1	-	Watered for 30 minutes

CDC Water Journal

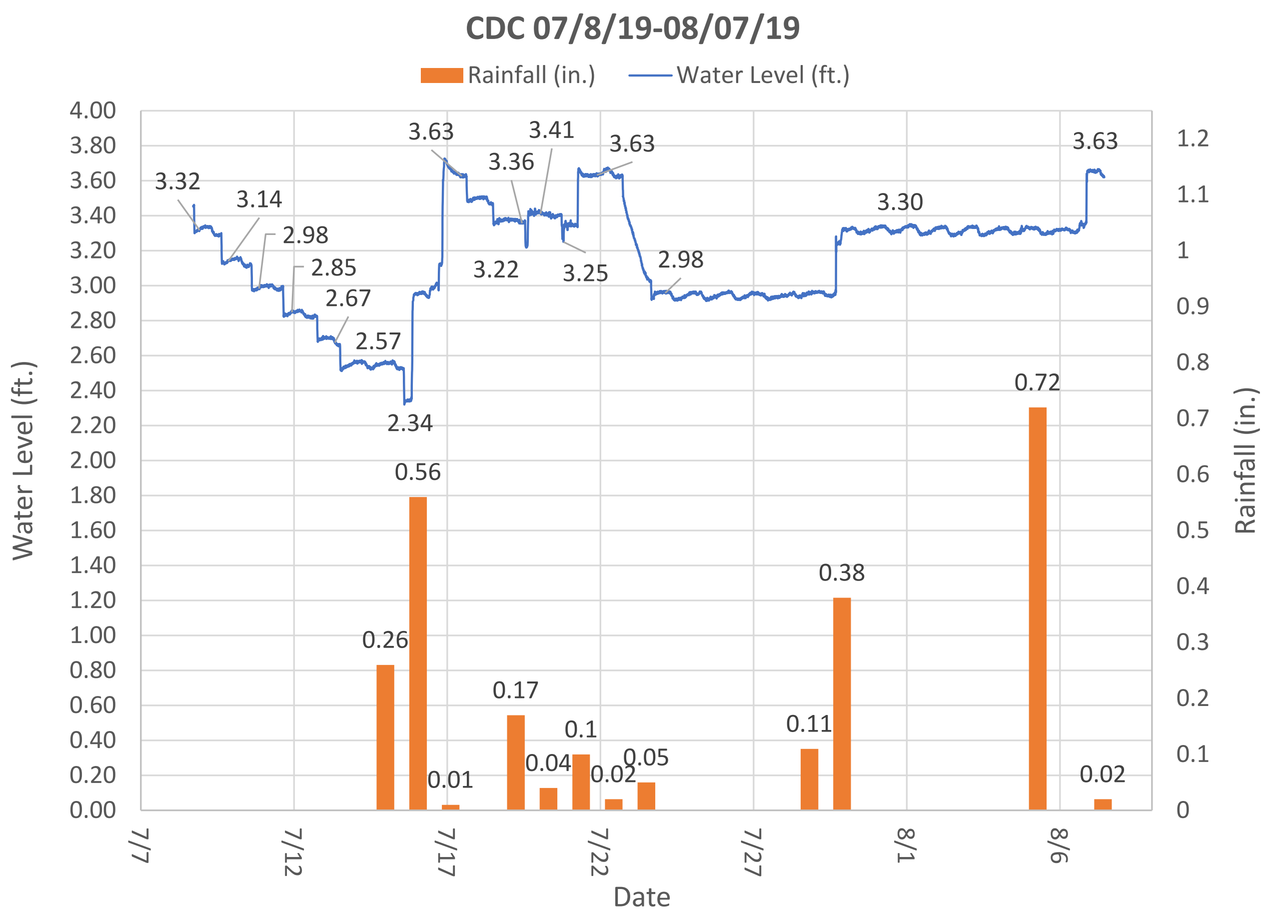
Data Source: 2019 KGD Water Journals

Est. Catchment Area (sq.ft.): 2200

Date	Rainfall Recorded on Site (in.)	Rainfall Detroit City Airport (in.)	Estimated Runoff For Collection (gal.)	Volume of Water Used to Irrigate (gal.)	Notes:
8/19/2019	-	0.00	-	-	Watered for 25 minutes
8/20/2019	-	0.52	-	231	Watered for 20 minutes
8/21/2019	-	0.05	-	-	Watered for 25 minutes
8/22/2019	-	0.00	-	254	Watered for 22 minutes
8/23/2019	-	0.00	-	231	Watered for 20 minutes
8/25/2019	0.23	0.00	283.9	-	-
8/26/2019	0.53	0.34	654.1	265	Watered for 23 minutes
8/28/2019	-	0.00	-	-	Watered for 25 minutes
8/29/2019	-	0.01	-	369	Watered for 32 minutes
9/1/2019	0.14	0.17	172.8	-	-
9/2/2019	0.42	0.22	518.4	-	-
9/3/2019	0.09	0.16	111.1	231	Watered for 20 minutes
9/4/2019	-	0.12	-	231	Watered for 20 minutes
9/6/2019	-	0.03	-	231	Watered for 20 minutes
9/11/2019	0.88	0.60	1086.1	-	-
9/12/2019	0.10	0.11	-	231	Watered for 20 minutes
9/13/2019	0.72	0.65	888.6	254	Watered for 23 minutes
9/15/2019	0.06	0.13	-	-	-
9/19/2019	-	0.00	-	254	-
9/20/2019	-	0.00	-	254	-
9/26/2019	-	Trace	-	231	Watered for 20 minutes
9/27/2019	0.78	0.15	962.7	-	-
10/2/2019	0.34	0.28	419.6	-	-
10/3/2019	0.47	0.38	580.1	-	-
10/6/2016	0.07	0.09	86.4	-	-
10/7/2019	-	0.00	-	115	-
10/8/2019	-	0.00	-	115	-
10/9/2019	-	0.00	-	192	-
10/10/2019	-	0.00	-	115	-



(1.22 ft.-1.09 ft.) x 12.14 sq.ft. x 7.48 gal./cu.ft. x 10 Totes = **118.0 gal. Harvested**
(1.16 ft.-0.99 ft.) x 12.14 sq.ft. x 7.48 gal./cu.ft. x 10 Totes = **154.4 gal. Harvested**
(1.13 ft.-0.99 ft.) x 12.14 sq.ft. x 7.48 gal./cu.ft. x 10 Totes = **127.1 gal. Harvested**
(1.13 ft.-0.99 ft.) x 12.14 sq.ft. x 7.48 gal./cu.ft. x 10 Totes = **127.1 gal. Harvested**
(1.77 ft.-0.81 ft.) x 12.14 sq.ft. x 7.48 gal./cu.ft. x 10 Totes = **871.8 gal. Harvested**
(1.27 ft.-0.99 ft.) x 12.14 sq.ft. x 7.48 gal./cu.ft. x 10 Totes = **254.3 gal. Harvested**
(1.34 ft.-1.10 ft.) x 12.14 sq.ft. x 7.48 gal./cu.ft. x 10 Totes = **217.9 gal. Harvested**



(3.63 ft.-2.34 ft.) x 12.14 sq.ft. x 7.48 gal./cu.ft. x 10 Totes = **1171.4 gal. Harvested**
(3.41 ft.-3.22 ft.) x 12.14 sq.ft. x 7.48 gal./cu.ft. x 10 Totes = **172.5 gal. Harvested**
(3.63 ft.-3.25 ft.) x 12.14 sq.ft. x 7.48 gal./cu.ft. x 10 Totes = **345.1 gal. Harvested**
(3.30 ft.-2.98 ft.) x 12.14 sq.ft. x 7.48 gal./cu.ft. x 10 Totes = **290.6 gal. Harvested**
(3.63 ft.-3.30 ft.) x 12.14 sq.ft. x 7.48 gal./cu.ft. x 10 Totes = **345.1 gal. Harvested**

CDC Water Journal Summary							
Month	**# of Days in the Month**	**# of Days With Journal Entries**	**# of Rain Days Recorded in Journal**	**Rainfall Recorded on Site (in.)**	**Estimated Runoff For Collection (gal.)**	**Estimated Volume of Water Collected (gal.)**	**Volume of Water Used to Irrigate (gal.)**
May	31	3	3*	-	-	1861.4	-
June	30	0	-	-	-	3886.6	-
July	31	13	8	1.84	2270.9	5848.0	**
August	31	14	3	0.82	1012.0	835.4	1350***
Septemb	30	13	8	3.19	3937.1	354.0	1917
October	31	7	3	0.88	1086.1	444.7	537
2019 Season Totals		50	25	6.73	8306.2	13230.1	3804
*Rain noted with no depth value given.							
**9 days noted watering with no volume value given.							
***8 days noted watering with no volume value given.							

Knaggs Creek Community Gardens

Site Name: Knaggs Creek
Site Address:
Contact:
Contact Phone #:

HOBO Diver S/N: 20370792
Launch Date: 9/14/2018

Volume of Reservoir: 300 gal.
Shape of Reservoir: Cube

	L	W	H
Dimesions (in.)	38	46	38.52
Dimensions (ft.)	3.17	3.83	3.21
Area, W x L, (sq.ft.)	12.14		

Site Notes: 2x 300 gal. totes connected in series
Location of Diver: NW Corner of House


Barometric Diver
Cisterns
Catchment Area
3956 W Lafayette Blvd
W Lafayette Blvd
© 2019 Google

Knaggs Creek - Field Sheet							
Date	Time On Site	Time Off Site	Depth of Reservoir (ft.)	Depth from top of Res. to Water Surface (ft.)	Depth of Water (ft.)	Volume (gal.)	Notes
9/14/2018	10:37 AM	11:46 AM	3.26				Diver installed and set to start recording at 4pm.
10/3/2018	1:48 PM	2:08 PM	3.26	0.37	2.89	~258	Data downloaded and point of measurment marked.
[redacted]						262	Calculated based off area and depth measurments.
11/9/2018	11:13 AM	11:18 AM	3.26	-	-	0	Cistern was empty. Drained prior to arrival. Diver pulled at 11:15am.
5/10/2019	9:00 AM	9:15 AM	-	-	-	-	Diver installed and set to start recording at 2pm.
7/8/2019	1:09 PM	1:35 PM	3.26	0.61	2.65	241	Data upload. Diver set to start recording at 5pm.
8/7/2019	12:14 PM	12:30 PM	3.26	1.34	1.92	174	Data upload. Diver set to start recording at 2pm.
8/22/2019	11:41 AM	12:00 PM	3.26	0.60	2.66	242	Data upload. Diver set to start recording at 2pm.
9/6/2019	12:12 PM	12:30 PM	3.26	2.41	0.85	77	Data upload. Diver set to start recording at 2:00pm. Note: Per John Miller, the conduit linking the two totes was damaged on Wednesday 9/4/19 resulting in the totes being drained. Conduit has been fixed. Water level = ~10.25" on scale drawn on side of tote.
9/20/2019	2:10 PM	2:19 PM	3.26	0.60	2.66	242	Data upload. Diver set to start recording at 4pm. Water level = ~32.0" on scale drawn on side of tote.
10/18/2019	4:45 PM	5:00 PM	3.26	0.68	2.58	234	Data upload. Diver set to start recording at 8pm. Water level = ~31.0" on scale drawn on side of tote.
11/1/2019	1:46 PM	2:10 PM	3.26	0.65	2.61	237	Data upload. Diver pulled for winter storage. Water level = ~32.0" on scale drawn on side of tote.

Knaggs Creek Water Journal					
Data Source:	2019 KGD Water Journals				
Est. Catchment Area (sq.ft.):	560				
Date	**Rainfall Recorded on Site (in.)**	**Rainfall Detroit City Airport (in.)**	**Estimated Runoff For Collection (gal.)**	**Volume of Water Used to Irrigate (gal.)**	**Notes:**
5/6/2019	0.02	0.08	6.3	-	
5/7/2019	0.21	0.27	66.0	-	
5/9/2019	0.21	0.12	66.0	-	
5/10/2019	0.04	0.03	12.6	-	
5/11/2019	0.26	Trace	81.7	-	
5/12/2019	0.21	0.18	66.0	-	
5/18/2019	0.25	0.18	78.5	-	
5/19/2019	0.63	0.64	197.9	-	
5/22/2019	0.17	0.17	53.4	-	
5/23/2019	0.23	0.12	72.3	-	
5/25/2019	0.19	0.12	59.7	-	
5/26/2019	0.04	0.27	12.6	-	
5/27/2019	0.14	0.09	44.0	-	
5/29/2019	0.22	0.15	69.1	-	
5/30/2019	0.18	0.15	56.5	-	
6/1/2019	0.60	0.74	188.5	-	
6/5/2019	0.57	0.32	179.1	-	
6/6/2019	0.01	0.00	3.1	-	
6/10/2019	0.11	0.16	34.6	-	
6/13/2019	0.21	0.27	66.0	-	
6/15/2019	0.05	0.02	15.7	-	
6/16/2019	0.73	0.29	229.3	-	

Knaggs Creek Water Journal

Data Source: 2019 KGD Water Journals

Est. Catchment Area (sq.ft.): 560

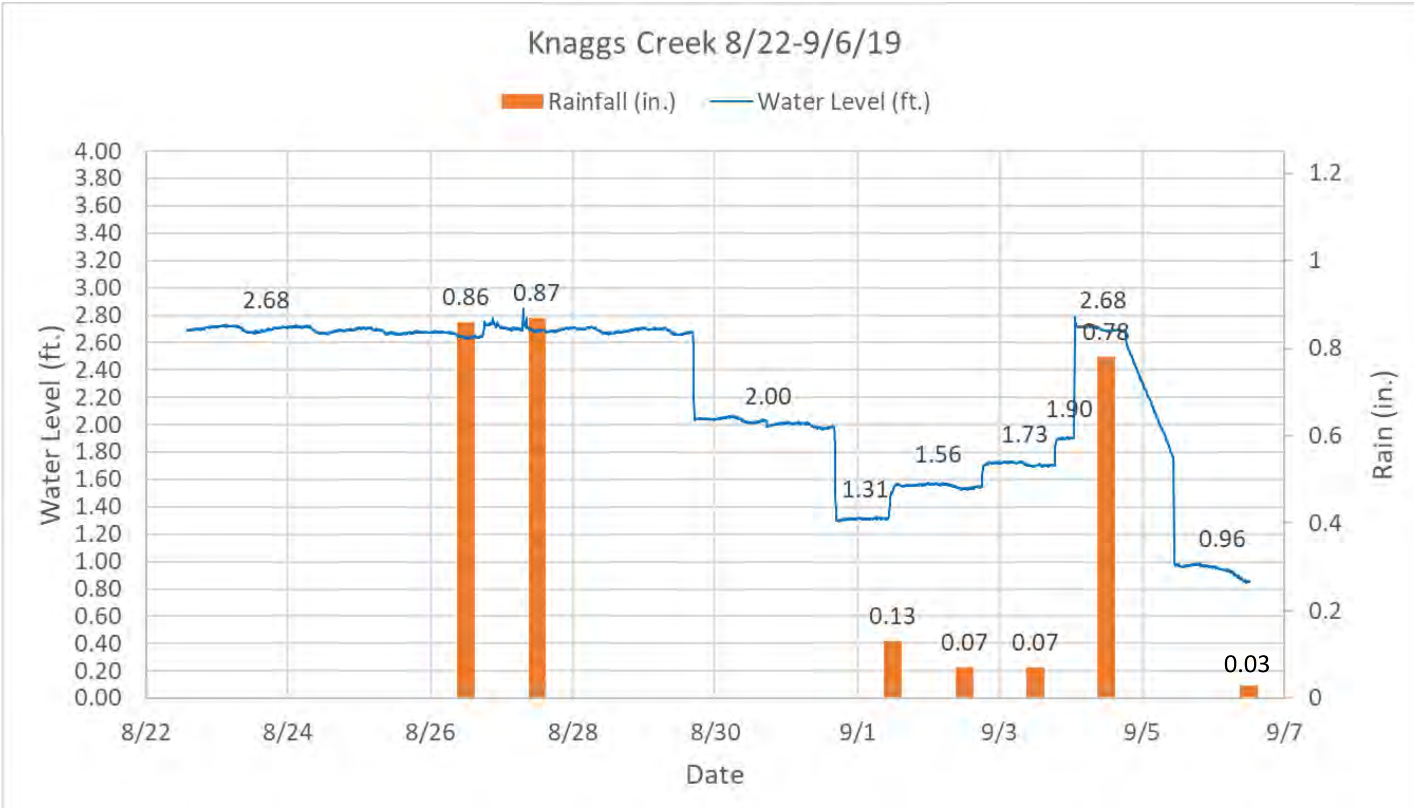
Date	Rainfall Recorded on Site (in.)	Rainfall Detroit City Airport (in.)	Estimated Runoff For Collection (gal.)	Volume of Water Used to Irrigate (gal.)	Notes:
6/17/2019	0.01	0.00	3.1	-	
6/20/2019	0.52	0.41	163.4	-	
6/24/2019	0.03	0.07	9.4	-	
6/29/2019	0.43	0.04	135.1	-	
7/2/2019	0.30	0.76	94.2	-	
7/5/2019	0.55	0.71	172.8	-	
7/6/2019	0.82	0.63	257.6	-	
7/15/2019	1.08	0.26	339.3	-	
7/16/2019	0.79	0.56	248.2	-	
7/17/2019	0.02	0.01	6.3	-	
7/18/2019	0.14	0.00	44.0	-	
7/19/2019	0.06	0.17	18.8	-	
7/20/2019	0.22	0.04	69.1	70	
7/21/2019	0.21	0.10	66.0	-	
7/22/2019	0.09	0.02	28.3	-	
7/23/2019	0.01	0.05	3.1	-	
7/25/2019	-	0.00	-	70	
7/28/2019	0.03	0.11	9.4	-	
7/29/2019	0.12	0.38	37.7	70	
8/2/2019	-	0.00	-	70	
8/4/2019	0.26	0.72	81.7	-	
8/6/2019	0.05	0.02	15.7	-	
8/7/2019	0.02	0.00	6.3	-	
8/13/2019	-	Trace	-	60	
8/15/2019	0.02	0.00	6.3	60	
8/17/2019	0.07	0.08	22.0	-	
8/18/2019	1.10	0.33	345.6	-	
8/20/2019	0.80	0.52	251.3	-	
8/23/2019	-	0.00	-	75	
8/26/2019	0.86	0.34	270.2	-	
8/27/2019	0.87	0.57	273.3	-	
8/29/2019	-	0.01	-	140	
8/31/2019	-	0.00	-	150	

Knaggs Creek Water Journal

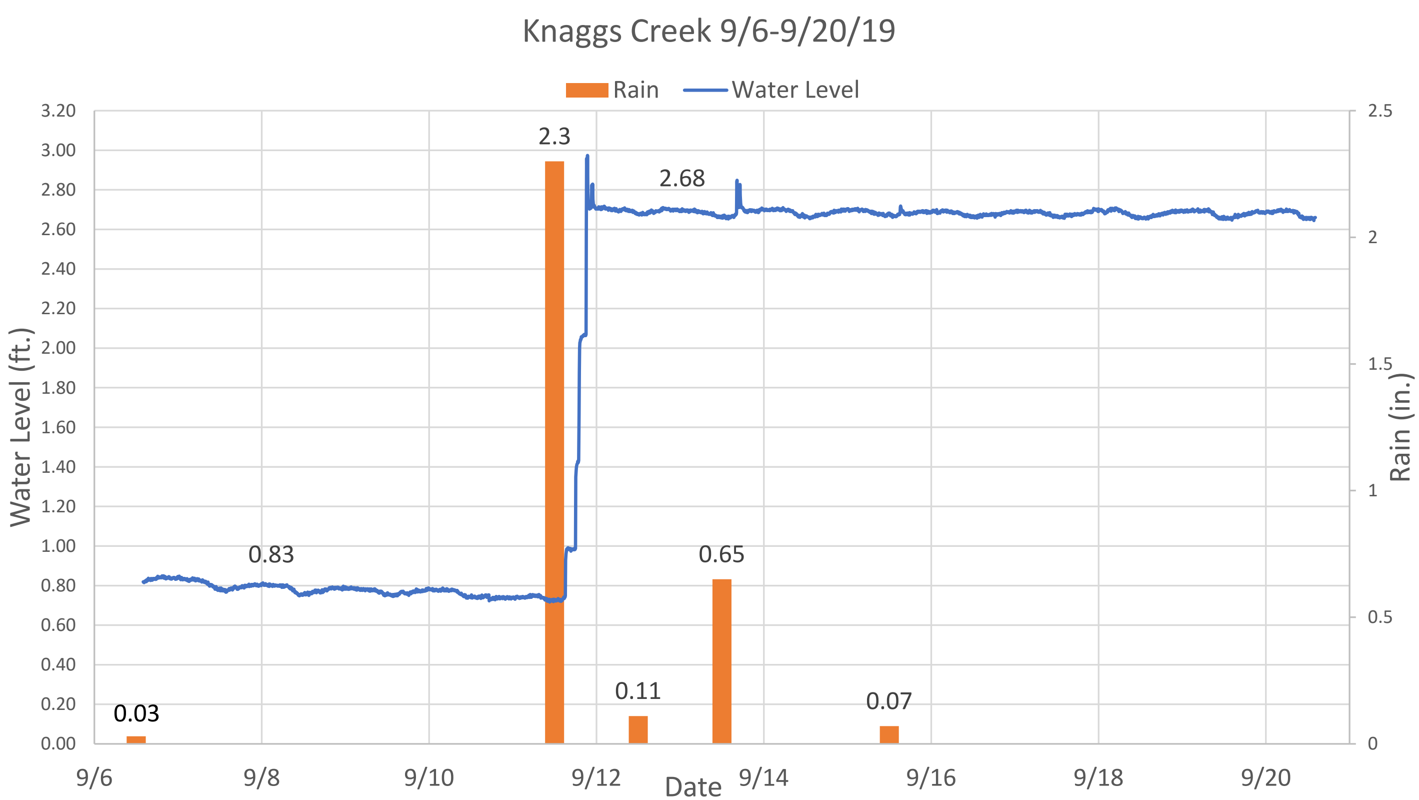
Data Source: 2019 KGD Water Journals

Est. Catchment Area (sq.ft.): 560

Date	Rainfall Recorded on Site (in.)	Rainfall Detroit City Airport (in.)	Estimated Runoff For Collection (gal.)	Volume of Water Used to Irrigate (gal.)	Notes:
9/1/2019	0.13	0.17	40.8	-	
9/2/2019	0.07	0.22	22.0	-	
9/3/2019	0.07	0.16	22.0	-	
9/4/2019	0.78	0.12	245.0	-	Major leak from tanks.
9/11/2019	2.30	0.60	722.6	-	
9/13/2019	0.41	0.65	128.8	-	
9/15/2019	0.07	0.13	22.0	-	
9/20/2019	-	0.00	-	13	
9/21/2019	0.06	0.02	18.8	-	
9/23/2019	-	Trace	-	80	
9/26/2019	0.01	Trace	3.1	-	
9/27/2019	0.78	0.15	245.0	-	
9/29/2019	0.06	0.11	18.8	-	
10/1/2019	0.01	0.00	3.1	-	
10/2/2019	1.17	0.28	367.6	-	
10/3/2019	-	0.38	-	6	
10/6/2019	0.15	0.09	47.1	-	
10/11/2019	0.28	0.11	88.0	8	
10/12/2019	0.01	0.07	3.1	-	
10/16/2019	0.04	0.13	12.6	-	
10/19/2019	-	0.00	-	8	
10/21/2019	0.24	0.20	75.4	-	
10/22/2019	0.02	0.07	6.3	-	
10/25/2019	-	0.00	-	8	
10/26/2019	1.29	1.15	405.3	-	
10/31/2019	1.56	0.80	490.1	-	



(2.68 ft.-1.31 ft.) x 12.14 sq.ft. x 7.48 gal./cu.ft. x 2 Totes = **248.8 gal. Harvested**



(2.68 ft.-0.83 ft.) x 12.14 sq.ft. x 7.48 gal./cu.ft. x 2 Totes = <u>336.0 gal. Harvested</u>

Knaggs Creek Water Journal Summary							
Month	**# of Days in the Month**	**# of Days With Journal Entries**	**# of Rain Days Recorded in Journal**	**Rainfall Recorded on Site (in.)**	**Estimated Runoff For Collection (gal.)**	**Estimated Volume of Water Collected (gal.)**	**Volume of Water Used to Irrigate (gal.)**
May	31	15	15	3.00	942.5	0	-
June	30	11	11	3.27	1027.3	0	-
July	31	15	14	4.44	1394.9	121.6	210
August	31	14	9	4.05	1272.3	572.1	555
September	30	13	11	4.74	1489.1	584.8	93
October	31	13	10	4.77	1498.5	0.0	30
2019 Season Totals		81	70	24.27	7624.7	1278.5	888

Earthworks Urban Farm

Site Name:	Earthworks
Site Address:	
Contact:	
Contact Phone #:	
HOBO Diver S/N:	20370787
Launch Date:	9/14/2018
Volume of Reservoir:	1,000 gal.
Shape of Reservoir:	Cylinder
	Dia.
Radius of Base (in.)	43.50
Radius of Base (ft.)	3.63
Area, pr^2, (sq.ft.)	41.26
Site Notes:	2x 1,000 gal. and 1x 3000 gal.
Location of Diver:	NW Corner of Hoop House


Meldrum St
St Paul Ave
Catchment Area
Cisterns

<u>Earthworks Urban Farm - Field Sheet</u>

Date	Time On Site	Time Off Site	Depth of Reservoir (ft.)	Depth from top of Res. to Water Surface (ft.)	Depth of Water (ft.)	Volume (gal.)	Notes
9/24/2018	9:10 AM	9:45 AM	4.09				Diver installed and set to start recording at 10am.
10/3/2018	2:30 PM	2:45 PM	4.09	0.21	3.88	~1075	Data downloaded and point of measurment marked.
[redacted]						1198	Calculated based off area and depth measurments.
11/9/2018	9:23 AM	9:33 AM	4.09	3.36	0.73	225	Calculated based off area and depth measurments. Diver pulled at 9:27 AM.
5/10/2019	7:30 AM	7:45 AM	-	-	-	-	Diver installed and set to start recording at 2pm.
7/8/2019	12:00 PM	12:15 PM	4.09	0.2	3.89	1201	Data upload. Diver set to start recording at 5pm.
8/7/2019	9:00 AM	9:18 AM	4.09	1.46	2.65	818	Data upload. Diver set to start recording at 2pm.
8/22/2019	8:30 AM	8:43 AM	4.09	1.41	2.68	827	Data upload. Diver set to start recording at 2pm.
9/6/2019	9:48 AM	10:00 AM	4.09	1.61	2.48	765	Data upload. Diver set to start recording at 2pm.
9/20/2019	11:15 AM	11:29 AM	4.09	1.74	2.35	725	Data upload. Diver set to start recording at 4pm.
10/18/2019	2:50 PM	-	4.09	1.88	2.21	682	Data upload. Diver set to start recording at 8pm.
11/1/2019	10:45 AM	10:51 AM	4.09	1.78	2.31	713	Data upload. Dive pulled for winter storage.

Making Shade Community Gardens

Site Name: Making Shade
Site Address:
Contact:
Contact Phone #:

HOBO Diver S/N: 20370788
Launch Date: 9/14/2018

Volume of Reservoir: 300 gal.
Shape of Reservoir: Cube

	L	W	H
Dimesions (in.)	38	46	38.52
Dimensions (ft.)	3.17	3.83	3.21
Area, W x L, (sq.ft.)	12.14		

Site Notes: 1x 300 gal. tote on stand
Location of Diver: SW Corner of Lot


Collection Area
Cistern
© 2019 Google

Making Shade Community Gardens - Field Sheet

Date	Time On Site	Time Off Site	Depth of Reservoir (ft.)	Depth from top of Res. to Water Surface (ft.)	Depth of Water (ft.)	Volume (gal.)	Notes
09/14/18	1:22 PM	1:33 PM	3.21				Diver installed and set to start recording at 4pm.
10/03/18	12:45 PM	1:03 PM	3.21	0.13	3.09	~265	Data downloaded and point of measurment marked.
[redacted]						280	Calculated based off area and depth measurments.
11/09/18	10:41 AM	10:47 AM	3.21	0.15	3.06	278	Calculated based off area and depth measurments.
05/10/19	-	-	-	-	-	-	Diver installed and set to start recording at 2pm.
07/08/19	12:50 AM	12:55 PM	3.21	0.16	3.05	277	Data upload. Diver set to start recording at 5pm.
08/07/19	10:24 AM	10:31 AM	3.21	0.15	3.06	278	Data upload. Diver set to start recording at 2pm.
08/22/19	9:53 AM	9:58 AM	3.21	3.15	0.06	5	Data upload. Diver set to start recording at 2pm.
09/06/19	11:00 AM	11:15 AM	3.21	2.31	0.90	82	Data upload. Diver set to start recording at 2pm. Water level marked at ~11" depth on scale drawn on tote.
09/20/19	1:10 PM	1:17 PM	3.21	1.75	1.46	133	Data upload. Diver set to start recording at 4pm. Water level marked at ~22.75" depth on scale drawn on tote.
10/18/19	1:44 PM	1:50 PM	3.21	1.75	1.46	133	Data upload. Diver set to start recording at 8pm. Water level marked at ~21" depth on scale drawn on tote.
11/01/19	1:28 PM	1:33 PM	3.21	0.77	2.44	222	Diver upload. Diver pulled for winter storage. Water level marked at 29" depth on scale frawn on tote.

Parker Community Gardens

Site Name:	Parker Community Gardens
Site Address:	
Contact:	
Contact Phone #:	
HOBO Diver S/N:	20370786
Launch Date:	9/14/2018
Volume of Reservoir:	1,100 gal.
Shape of Reservoir:	Cylinder
	Dia.
Radius of Base (in.)	43.5
Radius of Base (ft.)	3.63
Area, pr², (sq.ft.)	41.26
Site Notes:	1x 1,100 gal. cyinder partially burried
Location of Diver:	SW Corner of Lot


Catchment Area
Cistern
4827 Parker St
Van Dyke St
Willard St

Parker Community Gardens - Field Sheet							
Date	Time On Site	Time Off Site	Depth of Reservoir (ft.)	Depth from top of Res. to Water Surface (ft.)	Depth of Water (ft.)	Volume (gal.)	Notes
9/14/2018	12:09 PM	12:26 PM	4.1	-	-	-	Diver installed and set to start recording at 4pm.
10/3/2018	2:55 PM	3:15 PM	4.1	0.27	3.83	~1060	Data downloaded and point of measurment marked.
[redacted]						942	Calculated based off area and depth measurments.
11/9/2018	9:43 AM	9:50 AM	4.1	0.25	3.85	1188	Calculated based off area and depth measurments.
5/10/2019	7:30 AM	7:45 PM	-	-	-	-	Diver installed and set to start recording at 2pm.
7/8/2019	11:40 AM	11:55 AM	4.1	0.26	3.84	1185	Data upload. Diver set to start recording at 5pm.
8/7/2019	10:00 AM	10:08 AM	4.1	0.27	3.83	1182	Data upload. Diver set to start recording at 2pm.
8/22/2019	9:25 AM	9:35 AM	4.1	2.80	1.36	420	Data upload. Diver set to start recording at 2pm.
9/6/2019	9:30 AM	9:45 AM	4.1	1.21	2.89	892	Data upload. Diver set to start recording at 2pm.
9/20/2019	10:58 AM	11:06 AM	4.1	0.28	3.82	1179	Data upload. Diver set to start recording at 4pm.
10/18/2019	2:27 PM	2:35 PM	4.1	0.28	3.82	1179	Data upload. Diver set to start recording at 4pm.
11/1/2019	10:25 AM	10:35 AM	4.1	3.89	0.21	65	Diver pulled for winter storage.

Urban Agricultural Runoff Monitoring Project Sites

-Rainfall Simulation Results-

- Earthworks Urban Farm
- Keep Growing Detroit Farm
- Oakland Avenue Urban Farm

Earthworks Urban Farm

Site Name: Earthworks Tote
Site Address:
Contact:
Contact Phone #:

HOBO Diver S/N:
Launch Date:

Volume of Reservoir: 55 gal.
Shape of Reservoir: Rectangle

	L	W	H
Dimesions (in.)	45.88	21.37	19.50
Dimensions (ft.)	3.82	1.78	1.63
Area, W x L, (sq.ft.)	6.81		


Study Area
Monitoring Sump
Kercheval Ave
Meldrum St

Earthworks Tote - Field Sheet							
Date	Time On Site	Time Off Site	Depth of Reservoir (ft.)	Depth from top of Res. to Water Surface (ft.)	Depth of Water (ft.)	Volume (gal.)	Notes
8/7/2019	9:21 AM	9:36 AM	1.52	0.79	0.73	37.18	Data uploaded. Set to start recording at 2pm.
8/22/2019	8:47 AM	9:00 AM	1.52	0.71	0.81	41.25	Data uploaded. Set to start recording at 2pm.
9/6/2019	10:02 AM	10:10 AM	1.52	0.79	0.73	37.18	Data uploaded. Set to start recording at 2pm.
9/20/2019	11:32 AM	11:50 AM	1.52	0.78	0.74	37.69	Data uploaded. Set to start recording at 4pm. Tote pumped down to purge stagnant water. ~1.25" remaining.
10/3/2019	6:06 PM	6:22 PM	1.52	1.41	0.11	5.60	Data uploaded. Set to start recording at 8pm.
10/18/2019	3:00 PM	3:10 PM	1.52	1.44	0.08	4.24	Data uploaded. Set to start recording at 8pm.
11/1/2019	10:54 AM	11:05 AM	1.52	1.35	0.17	8.49	Data uploaded. Set to start recording at 4pm.

Location: Earthworks
Test Performed by: Chris
Test Date: 7/31/2019
Time Start: 12:00 PM
Time Stop: 4:00 PM
Duration (hour): 4.0 hr.
Application Area (sq.ft.): 150
Rainfall Depth (in.): 10.72
Plot #1: Sheet Flow

$$Precipitation\ Depth\ (in.) = \frac{Volume\ Applied\ (cu.ft.)}{Aplication\ Area\ (sq.ft.)} * 12$$

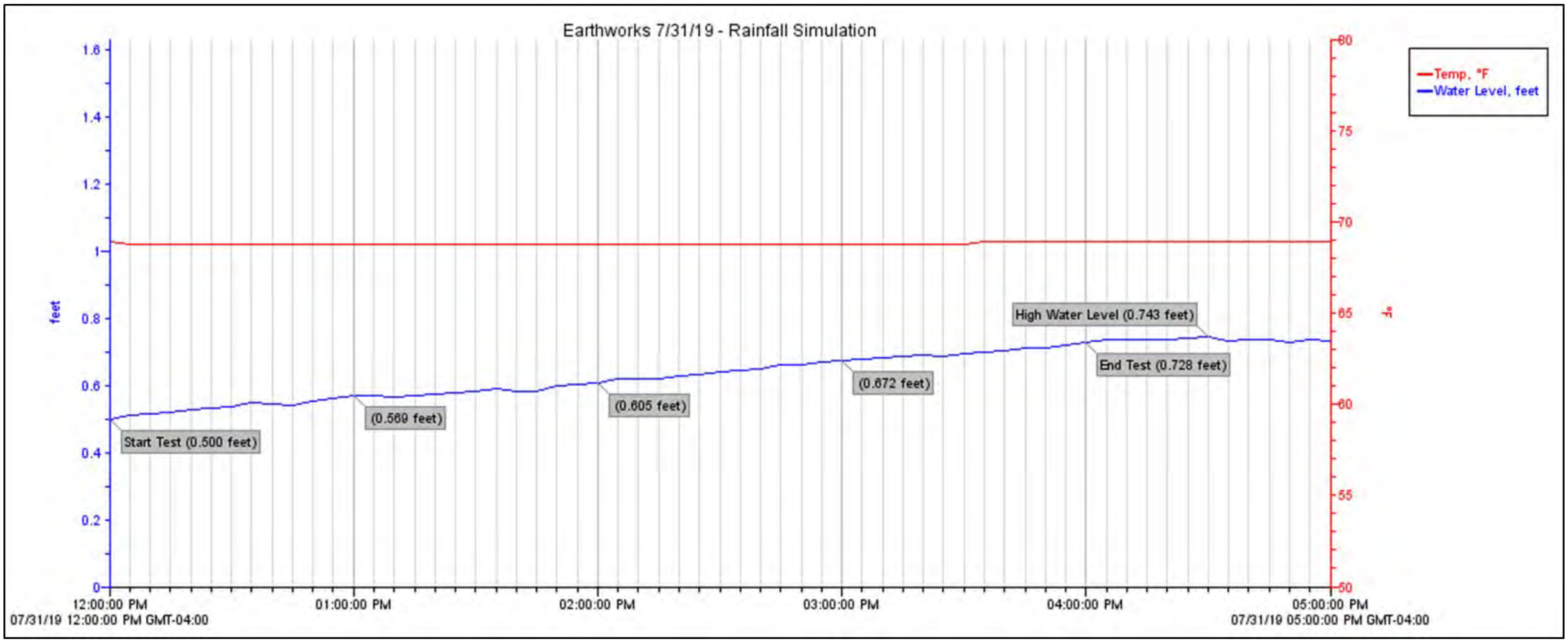
Dimensions of Reservoir	**L**	**W**	**H**	
	3.82	1.78	1.63	feet

Application Area (sq. ft.)		150
Volume Applied (gal.)		999.9
1 gal =	0.134 cu.ft.	
Volume Applied (cu. ft.)		133.99
Precipitation Depth (in.)		**10.72**

Water Level Start	**Water Level End**	**ΔH**		**Runoff Volume**
0.500	0.743	0.243	feet	12.4 gal

Time, T (HH:MM)	**Time, T (min.)**	**Applied Volume, V (gal.)**	**Application Rate, Q_{app} (gal./min.)**	**Notes:**
12:00 PM	0	0.0	-	
12:15 PM	15	57.1	3.81	
12:30 PM	30	114.2	3.81	
12:45 PM	45	172.7	3.90	
1:00 PM	60	234.6	4.13	Ponding observed.
1:15 PM	75	295.6	4.07	Ponding has been absorbed into soil.
1:30 PM	90	356.7	4.07	
1:45 PM	105	420.0	4.22	Ponding occurs but is quickly absorbed into soil.
2:00 PM	120	480.1	4.01	
2:15 PM	135	542.6	4.17	
2:30 PM	150	605.9	4.22	Slight drip of water into tote.
2:45 PM	165	669.9	4.27	
3:00 PM	180	734.2	4.29	
3:15 PM	195	798.1	4.26	Ponding observed.
3:30 PM	210	862.8	4.31	Ponding has been absorbed into soil.
3:45 PM	225	937.9	5.01	
4:00 PM	240	999.9	4.13	

Note: Diver margin of error =±.04' or 13gal.



Earthworks 7/31/19 - Rainfall Simulation
feet
°F
Temp, °F
Water Level, feet
Start Test (0.500 feet)
(0.569 feet)
(0.605 feet)
(0.672 feet)
High Water Level (0.743 feet)
End Test (0.728 feet)
1.6
1.4
1.2
1
0.8
0.6
0.4
0.2
0
80
75
70
65
60
55
50
12:00:00 PM
01:00:00 PM
02:00:00 PM
03:00:00 PM
04:00:00 PM
05:00:00 PM
07/31/19 12:00:00 PM GMT-04:00
07/31/19 05:00:00 PM GMT-04:00

Location: Earthworks
Test Performed by: Rick
Test Date: 10/29/2019
Time Start: 1:10 PM
Time Stop: 5:10 PM
Duration (hour): 4.0 hr.
Application Area (sq.ft.): 150
Rainfall Depth (in.): 11.03
Plot #1: Sheet Flow

Dimensions of Reservoir	**L**	**W**	**H**	
	3.82	1.78	1.63	feet

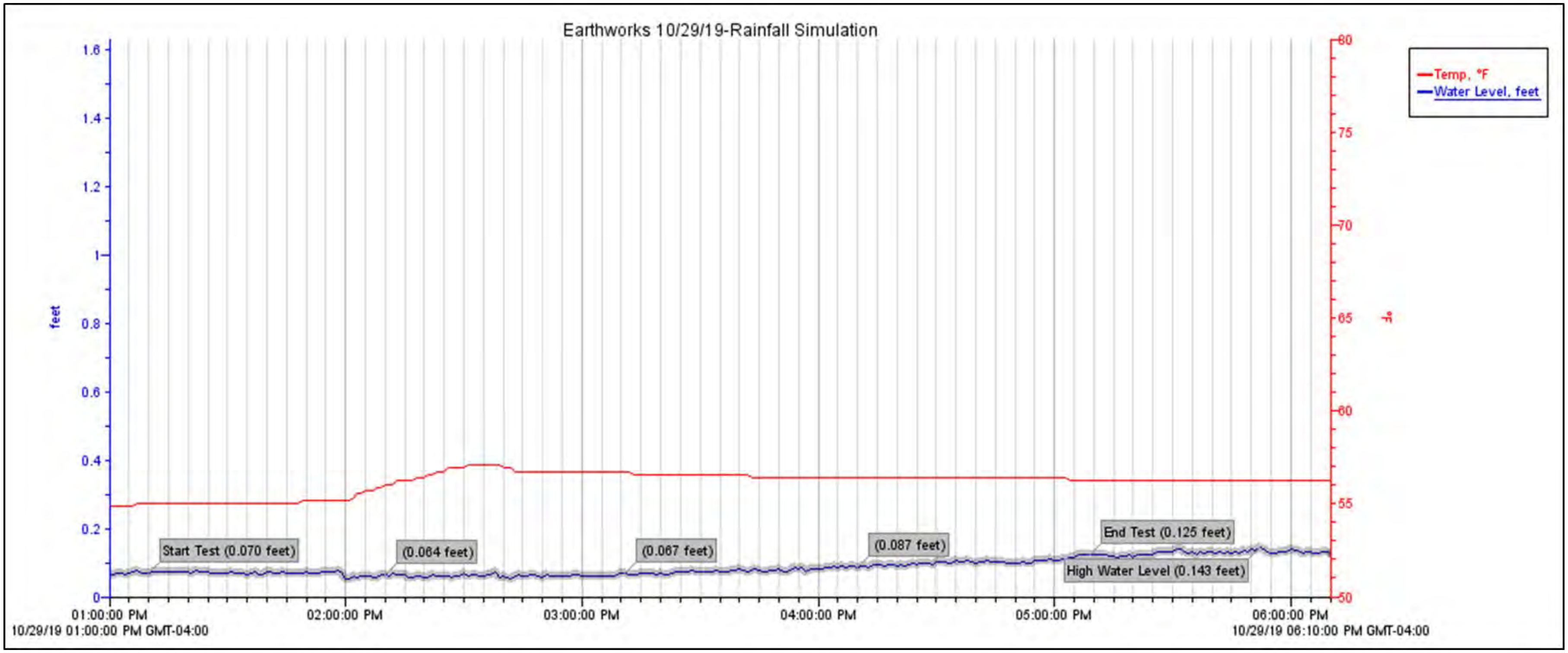
Water Level Start	**Water Level End**	**ΔH**		**Runoff Volume**
0.070	0.143	0.073	feet	3.7 gal

$$Precipitation\ Depth\ (in.) = \frac{Volume\ Applied\ (cu.ft.)}{Aplication\ Area\ (sq.ft.)} * 12$$

Application Area (sq. ft.)	150
Volume Applied (gal.)	1028.6
1 gal = 0.134 cu.ft.	
Volume Applied (cu. ft.)	137.83
Precipitation Depth (in.)	**11.03**

Time, T (HH:MM)	**Time, T (min.)**	**Applied Volume, V (gal.)**	**Application Rate, Q_{app} (gal./min.)**	**Notes:**
1:10 PM	0	-	-	Begin simulation. Note: 14.7gal water used prior to starting test to adjust spray pattern.
1:25 PM	15	78.0	5.20	Fixed leak at #4 B line.
1:40 PM	30	148.6	4.71	
1:55 PM	45	210.5	4.13	Puddling on surface in footprint.
2:10 PM	60	272.7	4.15	Slow drip into tote.
2:25 PM	75	335.6	4.19	
2:40 PM	90	398.8	4.21	Changed battery.
2:55 PM	105	463.0	4.28	Puddling still but not growing.
3:10 PM	120	525.3	4.15	
3:25 PM	135	588.8	4.23	
3:40 PM	150	652.7	4.26	59°F Cloudy
3:55 PM	165	717.0	4.29	
4:10 PM	180	779.0	4.13	Puddles growing a bit but still holding.
4:25 PM	195	841.7	4.18	Puddles remain. Footprint size to 15" x 10" at east end of plot.
4:40 PM	210	904.0	4.15	Puddles remain. Not growing in size.
4:55 PM	225	966.7	4.18	Very sligh rainfall starts. Barely a drizzle.
5:10 PM	240	1028.6	4.13	End simulation.

Note: Diver margin of error =±.04' or 13gal.



Earthworks 10/29/19-Rainfall Simulation
feet
°F
1.6
1.4
1.2
1
0.8
0.6
0.4
0.2
0
80
75
70
65
60
55
50
Temp, °F
Water Level, feet
Start Test (0.070 feet)
(0.064 feet)
(0.067 feet)
(0.087 feet)
End Test (0.125 feet)
High Water Level (0.143 feet)
01:00:00 PM
02:00:00 PM
03:00:00 PM
04:00:00 PM
05:00:00 PM
06:00:00 PM
10/29/19 01:00:00 PM GMT-04:00
10/29/19 06:10:00 PM GMT-04:00

Oakland Avenue Urban Farm
Oakland Avenue Urban Farm
Study Areas
Monitoring Sump
© 2019 Google
Goodwin St

Plot #1

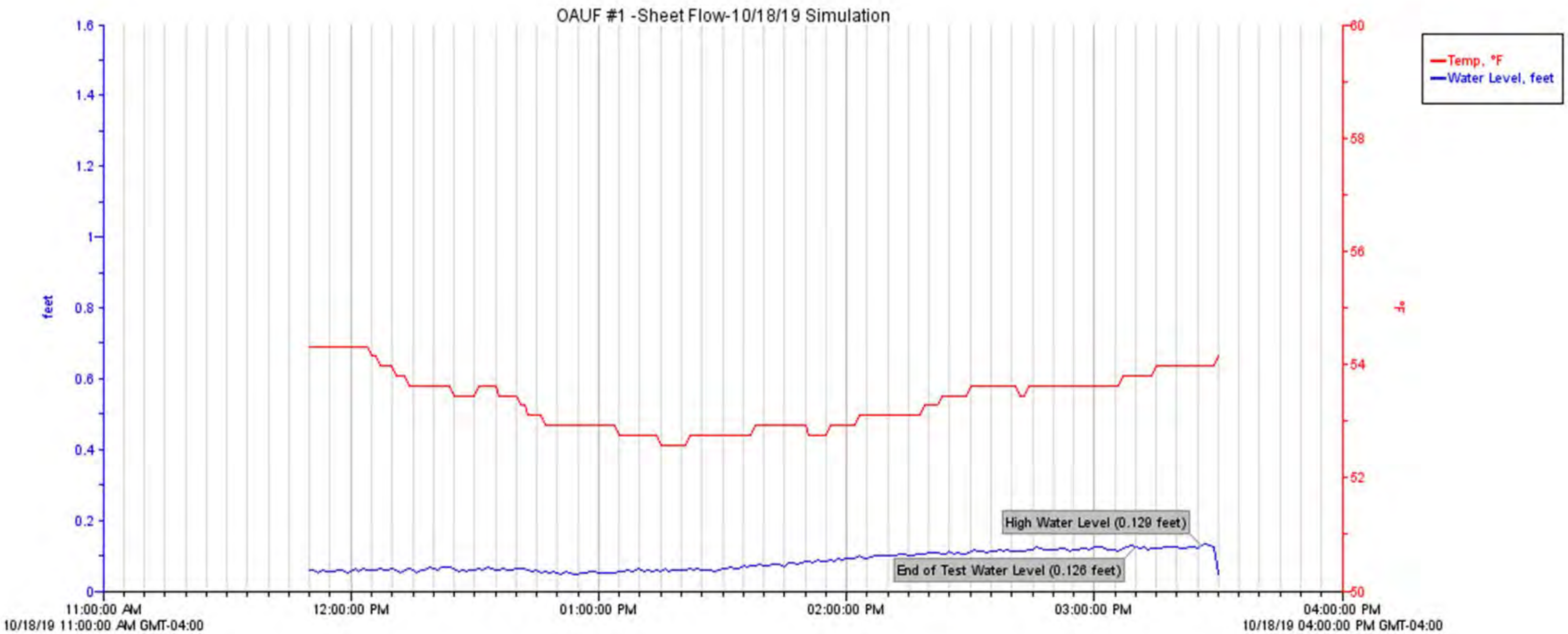
Oakland Avenue Urban Farm - Tote #1 - Sheet Flow - Field Sheet							
Date	Time On Site	Time Off Site	Depth of Reservoir (ft.)	Depth from top of Res. to Water Surface (ft.)	Depth of Water (ft.)	Volume (gal.)	Notes
8/7/2019	10:53 AM	11:17 AM	1.52	1.44	0.08	4.1	Data uploaded. Set to start recording at 2pm.
8/22/2019	10:18 AM	10:40 AM	1.52	1.52	0.00	0.0	Data uploaded. Set to start recording at 2pm.
9/6/2019	10:25 AM	10:45 AM	1.52	1.47	0.05	2.7	Data uploaded. Set to start recording at 2pm.
9/20/2019	12:03 PM	12:47 PM	1.52	1.47	0.06	3.2	Data uploaded. Set to start recording at 4pm.
10/3/2019	6:36 PM	7:05 PM	1.52	1.40	0.12	6.1	Data uploaded. Set to start recording at 8pm.
10/18/2019	9:00 AM		1.52	1.45	0.07	3.6	Data upload. Set to start 10:50am. Simulaton starts at 11:10 am.
10/18/2019	3:15 PM		1.52	1.40	0.12	6.1	Diver upload. Set to start 8:00pm.
11/1/2019	12:33 PM	1:07 PM	1.52		0.18	8.9	Diver upload. Set to start 4:00pm.

Location:	Oakland Avenue Urban Farm				
Test Date:	10/18/2019				
Time Start:	11:10 AM				
Time Stop:	3:10 PM				
Duration (hour):	4.0 hr.				
Application Area (sq.ft.):	150				
Rainfall Depth (in.):	9.24				
Plot #1 or 2:	#1 Sheet Flow				
Reservoir Type:	Husky 45 Gallon Latch and Stack Tote with Wheels				
Dimensions of Reservoir	**L**	**W**	**H**		
	30.5	18	18.96	inch	
	2.54	1.50	1.58	feet	
Water Level Start	**Water Level End**	**ΔH**		**Runoff Volume**	
0.07	0.132	0.06	feet	1.77 gal	

Time, T (HH:MM)	**Time, T (min.)**	**Applied Volume, V (gal.)**	**Application Rate, Q_{app} (gal./min.)**	**Notes:**
11:10 AM	0	0.0	-	Water on. Water level measured at ~.07' prior to beginning test. Plot is planted with
11:25 AM	15	55.9	3.73	
11:40 AM	30	111.2	3.69	
11:55 AM	45	166.2	3.67	
12:10 PM	60	219.8	3.57	
12:25 PM	75	274.9	3.67	
12:40 PM	90	329.4	3.63	Noticed slight drip of water into reservoir.
12:55 PM	105	383.8	3.63	Slight wind from west resulting in mist over tarp.
1:10 PM	120	436.6	3.52	Still sunny and clear skys, 52°F
1:25 PM	135	489.0	3.49	
1:40 PM	150	541.6	3.51	Slight puddling in center of test site by woodchips, but infiltrates quickly. Still dripping into reservoir.
1:55 PM	165	594.9	3.55	
2:10 PM	180	648.1	3.55	At 2:09pm almost a continuous stream into container.
2:25 PM	195	702.0	3.59	Still sunny and clear skys, 53°F
2:40 PM	210	755.1	3.54	Still sunny and clear skys, 54°F. Flow still dripping into reservoir.
2:55 PM	225	809.2	3.61	
3:10 PM	240	862.4	3.55	Water off. Water level = .126 ft. at end of test.
3:27 PM	257	-	-	Water level = .132 ft. at 3:27 PM.

Application Area (sq. ft.)	150
Volume Applied (gal.)	862.4
1 gal = 0.134 cu.ft.	
Volume Applied (cu. ft.)	115.56
Precipitation Depth (in.)	**9.24**

$$Precipitation\ Depth\ (in.) = \frac{Volume\ Applied\ (cu.ft.)}{Aplication\ Area\ (sq.ft.)} * 12$$



OAUF #1 -Sheet Flow-10/18/19 Simulation
feet
°F
Temp, °F
Water Level, feet
High Water Level (0.129 feet)
End of Test Water Level (0.126 feet)
1.6
1.4
1.2
1
0.8
0.6
0.4
0.2
0
60
58
56
54
52
50
11:00:00 AM
10/18/19 11:00:00 AM GMT-04:00
12:00:00 PM
01:00:00 PM
02:00:00 PM
03:00:00 PM
04:00:00 PM
10/18/19 04:00:00 PM GMT-04:00

Plot #2

Oaklland Avenue Urban Farm - Tote #2 - Sheet Flow - Field Sheet							
Date	Time On Site	Time Off Site	Depth of Reservoir (ft.)	Depth from top of Res. to Water Surface (ft.)	Depth of Water (ft.)	Volume (gal.)	Notes
8/7/2019	10:53 AM	11:17 AM	1.52	1.39	0.13	6.6	Data uploaded. Set to start recording at 2 pm.
8/22/2019	10:18 AM	10:40 AM	1.52	1.44	0.08	4.1	Data uploaded. Set to start recording at 2 pm.
9/6/2019	10:25 AM	10:45 AM	1.52	1.44	0.08	4.1	Data uploaded. Set to start recording at 2 pm.
9/20/2019	12:03 PM	12:47 PM	1.52	1.43	0.09	4.6	Data uploaded. Set to start recording at 4 pm.
10/3/2019	6:36 PM	7:05 PM	1.52	1.39	0.13	6.6	Data uploaded. Set to start recording at 8 pm.
10/18/2019	12:30 PM		1.52		0.08	4.2	Data uploaded. Set to start recording at 8 pm.Purged tote of stagnant water and rodent carcus.
11/1/2019	12:33 PM	1:07 PM	1.52	1.29	0.26	13.3	Diver Uploaded and set to start recording at 4 pm.

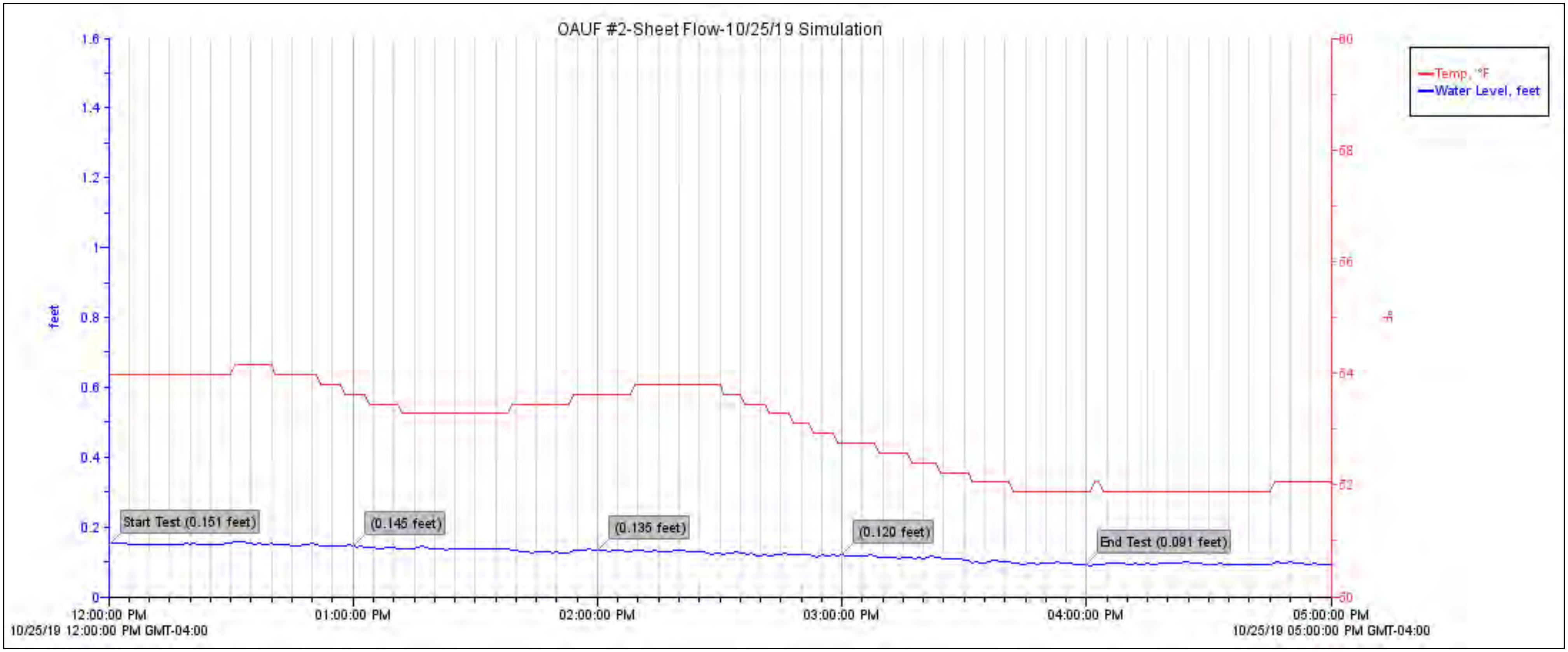
Oakland Avenue Urban Farm - Tote #3 - Underdrain -Field Sheet							
Date	Time On Site	Time Off Site	Depth of Reservoir (ft.)	Depth from top of Res. to Water Surface (ft.)	Depth of Water (ft.)	Volume (gal.)	Notes
8/7/2019	10:53 AM	11:17 AM	1.52	1.52	0	0	Data uploaded. Set to start recording at 2pm.
8/22/2019	10:18 AM	10:40 AM	1.52	1.52	0	0	Data uploaded. Set to start recording at 2pm.
9/6/2019	10:25 AM	10:45 AM	1.52	1.52	0	0	Data uploaded. Set to start recording at 2pm.
9/20/2019	12:03 PM	12:47 PM	1.52	1.52	0	0	Data uploaded. Set to start recording at 4pm.
10/3/2019	6:36 PM	7:05 PM	1.52	1.52	0	0	Data uploaded. Set to start recording at 8 pm.
10/18/2019	12:33 PM	1:07 PM	1.52	1.29	0.23	11.7	Data uploaded. Set to start recording at 8 pm.
11/1/2019	12:33 PM	1:07 PM	1.52	1.29	0.26	13.3	Diver Uploaded and set to start recording at 4 pm.

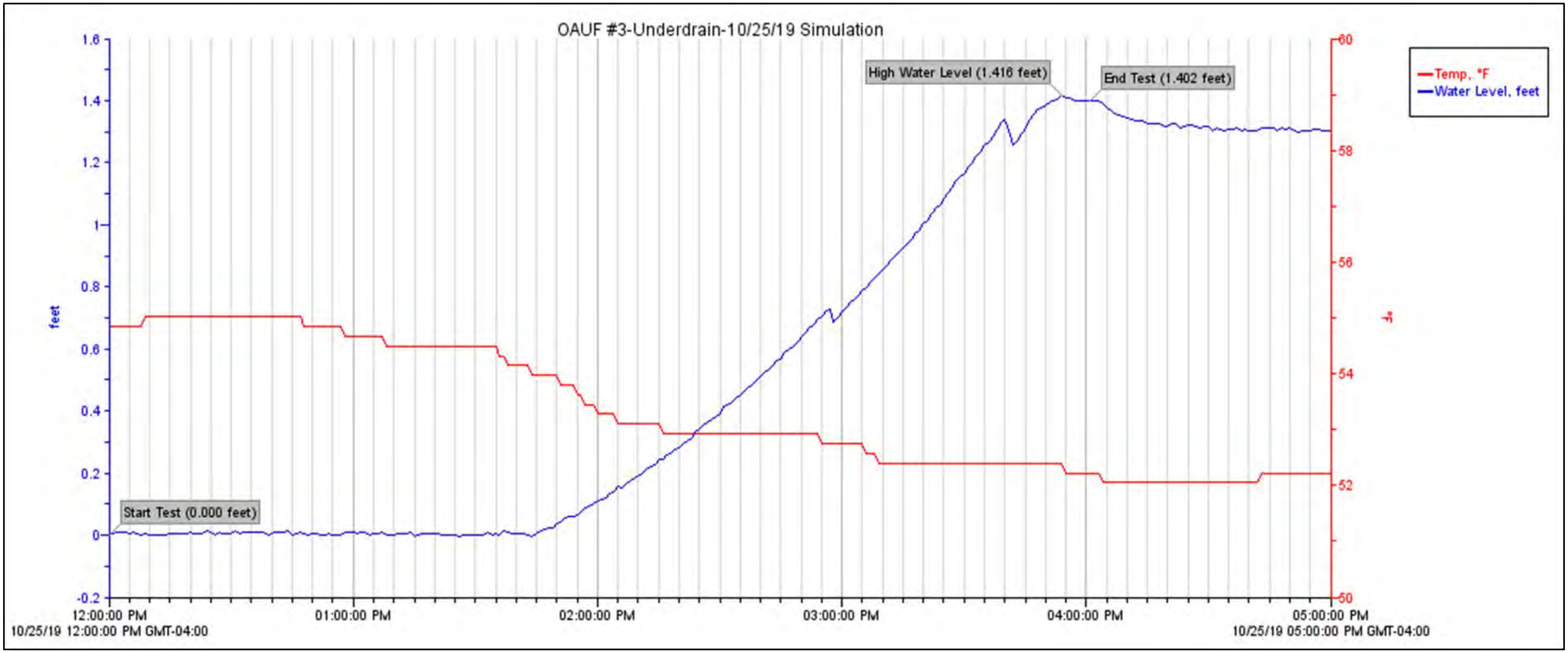
Location:	Oakland Avenue Urban Farm				
Test Date:	10/25/2019				
Time Start:	12:00 PM				
Time Stop:	4:00 PM				
Duration (hour):	4.0 hr.				
Application Area (sq.ft.):	150				
Rainfall Depth (in.):	9.37				
Plot #1 or 2:	#2 Sheet Flow and Underdrain				
Reservoir Type:	Husky 45 Gallon Latch and Stack Tote with Wheels				
Dimensions of Reservoir	**L**	**W**	**H**		
	30.5	18	18.96	inch	
	2.54	1.50	1.58	feet	
	Water Level Start	**Water Level End**	**ΔH**		**Runoff Volume**
Tote #2 Sheet Flow	0.151	0.094	0.00	feet	0.00 gal
Tote #3 Underdrain	0.000	1.402	1.402	feet	39.98 gal

Time, T (HH:MM)	Time, T (min.)	Applied Volume, V (gal.)	Application Rate, Q_{app} (gal./min.)	Notes:
12:00 PM	0	0.0	-	48°F and Cloudy. Wind @ 6 MPH with 60% hunidity. 16 mature collard plants in bed. Second bed empty. Underdrain tote is empty. Windscreen stands 44" above grade.
12:15 PM	15	55.3	3.69	
12:30 PM	30	109.9	3.64	
12:45 PM	45	164.7	3.65	
1:00 PM	60	217.8	3.54	
1:15 PM	75	270.4	3.51	Adjusted wind break
1:30 PM	90	323.4	3.53	
1:41 PM	101	-	-	Water dripping from underdrain @ 1:41 PM.
1:45 PM	105	376.5	3.54	Underdrain dripping steadily.
2:00 PM	120	431.0	3.63	Sheet flow drain has a very slow drip.
2:15 PM	135	485.8	3.65	Breeze from the North.
2:30 PM	150	540.2	3.63	Underdrain has a steady trickle.
2:45 PM	165	595.0	3.65	
3:00 PM	180	650.5	3.70	
3:15 PM	195	706.7	3.75	No puddling and sheet flow is not present.
3:30 PM	210	762.1	3.69	Wind speed @ 4mph.
3:45 PM	225	818.1	3.73	
4:00 PM	240	874.2	3.74	Underdrain tote is filled to 1" from top of tote.

Application Area (sq. ft.)	150
Volume Applied (gal.)	874.2
1 gal = 0.134 cu.ft.	
Volume Applied (cu. ft.)	117.14
Precipitation Depth (in.)	**9.37**

$$Precipitation\ Depth\ (in.) = \frac{Volume\ Applied\ (cu.ft.)}{Aplication\ Area\ (sq.ft.)} * 12$$


OAUF #2-Sheet Flow-10/25/19 Simulation
feet
°F
Temp, °F
Water Level, feet
1.6
1.4
1.2
1
0.8
0.6
0.4
0.2
0
60
58
56
54
52
50
Start Test (0.151 feet)
(0.145 feet)
(0.135 feet)
(0.120 feet)
End Test (0.091 feet)
12:00:00 PM
10/25/19 12:00:00 PM GMT-04:00
01:00:00 PM
02:00:00 PM
03:00:00 PM
04:00:00 PM
05:00:00 PM
10/25/19 05:00:00 PM GMT-04:00


OAUF #3-Underdrain-10/25/19 Simulation
feet
°F
Temp, °F
Water Level, feet
Start Test (0.000 feet)
High Water Level (1.416 feet)
End Test (1.402 feet)
1.6
1.4
1.2
1
0.8
0.6
0.4
0.2
0
-0.2
60
58
56
54
52
50
12:00:00 PM
01:00:00 PM
02:00:00 PM
03:00:00 PM
04:00:00 PM
05:00:00 PM
10/25/19 12:00:00 PM GMT-04:00
10/25/19 05:00:00 PM GMT-04:00

Earthworks Urban Farm

Site Name: KGD Farms
Site Address:
Contact:
Contact Phone #:

HOBO Diver S/N:
Launch Date:

Volume of Reservoir: 27 gal.
Shape of Reservoir: Rectangle

	L	W	H
Dimensions (in.)	28.55	21.37	19.50
Dimensions (ft.)	2.38	1.78	1.63
Area, W x L, (sq.ft.)	4.24		


Erskine St
Orleans St
Keep Growing Detroit Farm
Study Area
© 2019 Google

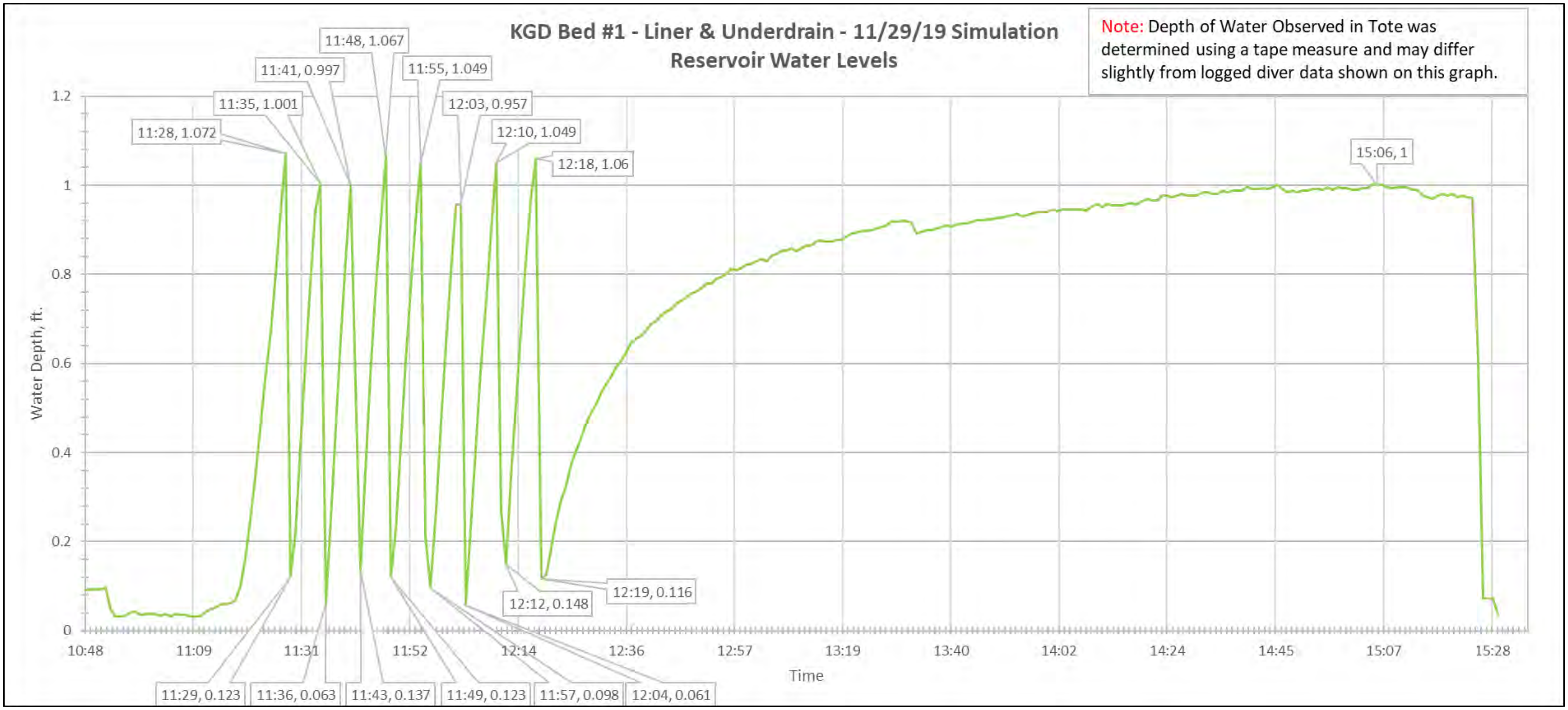
Location:	Keep Growing Detroit
Test Date:	11/29/2019
Time Start:	11:15 AM
Time Stop:	12:15 PM
Duration (hour):	1.00
Application Area (sq.ft.):	27
Rainfall Depth (in.):	13.92
Plot #1 or 2:	#1 (underdrain with liner)
Volume of Reservoir:	27 gal.
Shape of Reservoir:	Rectangle

	L	W	H
Dimesions (in.)	23.5	14.5	13.00
Dimensions (ft.)	1.96	1.21	1.08
Area, W x L, (sq.ft.)	2.37		

Time, T (HH:MM)	Time, T (min.)	V_{BATCH} (GPI Meter) (gal.)	Applied Volume, V (gal.)	Application Rate, Q_{app} (gal./min.)	Depth of Water Observed in Tote (in.)	Depth of Water Observed in Tote (ft.)	ΔH (ft.)	Runoff Volume (gal.)	Notes:
11:15 AM	0	5	5.0	-					Flow to system started
11:20 AM	5	24.2	19.2	3.84	2.5	0.21			Water began to trickle from underdrain withing the first few minutes.
11:25 AM	10	45.2	21.0	4.20	10.0	0.83			
11:27 AM	12	-	-	-	13.0	1.08	1.08	19.18	Start pumping.
11:28 AM	13	-	-	-	0.0	0.00			Stop pumping.
11:30 AM	15	66.2	21.0	4.20	6.0	0.50			Ponding noticed.
11:34 AM	19	-	-	-	13.0	1.08	1.00	17.70	Start pumping.
11:35 AM	20	86.9	20.7	4.14	1.0	0.08			Stop pumping.
11:40 AM	25	107.2	20.3	4.06	13.0	1.08	1.04	31.69	Start pumping.
11:41 AM	26	-	-	-	0.5	0.04			Stop pumping.
11:45 AM	30	127.8	20.6	4.12	9.5	0.79			Closed valve slightly to reduce flowrate.
11:47 AM	32	-	-	-	13.0	1.08	1.00	17.70	Start pumping.
11:48 AM	33	-	-	-	1.0	0.08			Stop pumping.
11:50 AM	35	146	18.2	3.64	5.3	0.44			
11:54 AM	39	-	-	-	13.0	1.08	1.04	18.44	Start pumping.
11:55 AM	40	163.8	17.8	3.56	0.5	0.04			Stop pumping.
12:00 PM	45	181.6	17.8	3.56	10.0	0.83			
12:02 PM	47	-	-	-	13.0	1.08	1.00	17.70	Start pumping.
12:03 PM	48	-	-	-	1.0	0.08			Stop pumping.
12:05 PM	50	199.2	17.6	3.52	5.3	0.44			
12:09 PM	54	-	-	-	13.0	1.08	0.83	14.75	Start pumping.
12:10 PM	55	217	17.8	3.56	3.0	0.25			Stop pumping.
12:11 PM	56	-	-	-	2.0	0.17			
12:13 PM	58	-	-	-	6.5	0.54			
12:15 PM	60	233.8	16.8	3.36	10.5	0.88			Flow to system turned off.
12:17 PM	62	-	-	-	13.0	1.08	1.04	18.44	Start pumping.
12:18 PM					0.5	0.04			Stop pumping.
12:21 PM	66	-	-	-	3.5	0.29	0.69	12.2	
12:22 PM	67	-	-	-	3.8	0.31			
12:25 PM	70	-	-	-	5.0	0.42			
12:30 PM	75				6.8	0.56			
12:36 PM	81				8.3	0.69			
1:06 PM	111				10.5	0.88			
1:34 PM	139				11.0	0.92			
1:53 PM	158				-				Slow drip from underdrain.
3:21 PM	246				11.75	0.98			Flow from underdrain stopped.

Note: Depth of Water Observed in Tote was determined using a tape measure and may differ slightly from logged diver data.

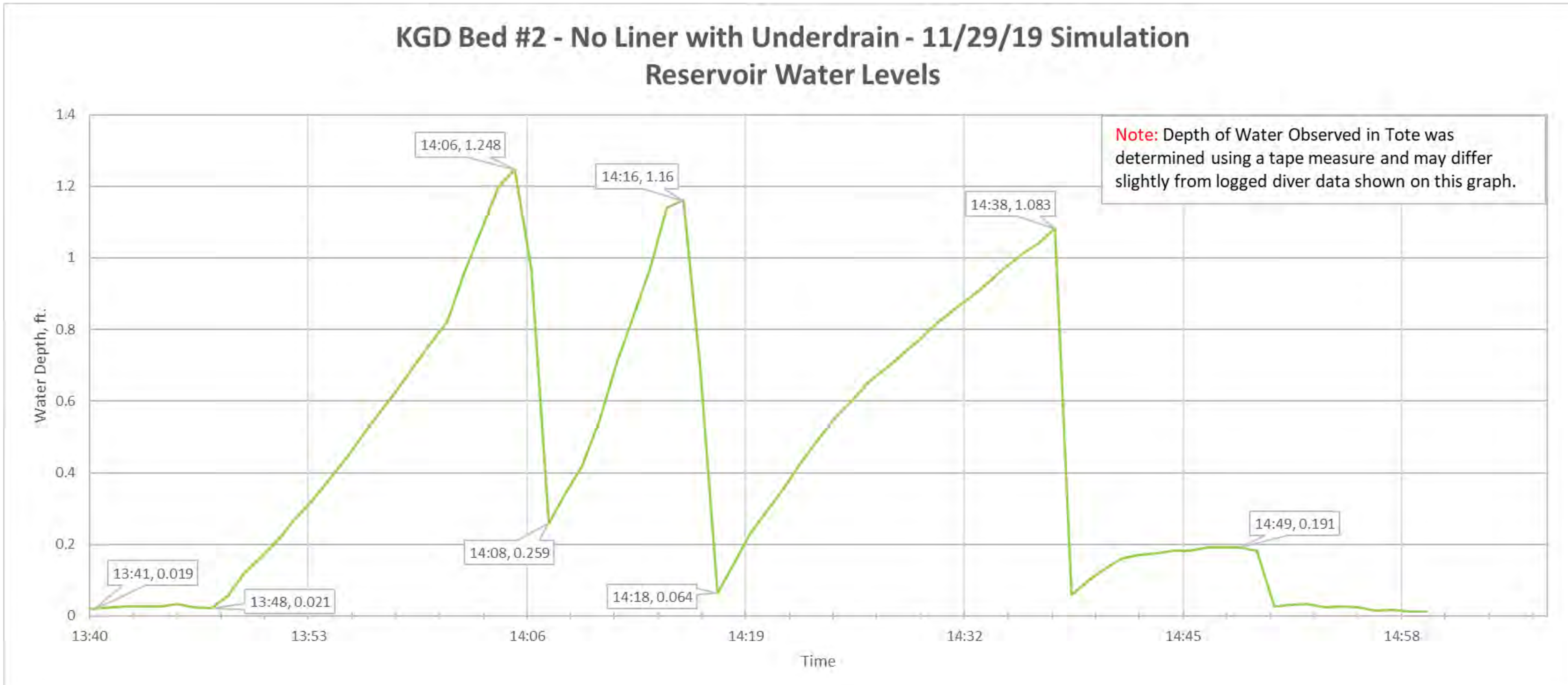
Avg. Application Rate	Runoff Volume
3.81 gal./min.	167.76 gal.


KGD Bed #1 - Liner & Underdrain - 11/29/19 Simulation
Reservoir Water Levels
Note: Depth of Water Observed in Tote was determined using a tape measure and may differ slightly from logged diver data shown on this graph.
Water Depth, ft.
Time
0
0.2
0.4
0.6
0.8
1
1.2
10:48
11:09
11:31
11:52
12:14
12:36
12:57
13:19
13:40
14:02
14:24
14:45
15:07
15:28
11:28, 1.072
11:35, 1.001
11:41, 0.997
11:48, 1.067
11:55, 1.049
12:03, 0.957
12:10, 1.049
12:18, 1.06
15:06, 1
12:12, 0.148
12:19, 0.116
11:29, 0.123
11:36, 0.063
11:43, 0.137
11:49, 0.123
11:57, 0.098
12:04, 0.061

Location:	Keep Growing Detroit			
Test Date:	11/29/2019			
Time Start:	1:40 PM			
Time Stop:	2:40 PM			
Duration (hour):	1.00			
Application Area (sq.ft.):	27			
Rainfall Depth (in.):	14.83			
Plot #1 or 2:	#2 (underdrain, no liner)			
Volume of Reservoir:	27 gal.			
Shape of Reservoir:	Rectangle			
		L	**W**	**H**
Dimesions (in.)		23.5	14.5	13.00
Dimensions (ft.)		1.96	1.21	1.08
Area, W x L, (sq.ft.)		2.37		

Time, T (HH:MM)	Time, T (min.)	V_{BATCH} (GPI Meter)	Applied Volume, V (gal.)	Application Rate, Q_{app} (gal./min.)	Depth of Water Observed in Tote (in.)	Depth of Water Observed in Tote (ft.)	ΔH (ft.)	Runoff Volume (gal.)	Notes:
1:40 PM	0	0.0	0.0	-	0.0	0.00			Begin test with empty tote.
1:45 PM	5	21.3	21.3	4.26	0.0	0.00			No flow to tote.
1:48 PM	8	-	-	-	-	-			Flow from underdrain noted.
1:50 PM	10	42.8	21.5	4.30	2.3	0.19			Continuous flow from underdrain.
1:55 PM	15	65.5	22.7	4.54	5.5	0.46			
2:00 PM	20	88.7	23.2	4.64	9.3	0.77			
2:03 PM	23	-	-	-	13.0	1.08	0.88	15.49	Start pumping. Overflow from pit into tote noted. Tote adjusted to solve issue.
2:06 AM	26	-	-	-	2.5	0.21			Stop pumping.
2:10 PM	30	135.6	46.9	4.69	6.5	0.54			
2:15 PM	35	159.9	24.3	4.86	12.5	1.04	1.04	18.44	Start Pumping.
2:16 PM	36	-	-	-	0.0	0.00			Stop pumping.
2:18 PM	38	-	-	-	-				Closed valve slightly to reduce flowrate.
2:20 PM	40	182.3	22.4	4.48	3.8	0.31			
2:25 PM	45	201.7	19.4	3.88	8.0	0.67			
2:30 PM	50	217.9	16.2	3.24	9.8	0.81			
2:35 PM	55	233.5	15.6	3.12	12.0	1.00			
2:37 PM	57	-	-	-	13.0	1.08	1.04	18.44	Start pumping.
2:38 PM	58	-	-	-	0.5	0.04			Stop pumping.
2:40 PM	60	249.0	-	-	2.0	0.17	0.15	15.49	End of simulation.
2:47 PM	67	-	-	-	-				No flow from underdrain.
2:48 PM	68	-	-	-	2.3	0.19			No flow from underdrain.

Avg. Application Rate		**Runoff Volume**
4.20 gal./min.		67.85 gal.



KGD Bed #2 - No Liner with Underdrain - 11/29/19 Simulation
Reservoir Water Levels
Note: Depth of Water Observed in Tote was determined using a tape measure and may differ slightly from logged diver data shown on this graph.
14:06, 1.248
14:16, 1.16
14:38, 1.083
14:08, 0.259
14:49, 0.191
13:41, 0.019
13:48, 0.021
14:18, 0.064
Water Depth, ft.
1.4
1.2
1
0.8
0.6
0.4
0.2
0
13:40
13:53
14:06
14:19
14:32
14:45
14:58
Time

Soil Sample Data - Antecedent Moisture Content

KGD Raised Garden w/ Liner

Date: 11/29/2019

Soil Type: Compost

	Soil Sample	**Pre-Simulation**	**Post-Simulation**
	Can #	1	3
Weight (gram)	**Wet soil + can (g)**	129.90	130.10
	Dry soil + can (g)	91.50	87.90
	Can (g)	49.20	48.80
	Dry soil (g)	**42.30**	**39.10**
	Moisture/water (g)	**38.40**	**42.20**
	Water content (%)	**90.78**	**107.93**

Key
Calculation
Measured

Soil Sample Data - Antecedent Moisture Content

KGD Raised Garden w/o Liner

Date: 11/29/2019

Soil Type: Compost

	Soil Sample	**Pre-Simulation**	**Post-Simulation**
	Can #	10	6
Weight (gram)	**Wet soil + can (g)**	133.70	134.60
	Dry soil + can (g)	95.40	93.20
	Can (g)	49.10	49.80
	Dry soil (g)	**46.30**	**43.40**
	Moisture/water (g)	**38.30**	**41.40**
	Water content (%)	**82.72**	**95.39**
	Average:	**86.75**	**101.66**

2019 Keep Growing Detroit - Site Runoff Summay Sheet																
Test #	**Date**	**Lot ID #**	**Plot #**	**Plot Description**	**Duration of Test (hr.)**	**Rainfall Depth Applied (in.)**	**Average Flowrate (gpm.)**	**Total Volume Applied (gal.)**	**Total Volume Runoff (gal.)**	**Ratio Water Off V.S. Water On**	**Plot Dimensions (ft.)**		**Application Area (sq.ft.)**	**Pre-simulation Soil Moisture Content (%)**	**Post-simulation Soil Moisture Content (%)**
1	7/13/19	Earthworks	1	Sheetflow	4	10.72	4.17	999.90	12.40	0.01	10	15	150	N.R.	N.R.
2	10/29/19	Earthworks	1	Sheetflow	4	11.03	4.29	1028.60	3.70	0.00	10	15	150	N.R.	N.R.
3	10/18/19	OAUF	1	Sheetflow	4	9.24	3.59	862.40	1.77	0.00	10	15	150	N.R.	N.R.
4	10/25/19	OAUF	2	Sheetflow	4	9.37	3.64	874.20	0.00	0.05	10	15	150	N.R.	N.R.
				Underdrain					39.98						
5	11/29/19	KGD	1	Underdrain with Liner	1	13.92	3.81	233.80	167.76	0.72	3	9	27	90.78	107.93
6	11/29/19	KGD	2	Underdrain w/o Liner	1	14.83	4.2	249.00	67.85	0.27	3	9	27	86.75	101.66

Attachment B – 2020 Summary Presentation

2020 Keep Growing Detroit

Urban Agricultural Water Learning Community

10/29/20

Table of Contents

Urban Agricultural Runoff Monitoring Project Sites

-Rainfall Simulation Results-

- Earthworks Urban Farm
- Keep Growing Detroit Farm
- Oakland Avenue Urban Farm

Earthworks Urban Farm

Site Name:	Earthworks Tote		
Site Address:			
Contact:			
Contact Phone #:			
HOBO Diver S/N:			
Launch Date:			
Volume of Reservoir:	55 gal.		
Shape of Reservoir:	Rectangle		
	L	W	H
Dimesions (in.)	45.88	21.37	19.50
Dimensions (ft.)	3.82	1.78	1.63
Area, W x L, (sq.ft.)	6.81		


Study Area
Monitoring Sump
Kercheval Ave
Meldrum St

Earthworks Tote - Sheet Flow - Field Sheet

Date	Time On Site	Time Off Site	Depth of Reservoir (ft.)	Depth from top of Res. to Water Surface (ft.)	Depth of Water (ft.)	Volume (gal.)	Notes
5/10/2020	11:48 AM	12:09 PM	1.52	1.52	0	0.00	Diver set to start recording at 12:00 PM on 5/10/20.
6/7/2020	2:08 PM	2:36 PM	1.52	1.48	0.04	2.12	Diver set to start recording at 12:00 AM on 6/8/20.
7/19/2020	1:17 PM	1:45 PM	1.52	0.52	1.00	50.93	Diver set to start recording at 3:00 PM on 7/19/20.
8/30/2020			1.52	1.52		0.00	Diver colleced from field, memory full.

Location: Earthworks
Test Performed by: Rick
Test Date: 7/25/2020
Time Start: 12:30 PM
Time Stop: 4:30 PM
Duration (hour): 4.0 hr.
Application Area (sq.ft.): 150
Rainfall Depth (in.): 21.64
Plot #1: Sheet Flow

$$Precipitation\ Depth\ (in.) = \frac{Volume\ Applied\ (cu.ft.)}{Aplication\ Area\ (sq.ft.)} * 12$$

Dimensions of Reservoir	L	W	H	
	3.82	1.78	1.63	feet

Water Level Start	Water Level End	ΔH		Runoff Volume
0.031	0.294	0.263	feet	13.4 gal

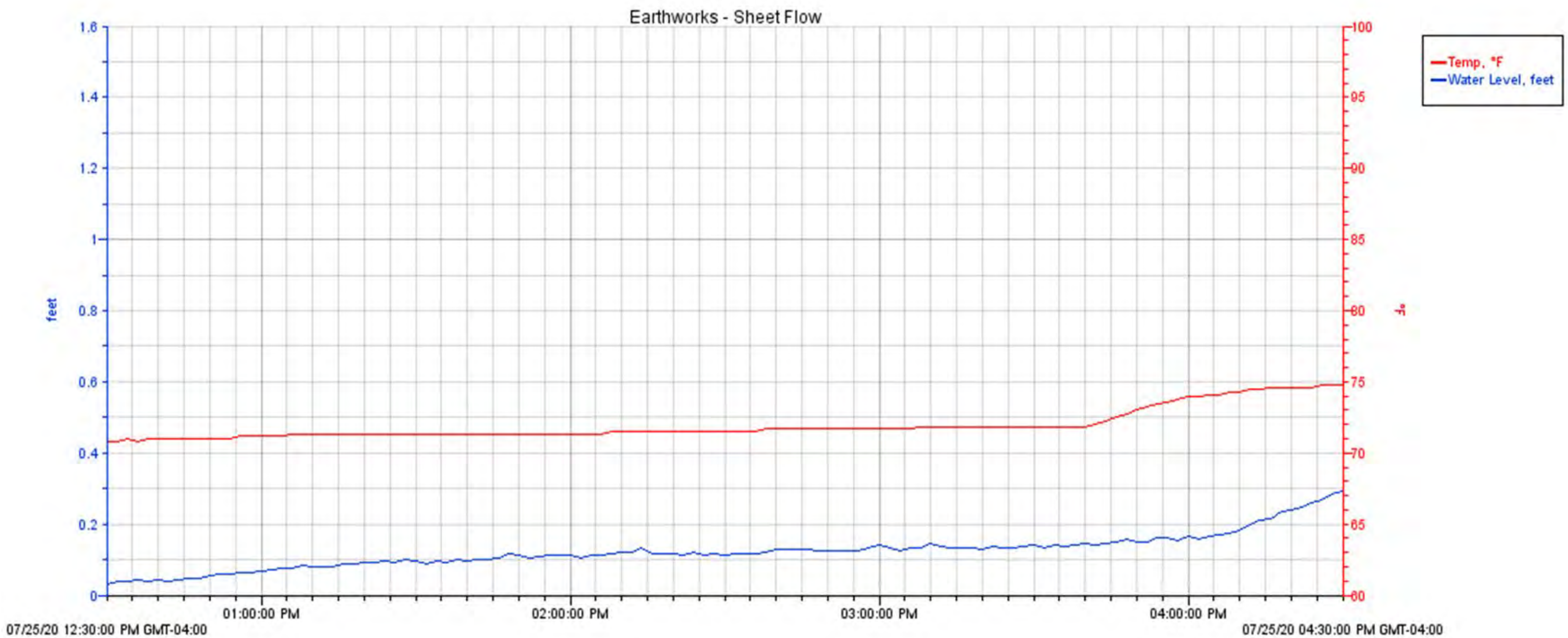
Application Area (sq. ft.)	150
Volume Applied (gal.)	2019.0
1 gal =0.134 cu.ft.	
Volume Applied (cu. ft.)	270.55
Precipitation Depth (in.)	**21.64**

Time, T (HH:MM)	Time, T (min.)	Applied Volume, V (gal.)	Application Rate, Q_{app} (gal./min.)	Notes:
12:30 PM	0	0.0	-	Water on.
12:45 PM	15	125.2	8.35	
1:00 PM	30	251.1	8.39	
1:15 PM	45	378.3	8.48	Puddling noticed in footprints
1:30 PM	60	505.4	8.47	
1:45 PM	75	630.4	8.33	
2:00 PM	90	756.5	8.41	Steady, slow drip into reservoir
2:15 PM	105	883.3	8.45	
2:30 PM	120	1007.5	8.28	
2:45 PM	135	1133.0	8.37	Additional puddling noted. Stead, fast drip into reservoir
3:00 PM	150	1260.2	8.48	
3:15 PM	165	1387.0	8.45	
3:30 PM	180	1513.0	8.40	Steady, fast drip into reservoir continues
3:45 PM	195	1640.2	8.48	1" of puddling on surface in spots
4:00 PM	210	1766.8	8.44	Soil saturated, flow noted entering cavity from sides of reservoir excavation
4:15 PM	225	1893.0	8.41	Approx. 3-4" of water noted in cavity. Steadt, fast drip into reservoir continues
4:30 PM	240	2019.0	8.40	Water off. Approx.5-6" of water noted in cavity

Additional Simulation Notes:

-Diver margin of error = ±.04’ or 13 gal.
-58.2 gal. applied prior to beginning test for nozzle and fitting adjustment
-Battery replaced at 11:45 AM to get sump pump operational
-82 °F, 5 mph wind from the south

07/25/20 - Field Simulation – Reservoir Water Levels




Oakland Avenue Urban Farm
Oakland Avenue Urban Farm
Study Areas
Monitoring Sump
Goodwin St
© 2019 Google

OAUF Tote #1 - Plot 1 - Sheet Flow - Field Sheet

Date	Time On Site	Time Off Site	Depth of Reservoir (ft.)	Depth from top of Res. to Water Surface (ft.)	Depth of Water (ft.)	Volume (gal.)	Notes
5/10/2020	11:48 AM	12:09 PM	1.52	1.52	0	0.00	Diver set to start recording at 12:00 PM on 5/10/20.
6/7/2020	2:08 PM	2:36 PM	1.52	1.48	0.04	2.12	Diver set to start recording at 12:00 AM on 6/8/20.
7/19/2020	1:17 PM	1:45 PM	1.52	1.34	0.18	9.02	Diver set to start recording at 3:00 PM on 7/19/20.
8/30/2020			1.52	1.52		0.00	Diver colleced from field, memory full.

OAUF Tote #2 - Plot 2 - Sheet Flow - Field Sheet

Date	Time On Site	Time Off Site	Depth of Reservoir (ft.)	Depth from top of Res. to Water Surface (ft.)	Depth of Water (ft.)	Volume (gal.)	Notes
5/10/2020	11:48 AM	12:09 PM	1.52	1.52	0	0.00	Diver set to start recording at 12:00 PM on 5/10/20.
6/7/2020	2:08 PM	2:36 PM	1.52	1.52	0	0.00	Diver set to start recording at 12:00 AM on 6/8/20.
7/19/2020	1:17 PM	1:45 PM	1.52	1.18	0.34	17.51	Diver set to start recording at 3:00 PM on 7/19/20.
8/30/2020			1.52	1.52		0.00	Diver colleced from field, memory full.

OAUF Tote #3 - Plot 2 - Underdrain - Field Sheet

Date	Time On Site	Time Off Site	Depth of Reservoir (ft.)	Depth from top of Res. to Water Surface (ft.)	Depth of Water (ft.)	Volume (gal.)	Notes
5/10/2020	11:48 AM	12:09 PM	1.52	1.52	0	0.00	Diver set to start recording at 12:00 PM on 5/10/20.
6/7/2020	2:08 PM	2:36 PM	1.52	1.52	0	0.00	Diver set to start recording at 12:00 AM on 6/8/20.
7/19/2020	1:17 PM	1:45 PM	1.52	1.52	0	0.00	Diver set to start recording at 3:00 PM on 7/19/20.
8/30/2020			1.52	1.52		0.00	Diver colleced from field, memory full.

Location: Oakland Avenue Urban Farm
Test Date: 7/31/2020
Time Start: 2:00 PM
Time Stop: 6:00 PM
Duration (hour): 4.0 hr.
Application Area (sq.ft.): 150
Rainfall Depth (in.): 15.73
Plot #1 or 2: #1 Sheet Flow
Reservoir Type: Husky 45 Gallon Latch and Stack Tote with Wheels
Dimensions of Reservoir

	L	W	H	
	30.5	18	18.96	inch
	2.54	1.50	1.58	feet

Water Level Start	Water Level End	ΔH		Runoff Volume
0.08	0.17	0.09	feet	2.57gal

$$Precipitation\ Depth\ (in.) = \frac{Volume\ Applied\ (cu.ft.)}{Aplication\ Area\ (sq.ft.)} * 12$$

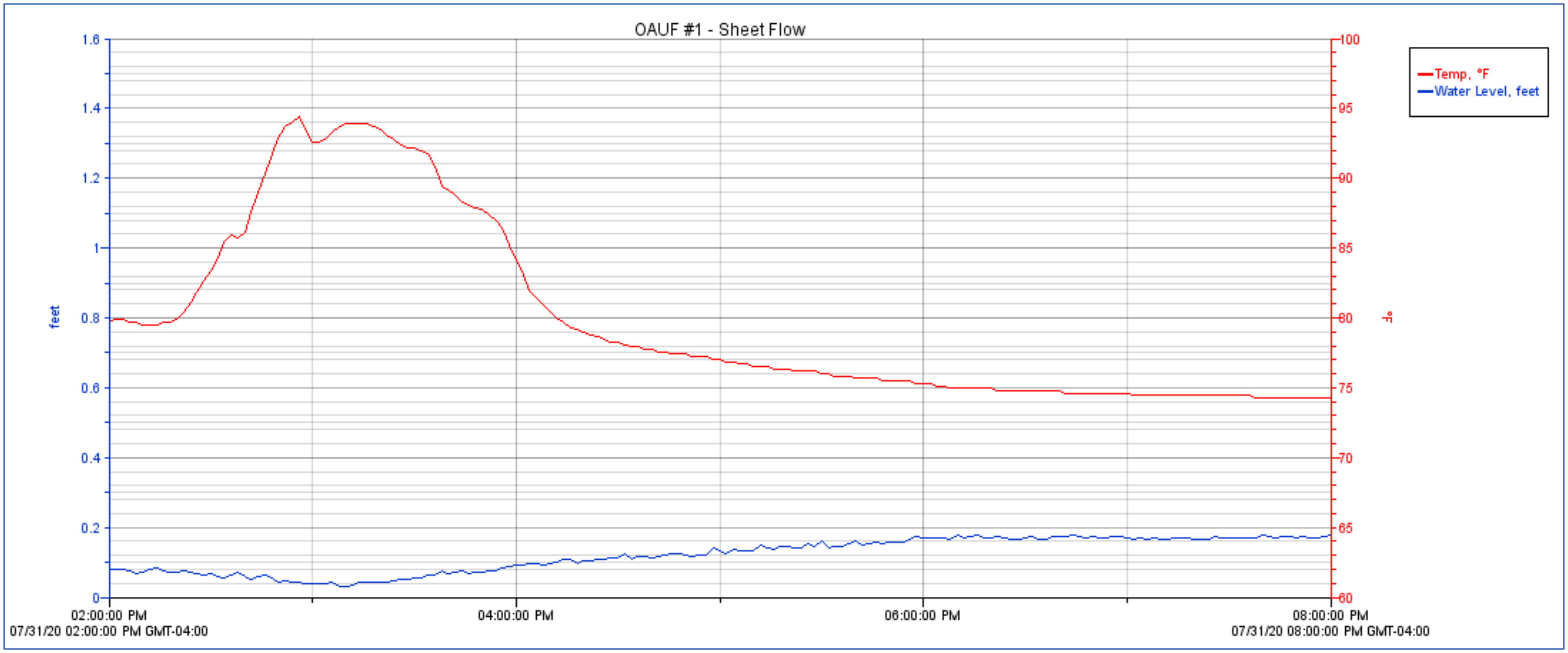
Application Area (sq. ft.)	150
Volume Applied (gal.)	1467.0
1 gal =0.134 cu.ft.	[redacted]
Volume Applied (cu. ft.)	196.58
Precipitation Depth (in.)	**15.73**

Time, T (HH:MM)	Time, T (min.)	Applied Volume, V (gal.)	Application Rate, Q_{app} (gal./min.)	Notes:
2:00 PM	0	0.0	-	Water on. At T=0 min. depth of water in tote was at ~ 0.75"
2:15 PM	15	90.8	6.05	
2:30 PM	30	181.1	6.02	
2:45 PM	45	272.6	6.10	
3:00 PM	60	364.9	6.15	Sheet flow begins, dribble, at 2:58 PM. See photo.
3:15 PM	75	456.7	6.12	
3:30 PM	90	547.9	6.08	
3:45 PM	105	638.9	6.07	
4:00 PM	120	730.5	6.11	Steady flow, dribble, into tank. See photo.
4:15 PM	135	822.6	6.14	
4:30 PM	150	915.3	6.18	
4:45 PM	165	1009.0	6.25	
5:00 PM	180	1102.0	6.20	Steady flow, dribble, into tank. No puddling observed in test area. See photo
5:15 PM	195	1194.0	6.13	
5:30 PM	210	1285.0	6.07	
5:45 PM	225	1375.5	6.03	
6:00 PM	240	1467.0	6.10	Water off. At T=240 min. depth of water in tote was at ~2.0"

Additional Simulation Notes:

- Diver margin of error = ±.04’ or 13 gal.
- 26.1 gal. applied prior to beginning test for nozzle and fitting adjustment
- 81 F; 9 mph wind
- Added 4 fixed, 90-degree arc nozzles to replace 4' and 12' VANs
- Bush Beans planted in test area

07/31/20 - Field Simulation – Reservoir Water Levels



Location:	Oakland Avenue Urban Farm
Test Date:	8/1/2020
Time Start:	9:45 AM
Time Stop:	1:30 PM
Duration (hour):	3.75 hr.
Application Area (sq.ft.):	150
Rainfall Depth (in.):	14.42
Plot #1 or 2:	#2 Sheet Flow & #3 Underdrain
Reservoir Type:	Husky 45 Gallon Latch and Stack Tote with Wheels

Dimensions of Reservoir

L	W	H	
30.5	18	18.96	inch
2.54	1.50	1.58	feet

Runoff Volume

Sheet Flow Reservoir	0.17gal
Underdrain Reservoir	247.36gal

$$Precipitation\ Depth\ (in.) = \frac{Volume\ Applied\ (cu.ft.)}{Aplication\ Area\ (sq.ft.)} * 12$$

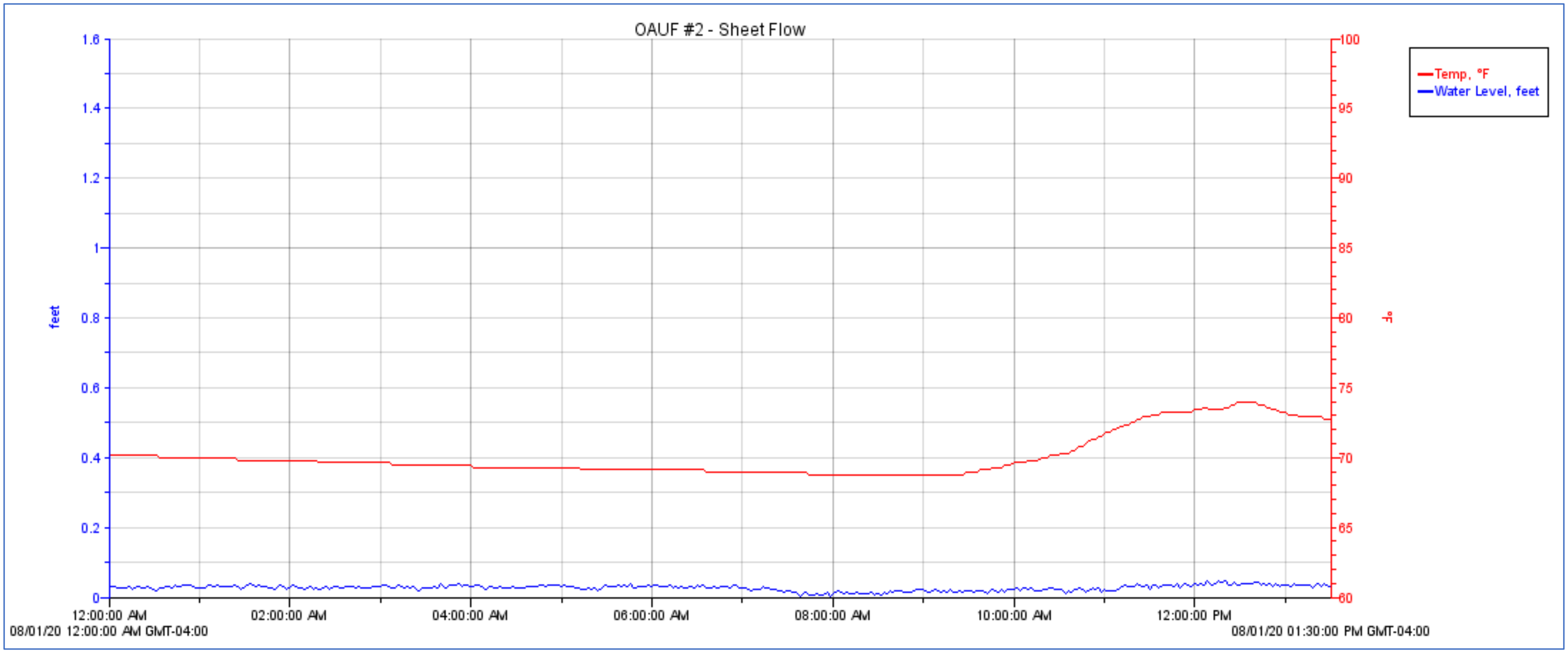
Application Area (sq. ft.)	150
Volume Applied (gal.)	1467.0
1 gal =0.134 cu.ft.	
Volume Applied (cu. ft.)	196.58
Precipitation Depth (in.)	**15.73**

Time, T (HH:MM)	Time, T (min.)	Applied Volume, V (gal.)	Application Rate, Q_{app} (gal./min.)	Notes:
9:45 AM	0	0.0	-	Water on. At T=0 min. depth of water in underdrain tote = 0" and sheetflow tote = 0.25"
10:00 AM	15	91.2	6.08	
10:15 AM	30	179.1	5.86	At T=35 min. (11:20 AM) water from underdrain begins to drip
10:30 AM	45	266.0	5.79	
10:45 AM	60	353.5	5.83	At T=66 min. (11:18 AM) pump hand activated in underdrain tank
11:00 AM	75	442.1	5.91	
11:15 AM	90	529.1	5.80	At T=93 min. (11:18 AM) pump hand activated. Flow from underdrain is now a stream.
11:30 AM	105	617.3	5.88	At T=116 min. (11:41 AM) pump activated
11:45 AM	120	707.8	6.03	At T=130 min. (11:55 AM) pump activated
12:00 PM	135	796.5	5.91	At T=148 min. (12:13 PM) pump activated
12:15 PM	150	887.2	6.05	
12:30 PM	165	975.7	5.90	
12:45 PM	180	1065.0	5.95	At T=184 min. (14:49 PM) pump self-activated
1:00 PM	195	1158.0	6.20	
1:15 PM	210	1250.0	6.13	Actual rainfall beings (drizzle)
1:30 PM	225	1345.0	6.33	Water off. Test concluded due to steady rainfall.

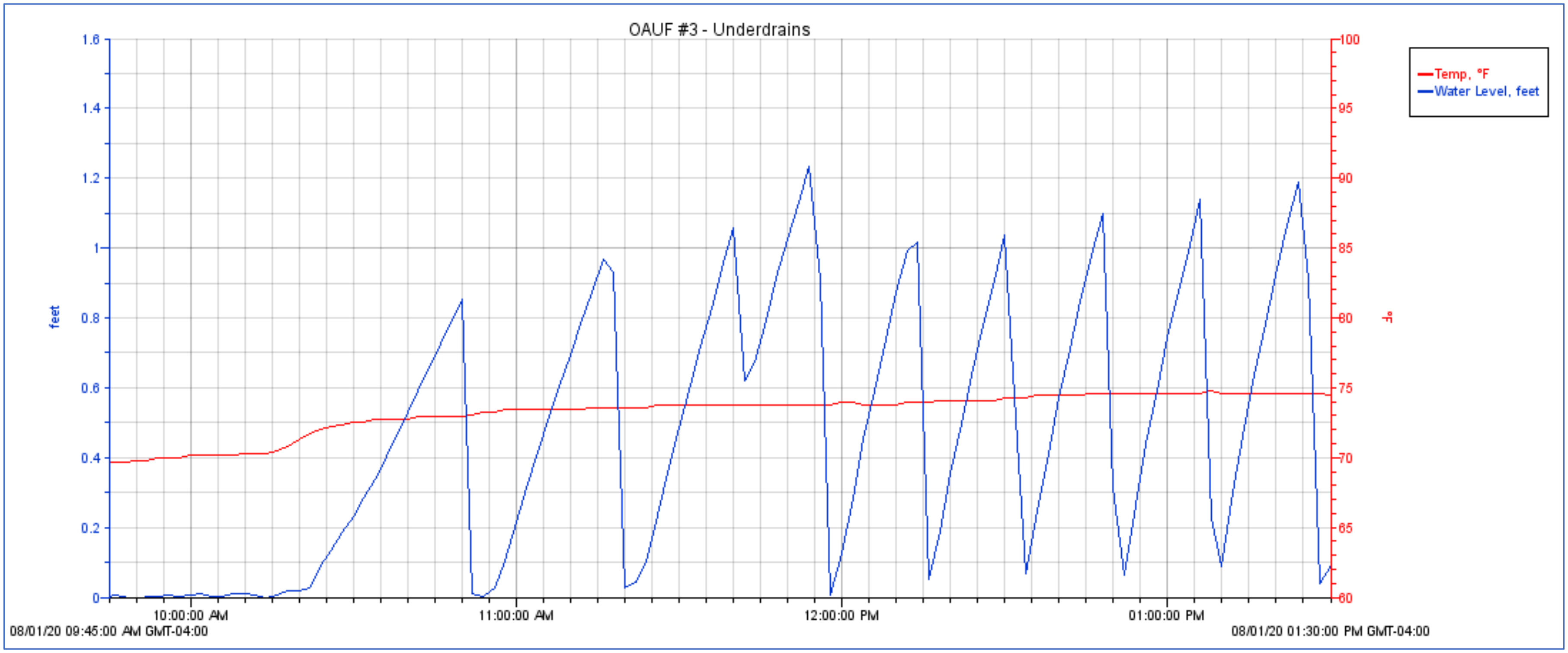
Additional Simulation Notes:

- Diver margin of error = ±.04’ or 13 gal.
- 56.3 gal. applied prior to beginning test for nozzle and fitting adjustment
- Float switch in underdrain tank wasn't working; battery dead; switched battery to get it working and noticed that the bottom limit hangs up on a ridge and doesn't shut down pump. This is probably why battery died.
- 77 F; wind speed 8mph; sunny early then overcast starting at 10:30 AM.
- At 11:09 AM irrigation system on tomatoes turned on (same line) but no effect noticed.

08/01/20 - Field Simulation – Reservoir Water Levels



08/01/20 - Field Simulation – Reservoir Water Levels



Keep Growing Detroit

Site Name:	KGD Farms		
Site Address:			
Contact:			
Contact Phone #:			
HOBO Diver S/N:			
Launch Date:			
Volume of Reservoir:	27 gal.		
Shape of Reservoir:	Rectangle		
	L	W	H
Dimensions (in.)	28.55	21.37	19.50
Dimensions (ft.)	2.38	1.78	1.63
Area, W x L, (sq.ft.)	4.24		


Erskine St
Orleans St
Keep Growing Detroit Farm
Study Area
© 2019 Google

KGD Tote #1 - Underdrain w/ Liner - Field Sheet

Date	Time On Site	Time Off Site	Depth of Reservoir (ft.)	Depth from top of Res. to Water Surface (ft.)	Depth of Water (ft.)	Volume (gal.)	Notes
6/7/2020	1:14 PM	1:32 PM	1.63	1.63	0.00	0.00	Diver set to start recording at 12:00 AM on 6/8/20.
7/19/2020	12:16 PM	1:08 PM	1.63	1.34	0.29	9.24	Diver set to start recording at 3:00 PM on 7/19/20.
8/30/2020	2:51 PM	3:24 PM	1.63	0.51	1.13	35.65	Diver colleced from field. Memory full.

KGD Tote #2 - Underdrain w/o Liner - Field Sheet

Date	Time On Site	Time Off Site	Depth of Reservoir (ft.)	Depth from top of Res. to Water Surface (ft.)	Depth of Water (ft.)	Volume (gal.)	Notes
6/7/2020	1:14 PM	1:32 PM	1.63	1.63	0.00	0.00	Diver set to start recording at 12:00 AM on 6/8/20.
7/19/2020	12:16 PM	1:08 PM	1.63	0.88	0.75	23.77	Diver set to start recording at 3:00 PM on 7/19/20.
8/30/2020	2:51 PM	3:24 PM	1.63	0.55	1.08	34.33	Diver colleced from field. Memory full.

Location: Keep Growing Detroit
Test Date: 8/22/2020
Time Start: 4:30 PM
Time Stop: 5:30 PM
Duration (hour): 1.00
Application Area (sq.ft.): 27
Rainfall Depth (in.): 11.08
Plot #1 or 2: #1 (underdrain with liner)
Reservoir Type: 27 Gallon Husky Tote
Dimensions of Reservoir

L	W	H
23.5	14.5	13.00
1.96	1.21	1.08

Runoff Volume

97.35gal.

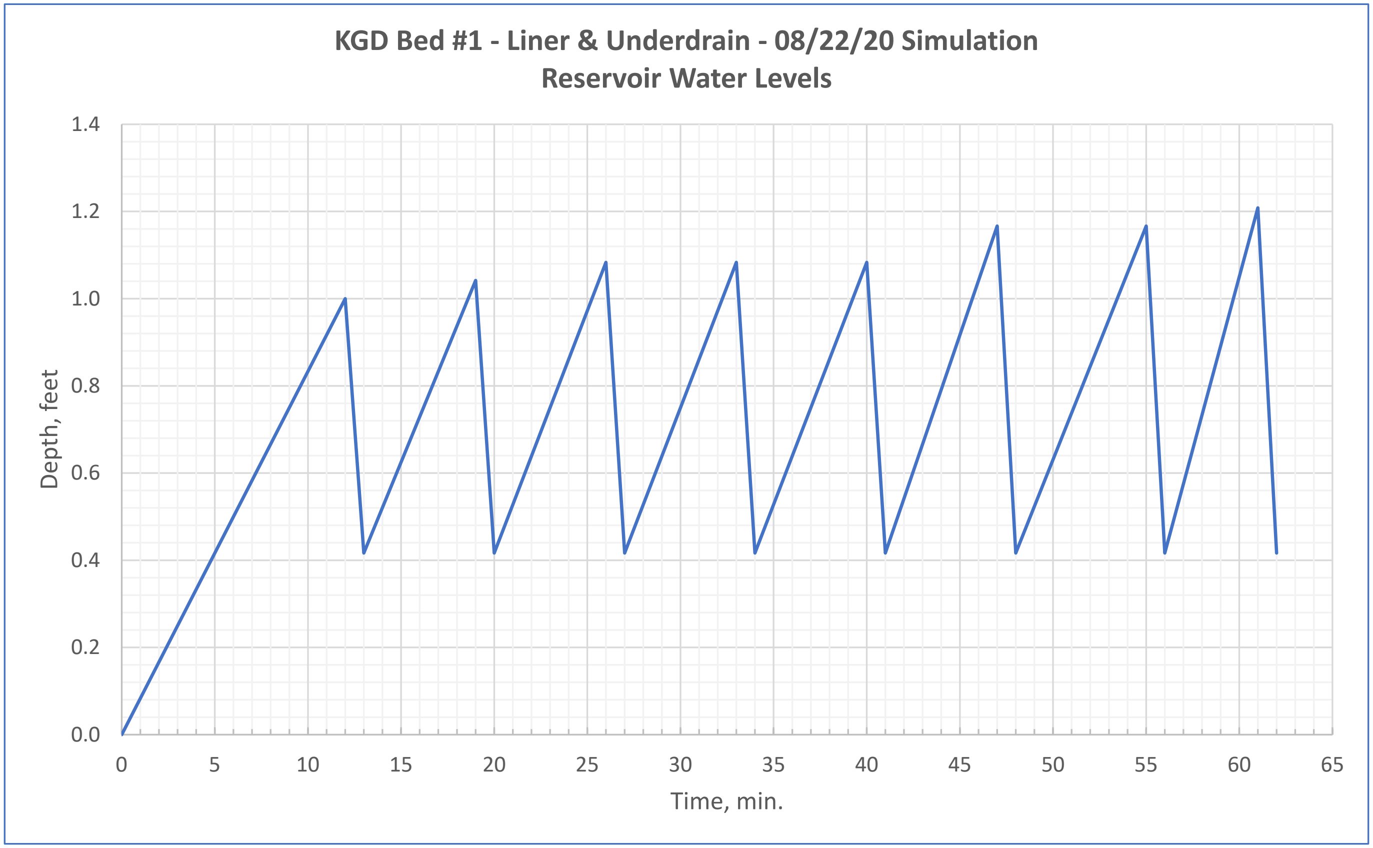
$$Precipitation\ Depth\ (in.) = \frac{Volume\ Applied\ (cu.ft.)}{Aplication\ Area\ (sq.ft.)} * 12$$

Application Area (sq. ft.)	27
Volume Applied (gal.)	186.1
1 gal =0.134 cu.ft.	
Volume Applied (cu. ft.)	24.94
Precipitation Depth (in.)	**11.08**

Time, T (HH:MM)	Time, T (min.)	V_{BATCH} (GPI Meter) (gal.)	Applied Volume, V (gal.)	Application Rate, Q_{app} (gal./min.)	Depth of Water Observed in Tote (in.)	Depth of Water Observed in Tote (ft.)	ΔH (ft.)	Runoff Volume (gal.)	Notes:
4:30 PM	0	0	0.0	-	-	-	-	-	Water on. Approx. 1" of water in tote prior to starting simulation.
4:35 PM	5	20	20.0	4.00	-	-	-	-	Flow into reservoir noted.
4:40 PM	10	36.3	16.3	3.26	-	-	-	-	
4:42 PM	12	-	-	-	12.0	1.00	0.58	10.33	Pump on
4:43 PM	13	-	-	-	5.0	0.42			Pump off
4:45 PM	15	50.2	13.9	2.78	-	-	-	-	
4:49 PM	19	-	-	-	12.5	1.04	0.63	11.06	Pump on
4:50 PM	20	64.4	14.2	2.84	5.0	0.42			Pump off
4:55 PM	25	78.5	14.1	2.82	-	-	-	-	
4:56 PM	26	-	-	-	13.0	1.08	0.67	11.80	Pump on
4:57 PM	27	-	-	-	5.0	0.42			Pump off
5:00 PM	30	94.3	15.8	3.16	-	-	-	-	
5:03 PM	33	-	-	-	13.0	1.08	0.67	11.80	Pump on
5:04 PM	34	-	-	-	5.0	0.42			Pump off
5:05 PM	35	108.1	13.8	2.76	-	-	-	-	
5:10 PM	40	122	13.9	2.78	13.0	1.08	0.67	11.80	Pump on
5:11 PM	41	-	-	-	5.0	0.42			Pump off
5:15 PM	45	136.9	14.9	2.98	-	-	-	-	
5:17 PM	47	-	-	-	14.0	1.17	0.75	13.28	Pump on
5:18 PM	48	-	-	-	5.0	0.42			Pump off
5:20 PM	50	153.8	16.9	3.38	-	-	-	-	
5:25 PM	55	170.3	16.5	3.30	14.0	1.17	0.75	13.28	Pump on
5:26 PM	56	-	-	-	5.0	0.42			Pump off
5:30 PM	60	186.1	15.8	3.16	-	-	-	-	Water off.
5:31 PM	61	-	-	-	14.5	1.21	0.79	14.01	
5:32 PM	62	-	-	-	5.0	0.42			

Additional Simulation Notes:

- Diver margin of error = ±.04’ or 13 gal.
- Diver was not logging during the time of simulation.
- 90 F, clear; wind gusty, 7-10 mph.
- Chard growing in bed (harvestable).
- 9.2 gal. was applied to test area prior to simulation for nozzle and fitting adjustment.



Note: Issue with diver deployment resulted in no data being collected during simulation.

Location: Keep Growing Detroit
Test Date: 8/22/2020
Time Start: 11:25 AM
Time Stop: 12:25 PM
Duration (hour): 1.00
Application Area (sq.ft.): 27
Rainfall Depth (in.): 11.93
Plot #1 or 2: #2 (underdrain without liner)
Reservoir Type: 27 gal. Husky Tote
Dimensions of Reservoir

L	W	H
23.5	14.5	13.00
1.96	1.21	1.08

Runoff Volume

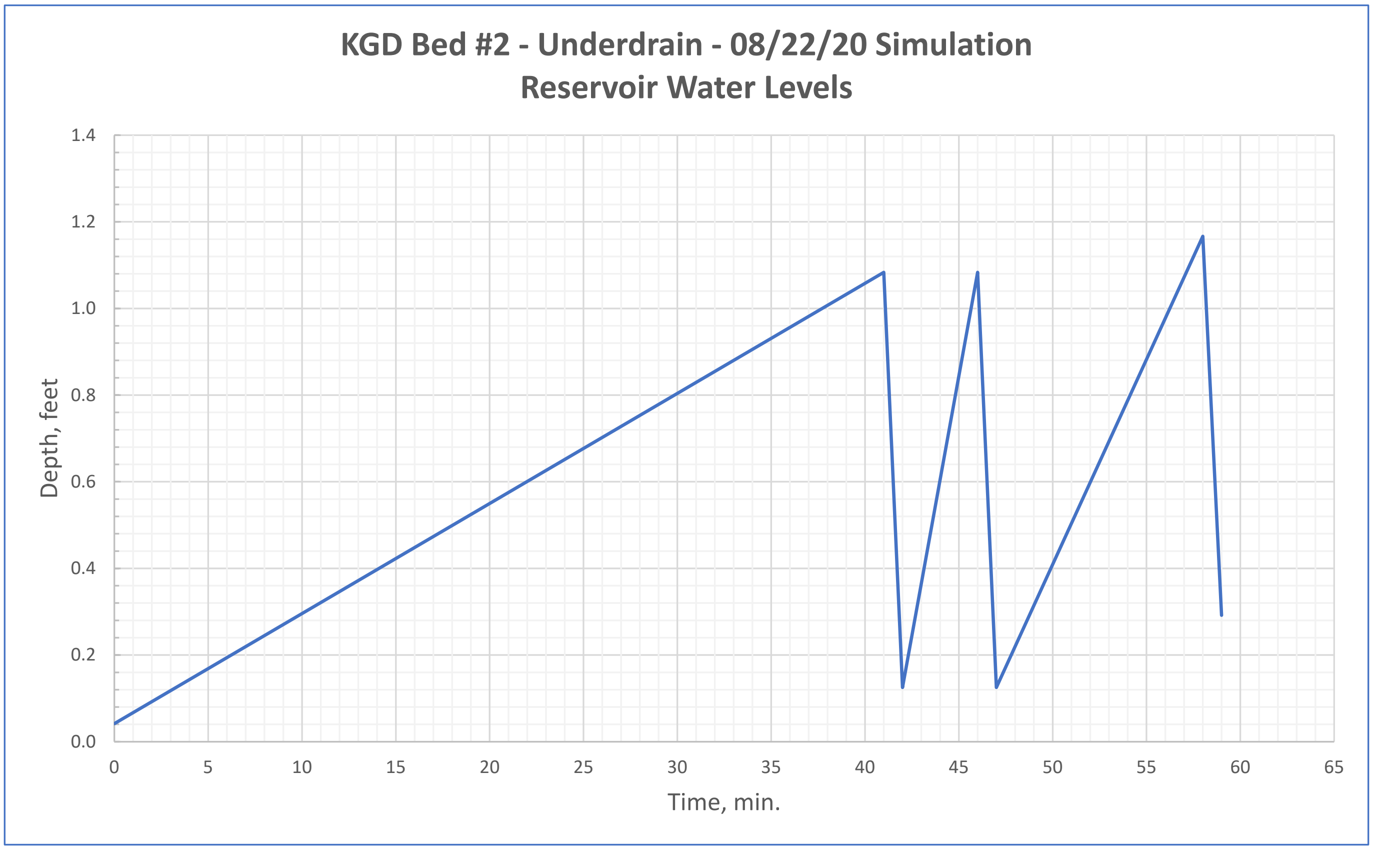
49.41gal.

Application Area (sq. ft.)	27
Volume Applied (gal.)	200.4
1 gal =0.134 cu.ft.	
Volume Applied (cu. ft.)	26.85
Precipitation Depth (in.)	**11.93**

Time, T (HH:MM)	Time, T (min.)	V_{BATCH} (GPI Meter) (gal.)	Applied Volume, V (gal.)	Application Rate, Q_{app} (gal./min.)	Depth of Water Observed in Tote (in.)	Depth of Water Observed in Tote (ft.)	ΔH (ft.)	Runoff Volume (gal.)	Notes:
11:25 AM	0	0	0.0		-	-	-	-	Water on. Approx. 0.5" of water in tote prior to starting simulation.
11:30 AM	5	20.3	20.3	4.06	-	-	-	-	At T =7 min. water drips from underdrain into reservoir.
11:35 AM	10	38.9	18.6	3.72	-	-	-	-	At T=11 min. steady flow from underdrain to reservoir.
11:40 AM	15	59.1	20.2	4.04	-	-	-	-	
11:45 AM	20	63.4	4.3	0.86	-	-	-	-	Drip irrigation for the farm turned on at T=20 min.and turned off at T=22 min .
11:50 AM	25	75.3	11.9	2.38	-	-	-	-	Seepage of water from base of reservoir excavation sidewalls begins.
11:55 AM	30	91.9	16.6	3.32	-	-	-	-	
12:00 PM	35	109.5	17.6	3.52	-	-	-	-	Seepage of water from sidewalls continues.
12:05 PM	40	126	16.5	3.30	-	-	-	-	
12:06 PM	41	-	-	-	13.0	1.08	0.96	16.96	
12:07 PM	42	-	-	-	1.5	0.13			
12:10 PM	45	145.3	19.3	3.86	-	-	-	-	
12:11 PM	46	-	-	-	13.0	1.08	0.96	16.96	
12:12 PM	47	-	-	-	1.5	0.13			
12:15 PM	50	162.6	17.3	3.46	-	-	-	-	Seepage rate of water from sidewalls increasing.
12:20 PM	55	181.4	18.8	3.76	-	-	-	-	
12:23 PM	58	-	-	-	14.0	1.17	0.88	15.49	
12:24 PM	59	-	-	-	3.5	0.29			
12:25 PM	60	200.4	19.0	3.80	-	-	-	-	Water off.

Additional Simulation Notes:

- Diver margin of error = ±.04’ or 13 gal.
- Diver was not logging during the time of simulation.
- 98 F, clear; wind gusty, 7-10 mph.
- Chard growing in bed (harvestable).
- 4.0 gal. was applied to test area prior to simulation for nozzle and fitting adjustment.



Note: Issue with diver deployment resulted in no data being collected during simulation.

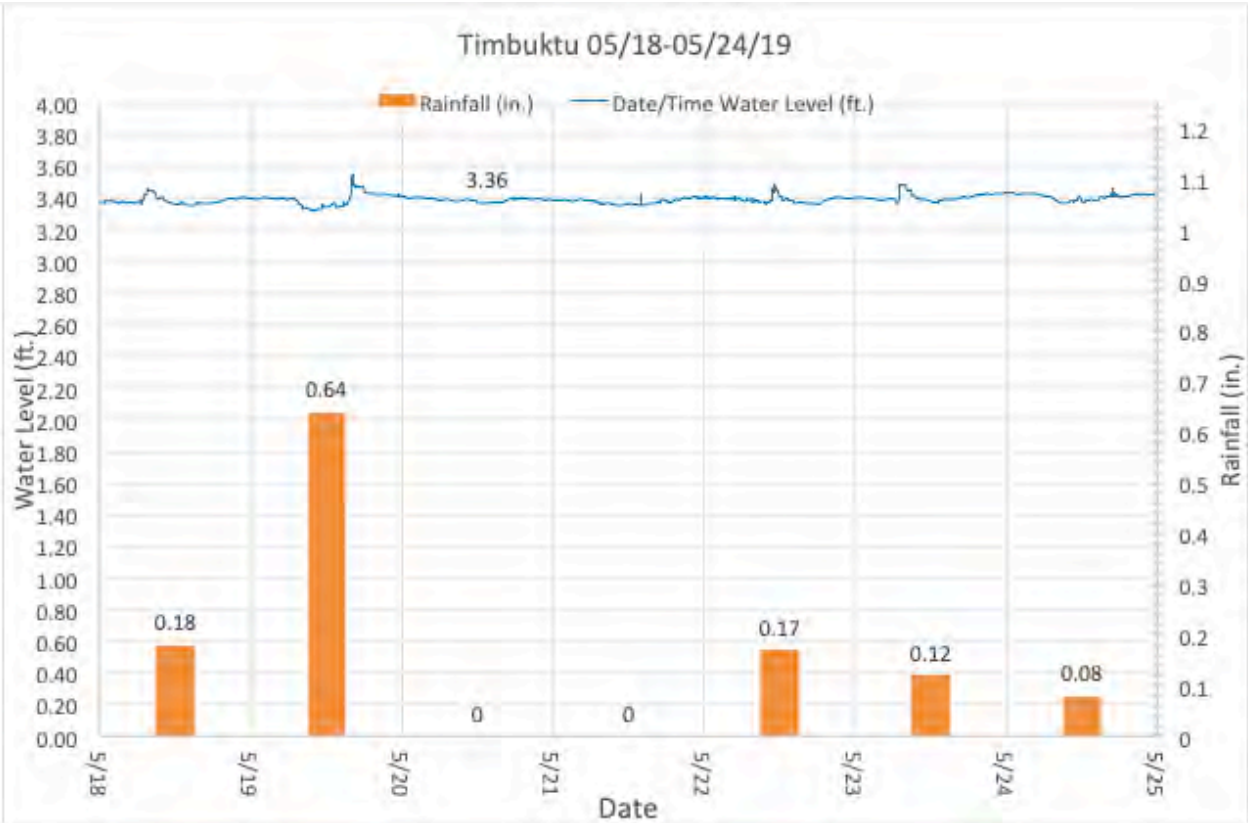
2020 Keep Growing Detroit - Site Runoff Simulation Summary Sheet

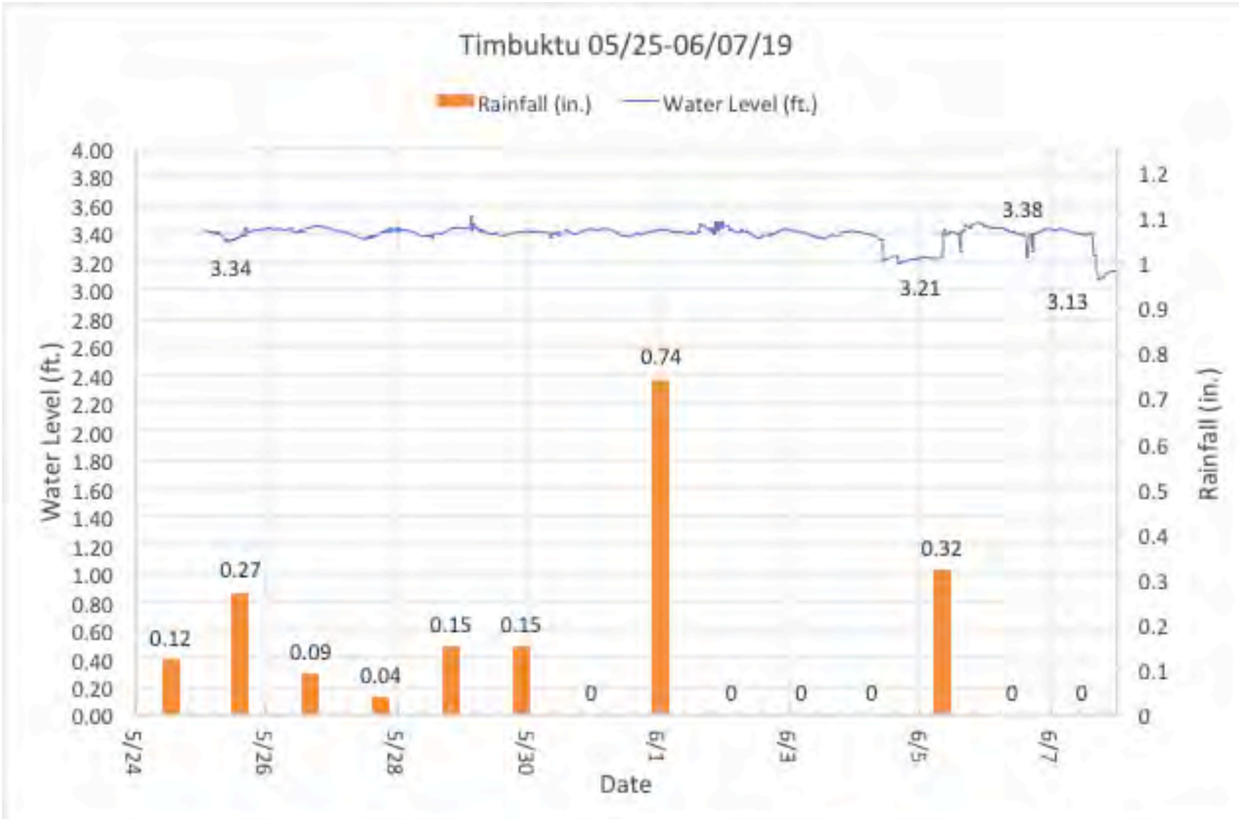
Test #	Date	Lot ID	Plot #	Plot Description	Duration of Test (hr.)	Rainfall Depth Applied (in.)	Averagre Flowrate (gpm.)	Total Volume Applied (gal.)	Total Volume Runoff (gal.)	Ratio Water Off V.S. Water On	Plot Dimensions (ft.)		Application Area (sq.ft.)
1	7/25/2020	Earthworks	1	Sheetflow	4	21.60	8.41	2019	13.4	0.01	10	15	150
2	7/31/2020	OAUF	1	Sheetflow	4	15.73	6.11	1467	2.57	0.00	10	15	150
3	8/1/2020	OAUF	2	Sheetflow	3.75	14.42	5.98	1345	0.17	0.35	10	15	150
				Underdrain					247.36				
4	8/22/2020	KGD	1	Underdrain w/Liner	1	11.08	3.1	186	97.35	0.52	3	9	27
5		KGD	2	Underdrain w/o Liner	1	11.93	3.34	200	49.41	0.25	3	9	27

Attachment C – Rainwater Harvesting Data

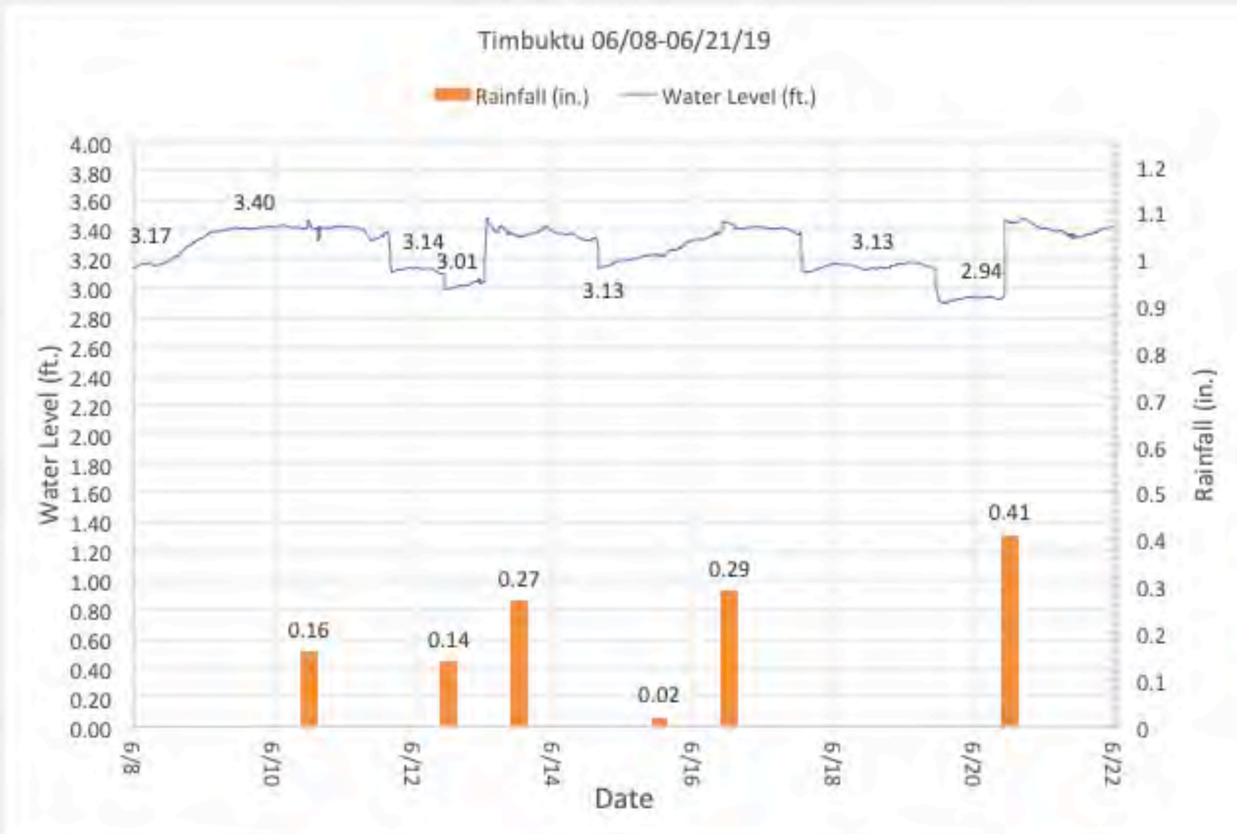
2 Totes in Series:

(3.34 ft.-2.11 ft.) x 12.14 sq.ft. x 7.48 gal./cu.ft. = 111.7gal.
Therefore: 111.7 gal./tote x 2 = 223.4 gal. Harvested


Timbuktu 05/18-05/24/19
Rainfall (in.)
Date/Time Water Level (ft.)
Water Level (ft.)
Rainfall (in.)
4.00
3.80
3.60
3.40
3.20
3.00
2.80
2.60
2.40
2.20
2.00
1.80
1.60
1.40
1.20
1.00
0.80
0.60
0.40
0.20
0.00
1.2
1.1
1
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
3.36
0.18
0.64
0
0
0.17
0.12
0.08
5/18
5/19
5/20
5/21
5/22
5/23
5/24
5/25
Date



2 Totes in Series:
(3.38 ft.-3.21 ft.) x 12.14 sq.ft. x 7.48 gal./cu.ft. x 2 Totes = **30.8 gal. Harvested**

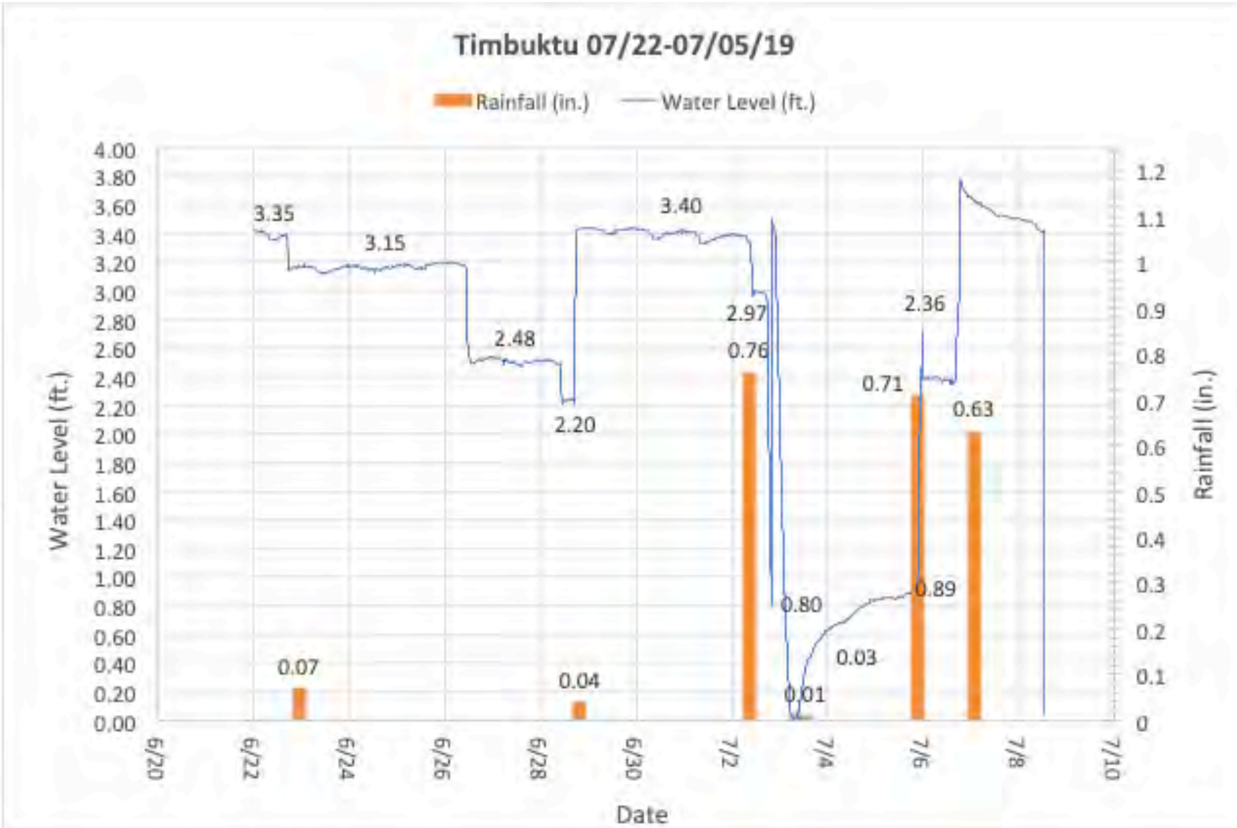


2 Totes in Series:

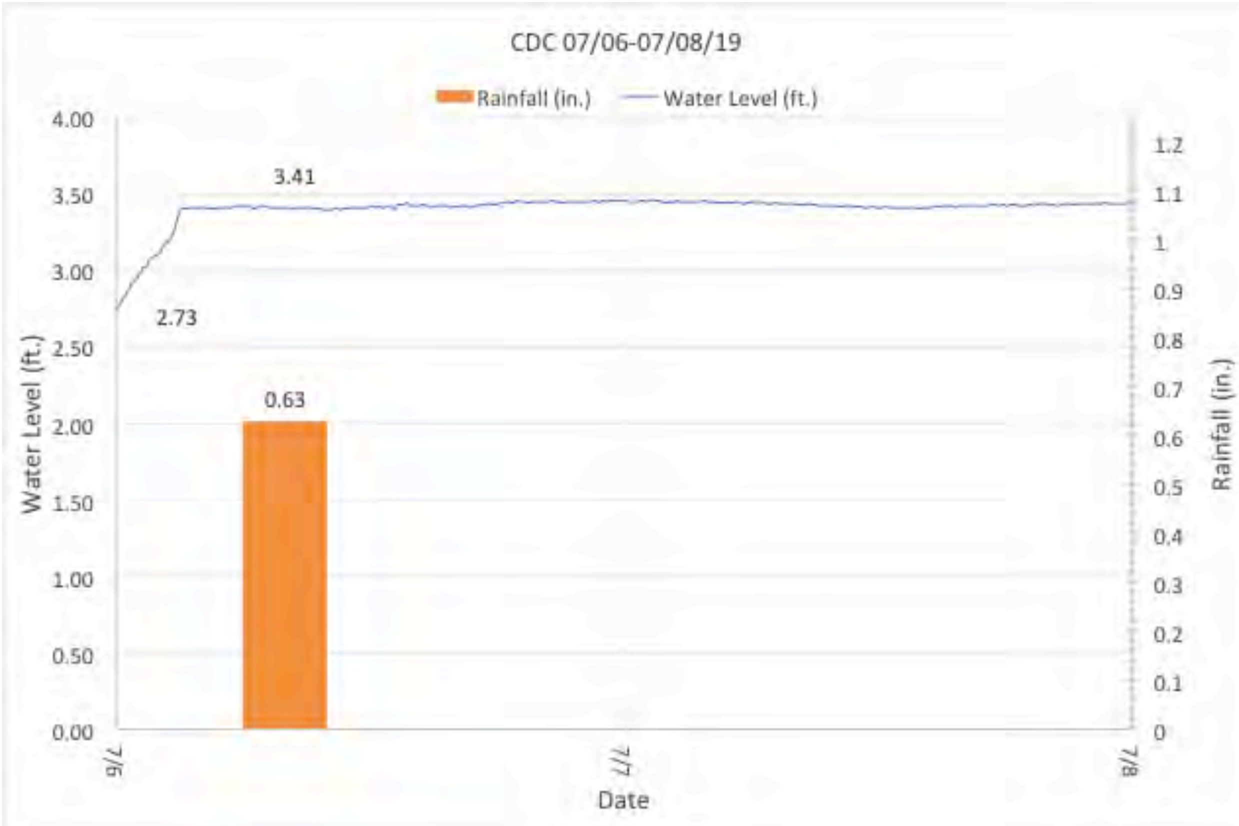
(3.40 ft.-3.01 ft.) x 12.14 sq.ft. x 7.48 gal./cu.ft. = 35.4 gal.
Therefore: 35.4 gal./tote x 2 = 70.8 gal. Harvested

(3.40 ft.-3.13 ft.) x 12.14 sq.ft. x 7.48 gal./cu.ft. = 49.0 gal.
Therefore: 49.0 gal./tote x 2 = 98.0 gal. Harvested

(3.40 ft.-2.94 ft.) x 12.14 sq.ft. x 7.48 gal./cu.ft. = 41.8 gal.
Therefore: 41.8 gal./tote x 2 = 83.6 gal. Harvested

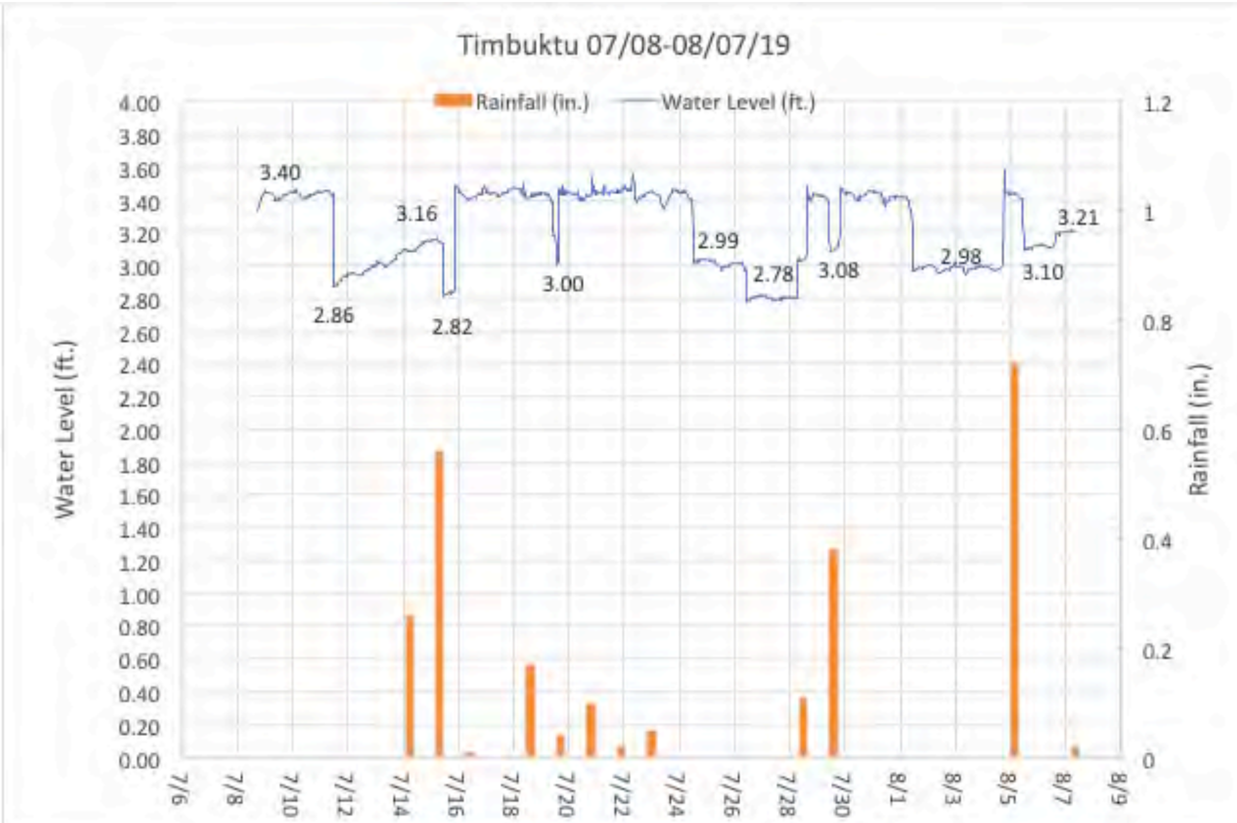


(3.40 ft.-2.20 ft.) x 12.14 sq.ft. x 7.48 gal./cu.ft. x 2 Totes = <u>218.0 gal. Harvested</u>
(3.40 ft.-0.8 ft.) x 12.14 sq.ft. x 7.48 gal./cu.ft. x 2 Totes = <u>472.2 gal. Harvested</u>
(3.40 ft.-0.03 ft.) x 12.14 sq.ft. x 7.48 gal./cu.ft. x 2 Totes = <u>612.0 gal. Harvested</u>

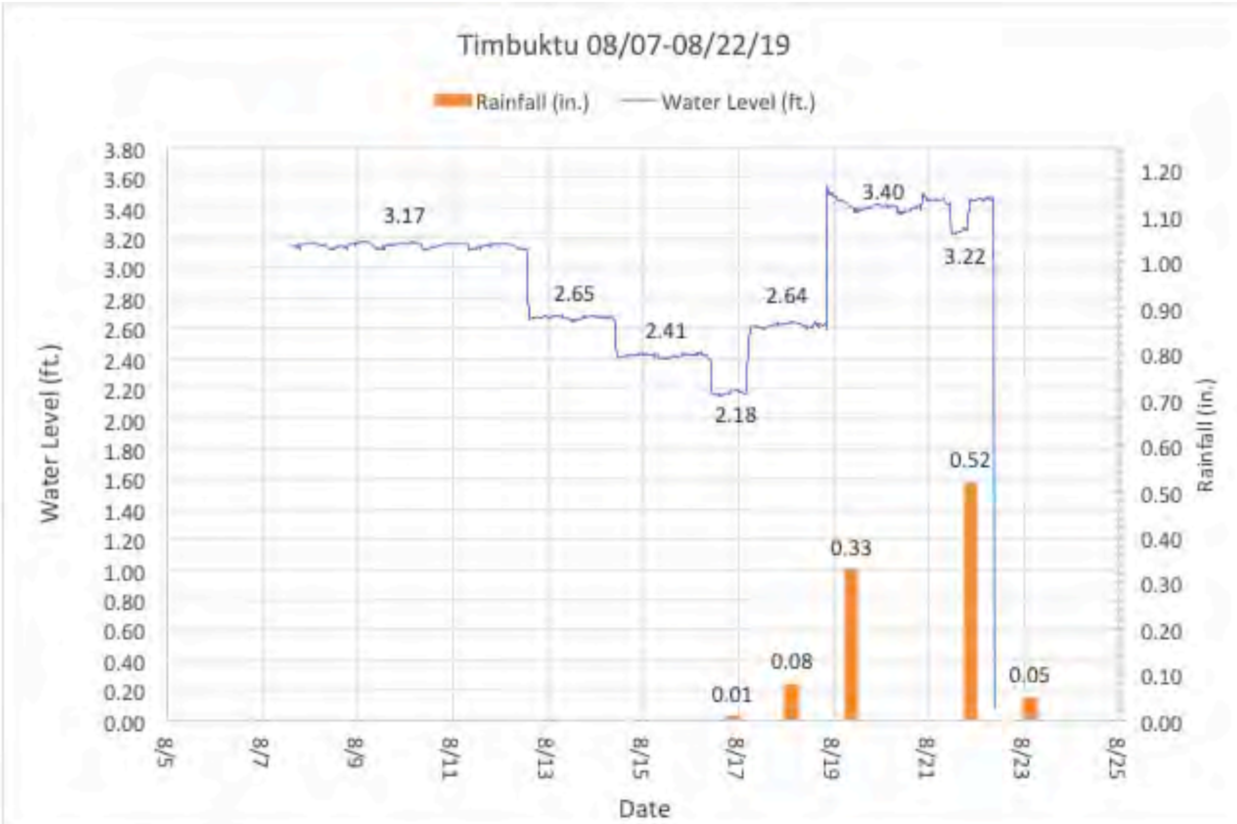


2 Totes in Series:

(3.40 ft.-2.73 ft.) x 12.14 sq.ft. x 7.48 gal./cu.ft. = 60.8 gal.
Therefore: = 60.8 gal./tote x 2 = 121.6 gal. Harvested



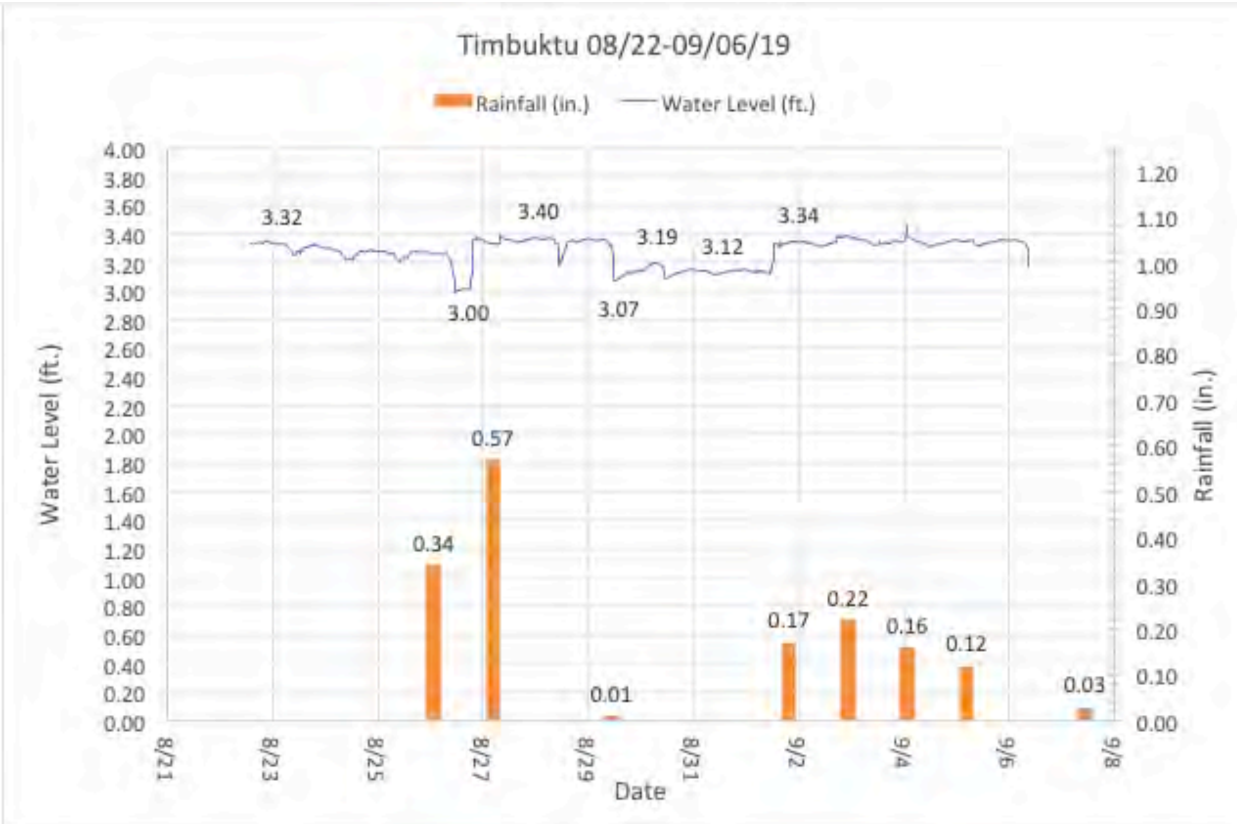
(3.16 ft.-2.86 ft.) x 12.14 sq.ft. x 7.48 gal./cu.ft. x 2 Totes = <u>54.4 gal. Harvested</u>
(3.40 ft.-2.82 ft.) x 12.14 sq.ft. x 7.48 gal./cu.ft. x 2 Totes = <u>105.4 gal. Harvested</u>
(3.40 ft.-3.00 ft.) x 12.14 sq.ft. x 7.48 gal./cu.ft. x 2 Totes = <u>72.6 gal. Harvested</u>
(3.40 ft.-2.78 ft.) x 12.14 sq.ft. x 7.48 gal./cu.ft. x 2 Totes = <u>112.6 gal. Harvested</u>
(3.40 ft.-3.08ft.) x 12.14 sq.ft. x 7.48 gal./cu.ft. x 2 Totes = <u>58.2 gal. Harvested</u>
(3.40 ft.-2.98 ft.) x 12.14 sq.ft. x 7.48 gal./cu.ft. x 2 Totes = <u>76.2 gal. Harvested</u>
(3.21 ft.-3.10ft.) x 12.14 sq.ft. x 7.48 gal./cu.ft. x 2 Totes = <u>20.0 gal. Harvested</u>



2 Totes in Series:

(3.40 ft.-2.18 ft.) x 12.14 sq.ft. x 7.48 gal./cu.ft. = 110.8 gal.
Therefore: = 110.8 gal./tote x 2 = <u>221.6 gal. Harvested</u>

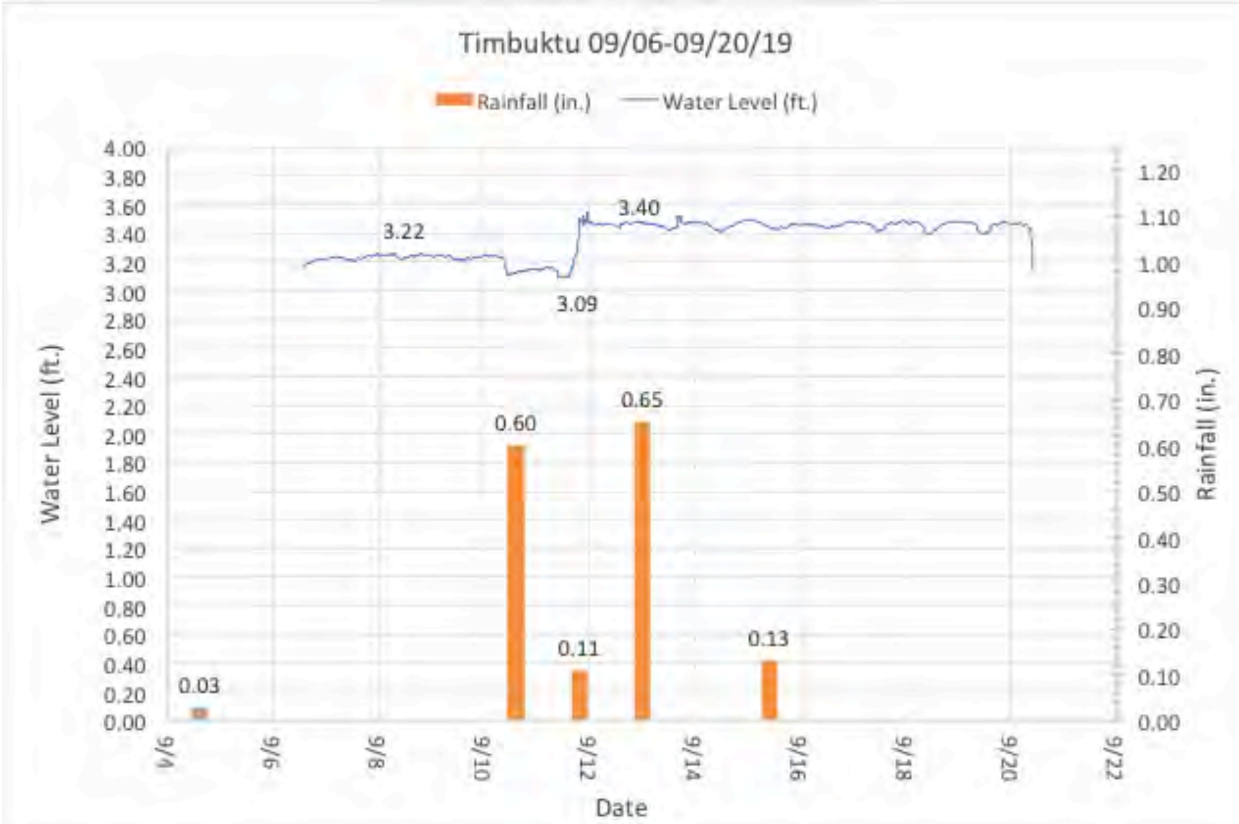
(3.40 ft.-2.22 ft.) x 12.14 sq.ft. x 7.48 gal./cu.ft. = 16.3 gal.
Therefore: = 16.3 gal./tote x 2 = <u>32.6 gal. Harvested</u>



2 Totes in Series:

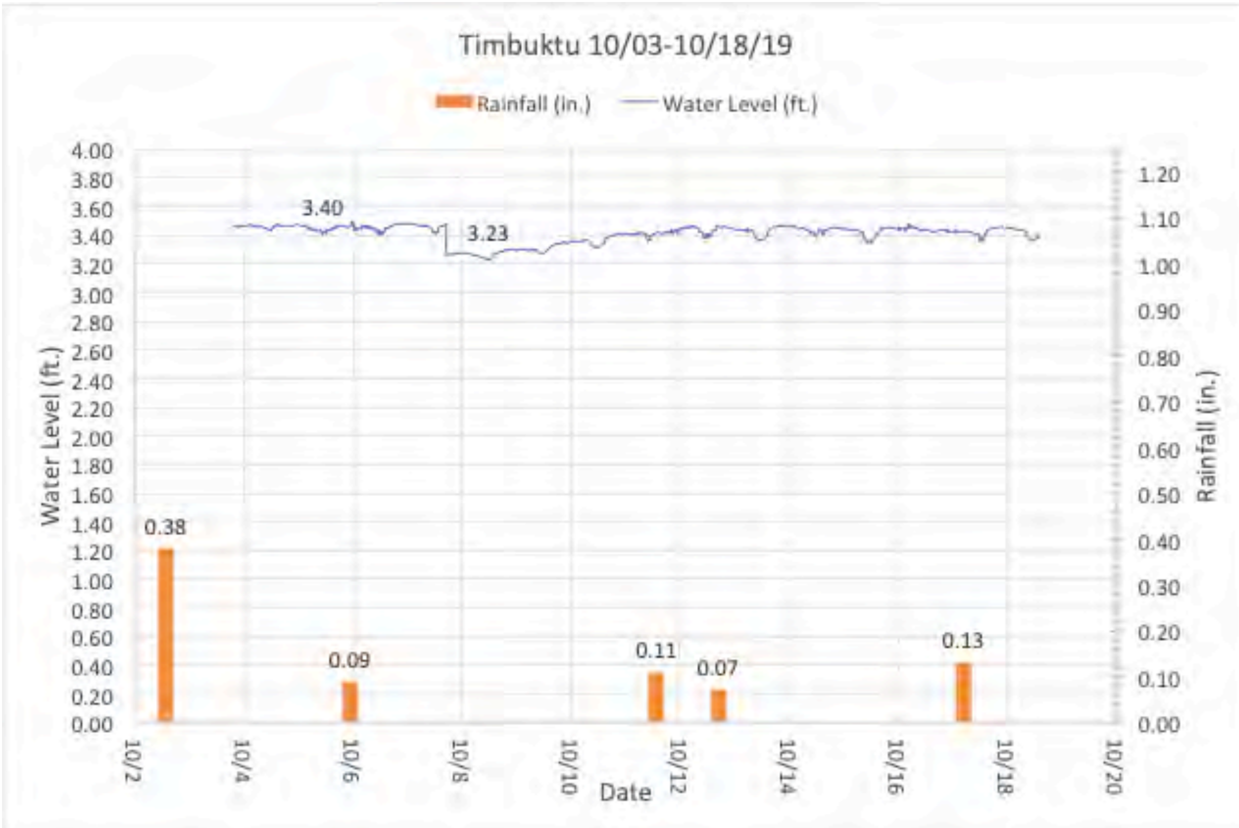
(3.40 ft.-3.00 ft.) x 12.14 sq.ft. x 7.48 gal./cu.ft. = 36.3 gal.
Therefore: = 36.3 gal./tote x 2 = 72.4 gal. Harvested

(3.34 ft.-3.12 ft.) x 12.14 sq.ft. x 7.48 gal./cu.ft. = 20.2 gal.
Therefore: = 20.0 gal./tote x 2 = 40.0 gal. Harvested



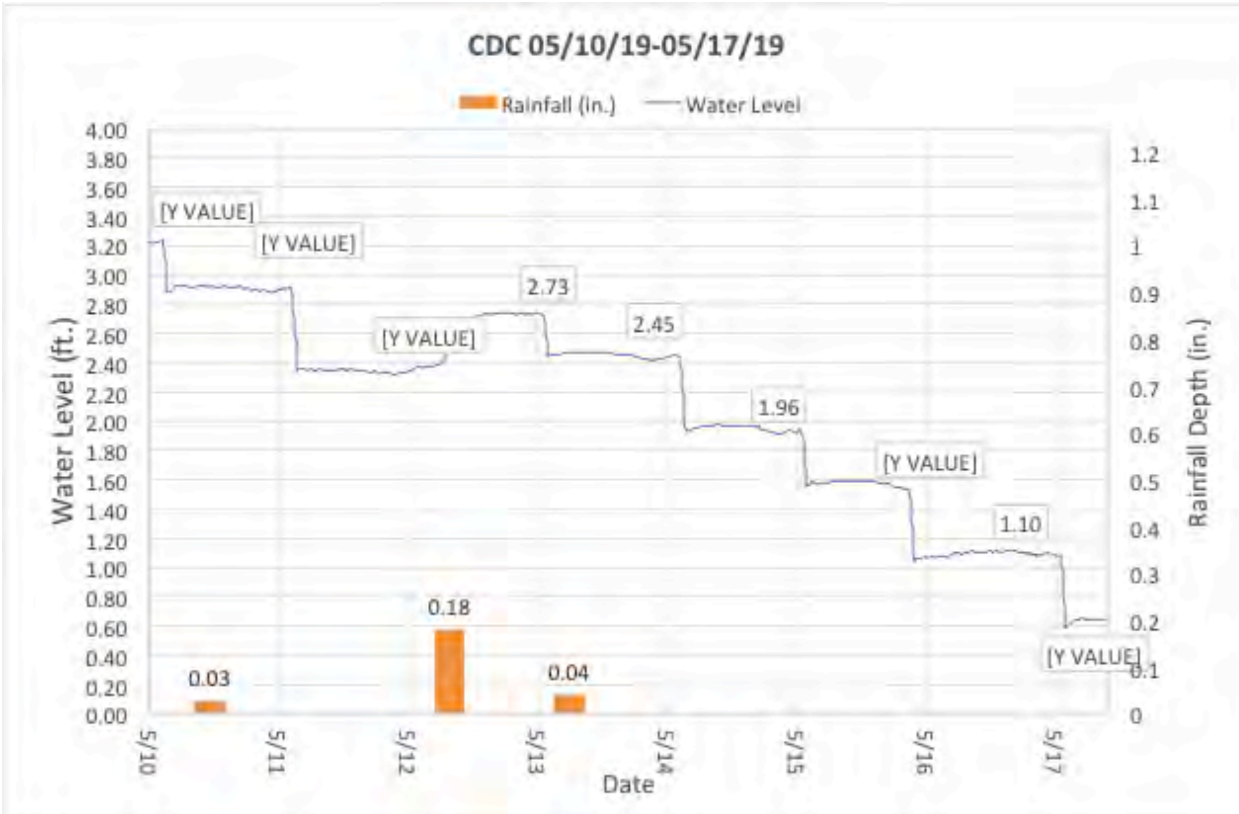
2 Totes in Series:

(3.40 ft.-3.09 ft.) x 12.14 sq.ft. x 7.48 gal./cu.ft. = 28.2 gal.
Therefore: = 28.2 gal./tote x 2 = <u>56.4 gal. Harvested</u>

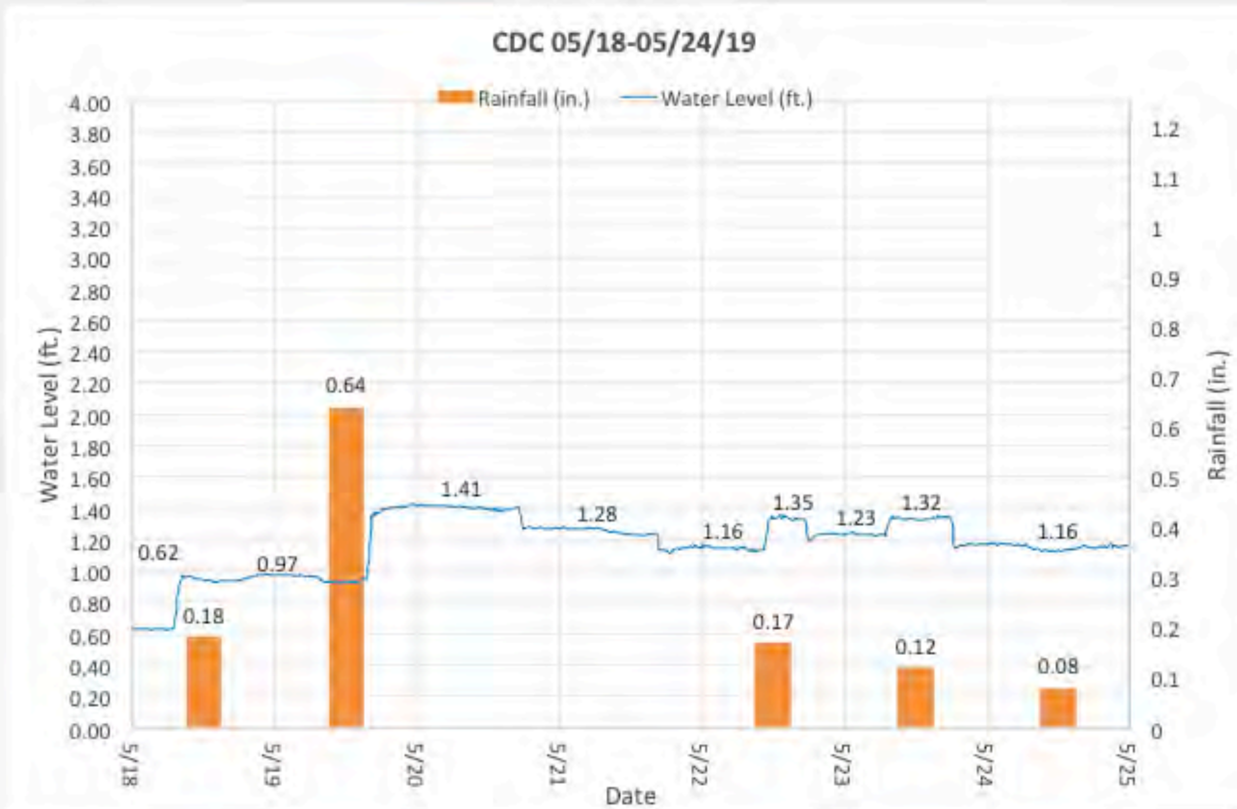


2 Totes in Series:

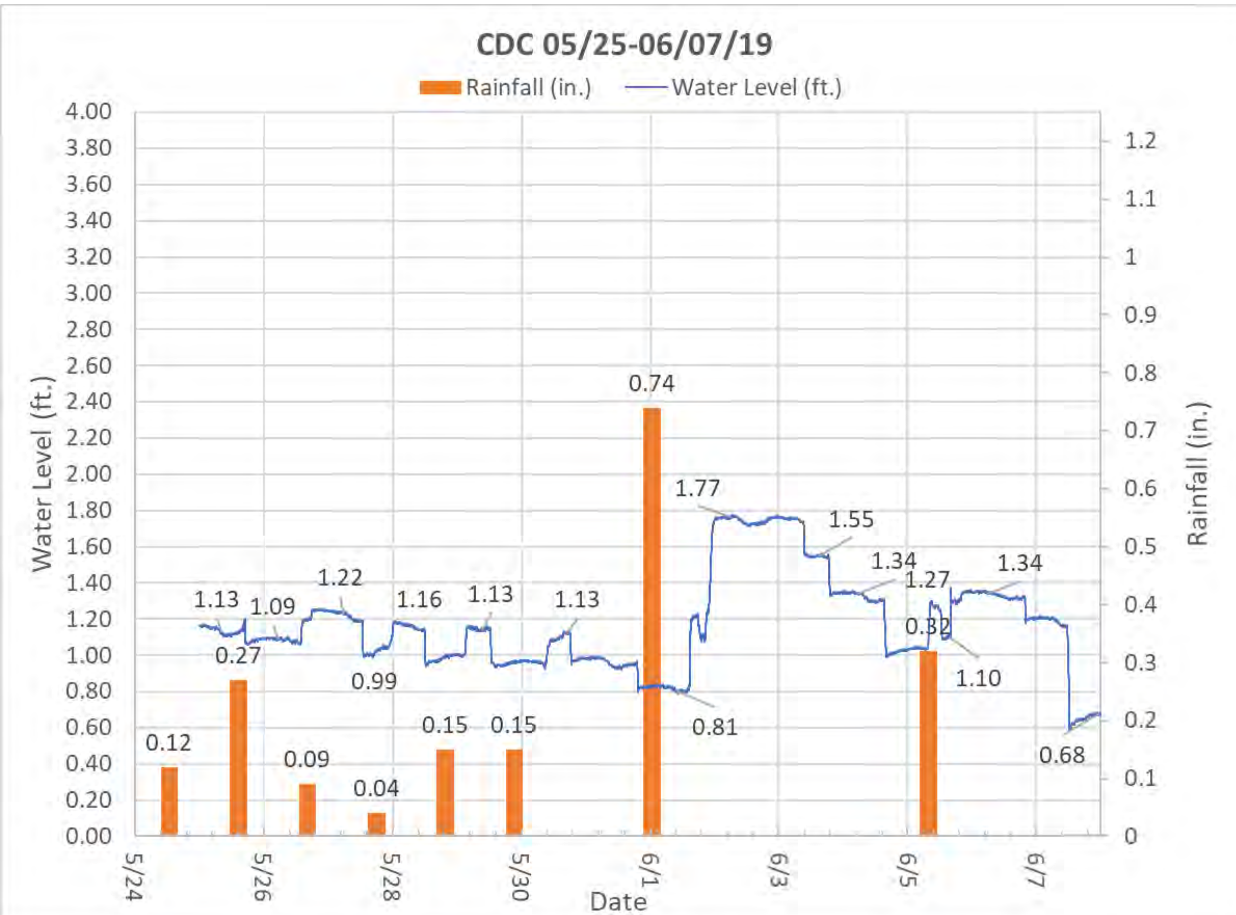
(3.40 ft.-3.23 ft.) x 12.14 sq.ft. x 7.48 gal./cu.ft. = 15.4 gal.
Therefore: = 15.4 gal./tote x 2 = 30.8 gal. Harvested



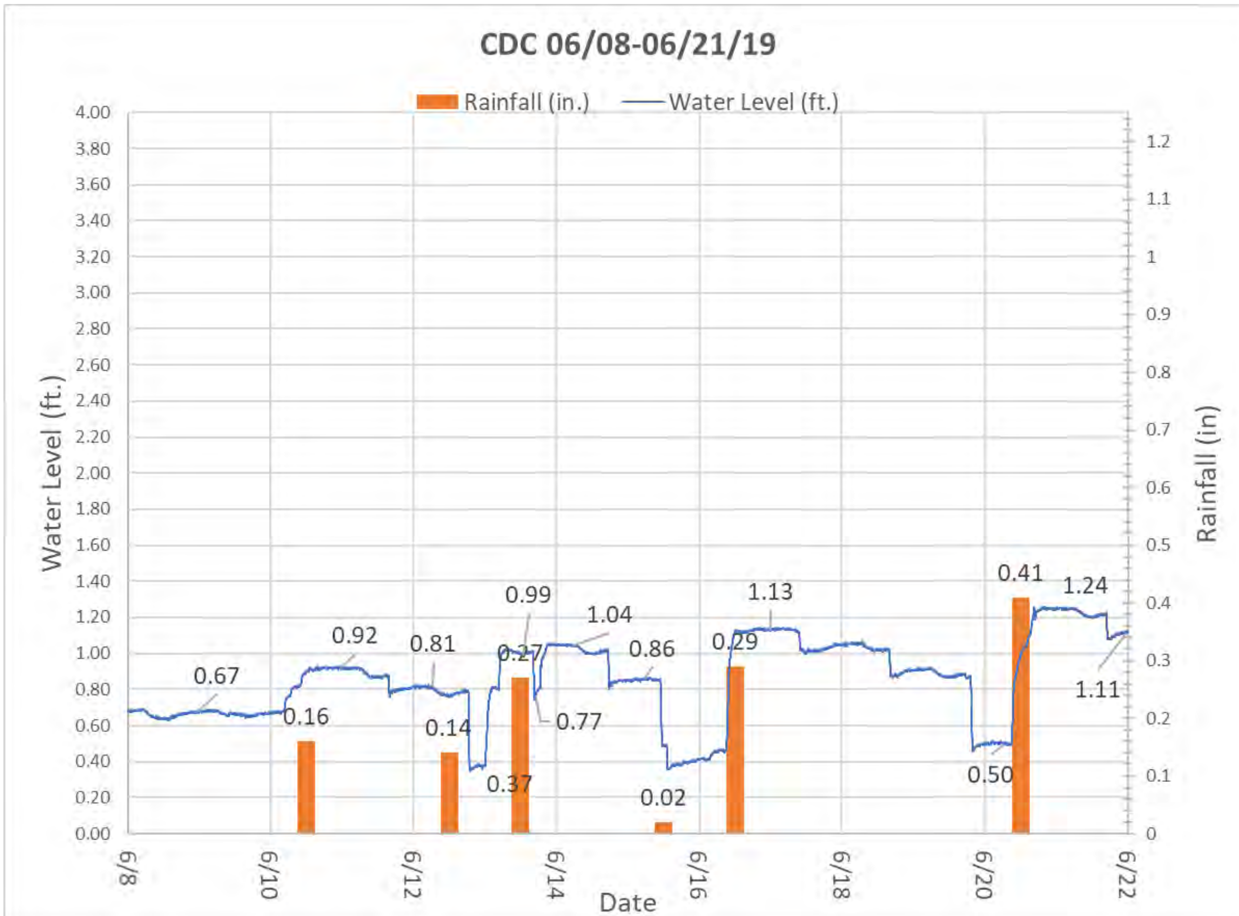
(2.73 ft.-2.33 ft.) x 12.14 sq.ft. x 7.48 gal./cu.ft. x 10 Totes = **363.2 gal. Harvested**



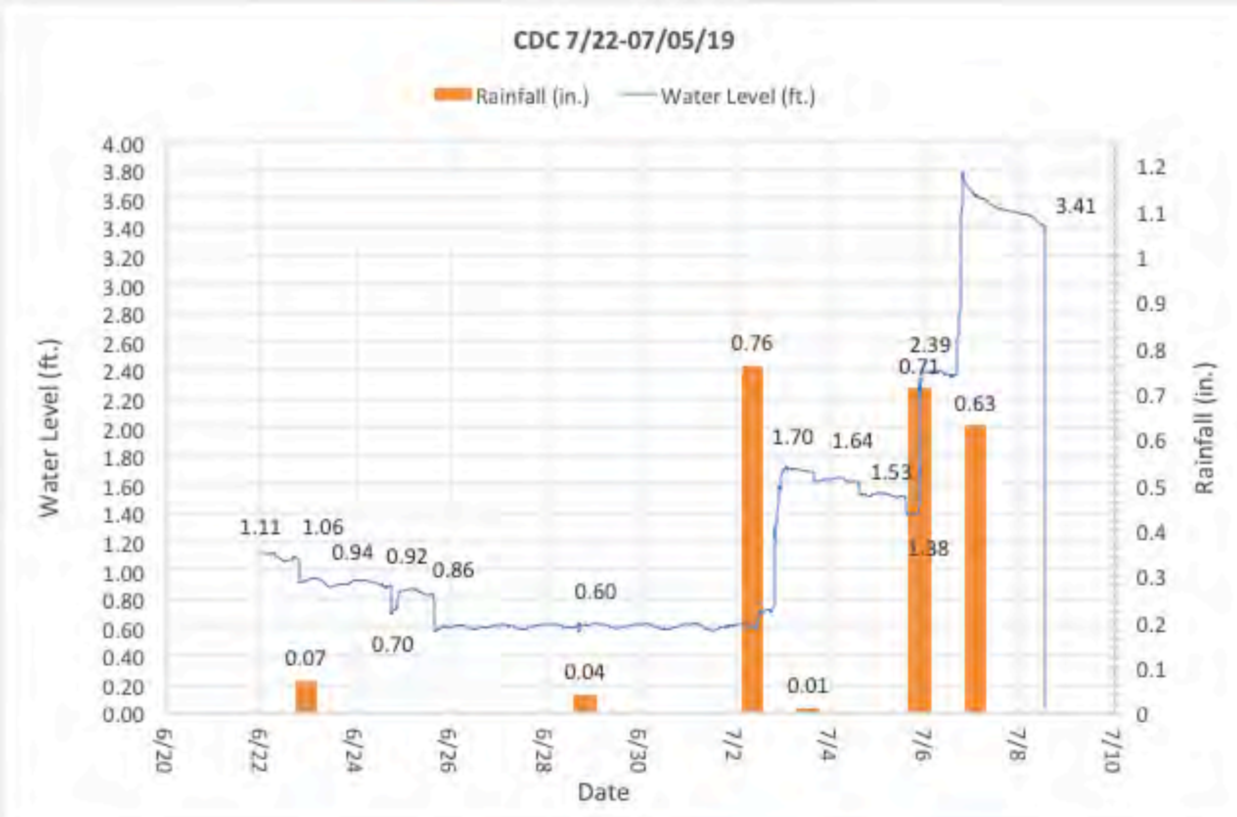
(0.97 ft.-0.62 ft.) x 12.14 sq.ft. x 7.48 gal./cu.ft. x 10 Totes = **317.8 gal. Harvested**
(1.41 ft.-0.97 ft.) x 12.14 sq.ft. x 7.48 gal./cu.ft. x 10 Totes = **399.6 gal. Harvested**
(1.35 ft.-1.16 ft.) x 12.14 sq.ft. x 7.48 gal./cu.ft. x 10 Totes = **172.5 gal. Harvested**
(1.32 ft.-1.23 ft.) x 12.14 sq.ft. x 7.48 gal./cu.ft. x 10 Totes = **81.7 gal. Harvested**



(1.22 ft.-1.09 ft.) x 12.14 sq.ft. x 7.48 gal./cu.ft. x 10 Totes = **118.0 gal. Harvested**
(1.16 ft.-0.99 ft.) x 12.14 sq.ft. x 7.48 gal./cu.ft. x 10 Totes = **154.4 gal. Harvested**
(1.13 ft.-0.99 ft.) x 12.14 sq.ft. x 7.48 gal./cu.ft. x 10 Totes = **127.1 gal. Harvested**
(1.13 ft.-0.99 ft.) x 12.14 sq.ft. x 7.48 gal./cu.ft. x 10 Totes = **127.1 gal. Harvested**
(1.77 ft.-0.81 ft.) x 12.14 sq.ft. x 7.48 gal./cu.ft. x 10 Totes = **871.8 gal. Harvested**
(1.27 ft.-0.99 ft.) x 12.14 sq.ft. x 7.48 gal./cu.ft. x 10 Totes = **254.3 gal. Harvested**
(1.34 ft.-1.10 ft.) x 12.14 sq.ft. x 7.48 gal./cu.ft. x 10 Totes = **217.9 gal. Harvested**



(1.22 ft.-1.09 ft.) x 12.14 sq.ft. x 7.48 gal./cu.ft. x 10 Totes = **118.0 gal. Harvested**
(1.16 ft.-0.99 ft.) x 12.14 sq.ft. x 7.48 gal./cu.ft. x 10 Totes = **154.4 gal. Harvested**
(1.13 ft.-0.99 ft.) x 12.14 sq.ft. x 7.48 gal./cu.ft. x 10 Totes = **127.1 gal. Harvested**
(1.13 ft.-0.99 ft.) x 12.14 sq.ft. x 7.48 gal./cu.ft. x 10 Totes = **127.1 gal. Harvested**
(1.77 ft.-0.81 ft.) x 12.14 sq.ft. x 7.48 gal./cu.ft. x 10 Totes = **871.8 gal. Harvested**
(1.27 ft.-0.99 ft.) x 12.14 sq.ft. x 7.48 gal./cu.ft. x 10 Totes = **254.3 gal. Harvested**
(1.34 ft.-1.10 ft.) x 12.14 sq.ft. x 7.48 gal./cu.ft. x 10 Totes = **217.9 gal. Harvested**

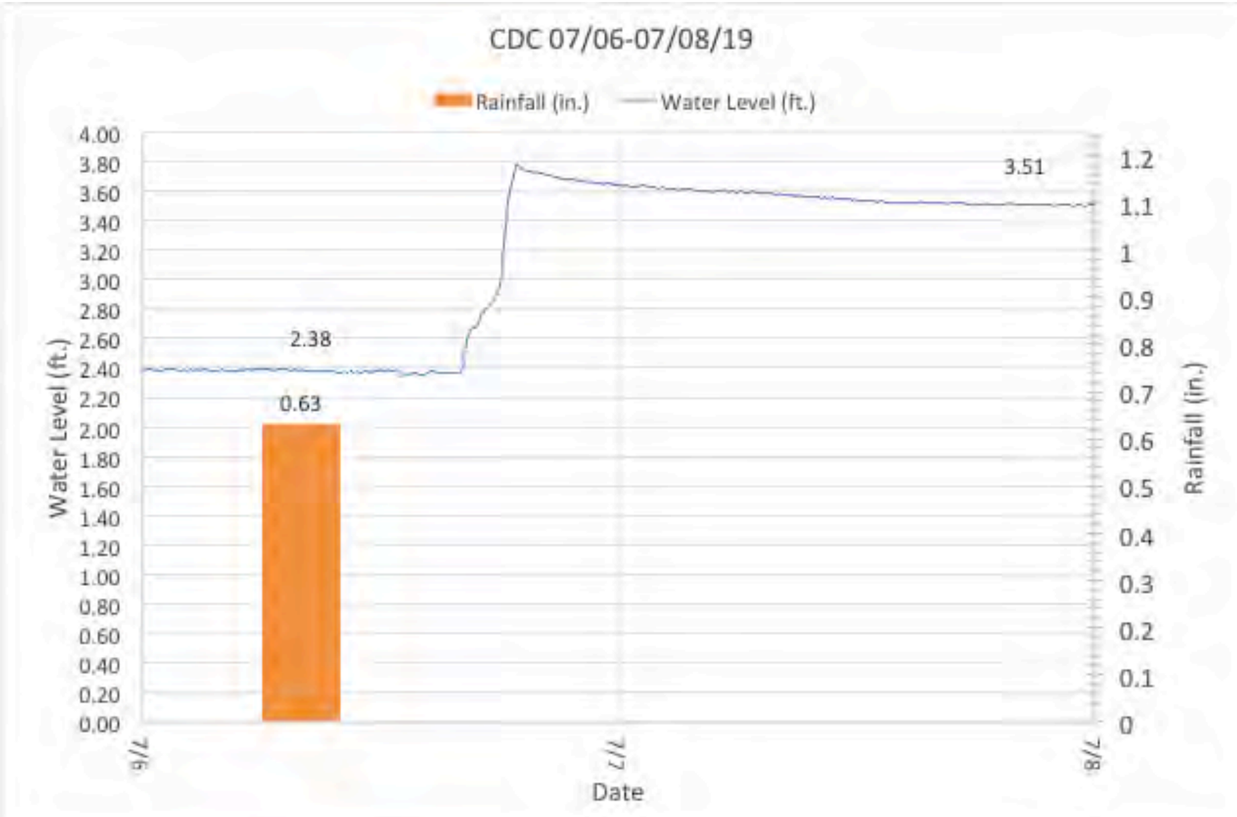


10 Totes in Series:

(0.86 ft.-0.70 ft.) x 12.14 sq.ft. x 7.48 gal./cu.ft. x 10 Totes = 145.3 gal. Harvested

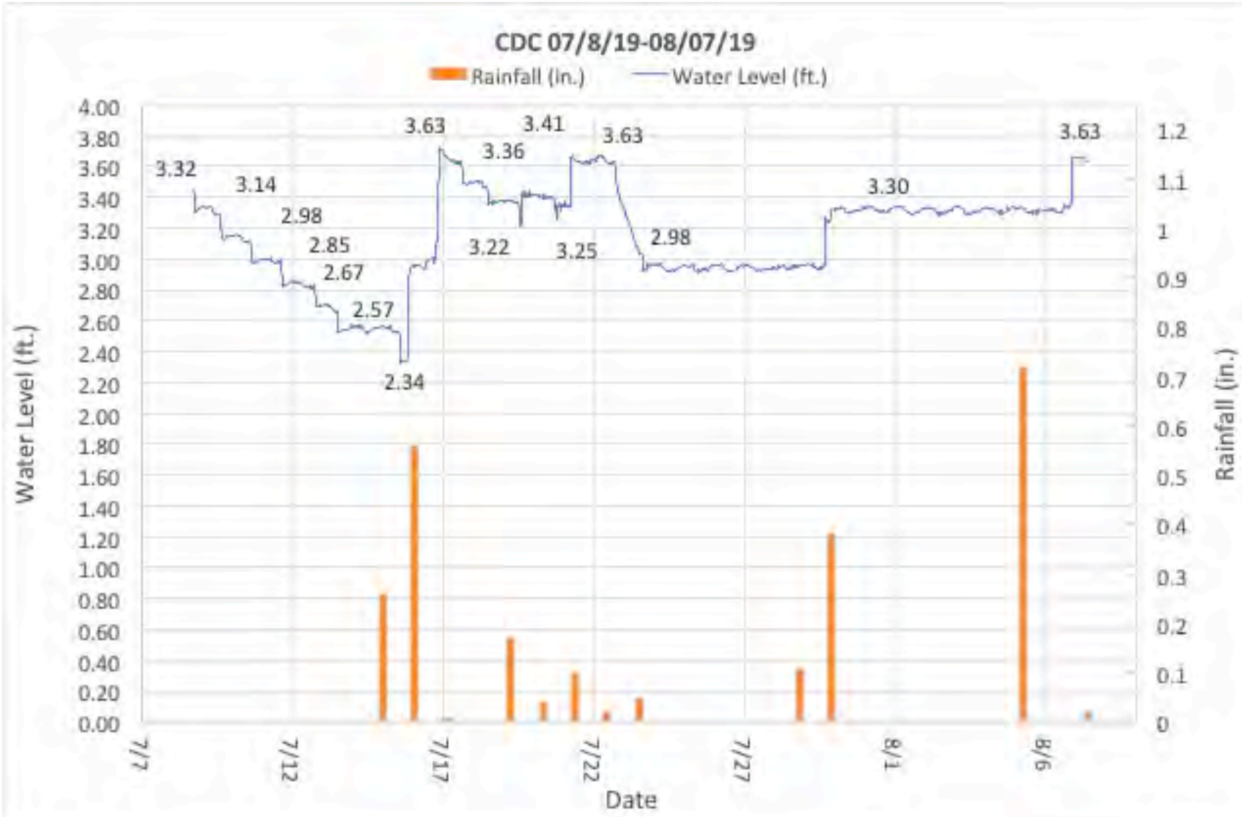
(1.70 ft.-0.60 ft.) x 12.14 sq.ft. x 7.48 gal./cu.ft. x 10 Totes = 998.9 gal. Harvested

(3.41 ft.-1.38 ft.) x 12.14 sq.ft. x 7.48 gal./cu.ft. x 10 Totes = 1843.4 gal. Harvested

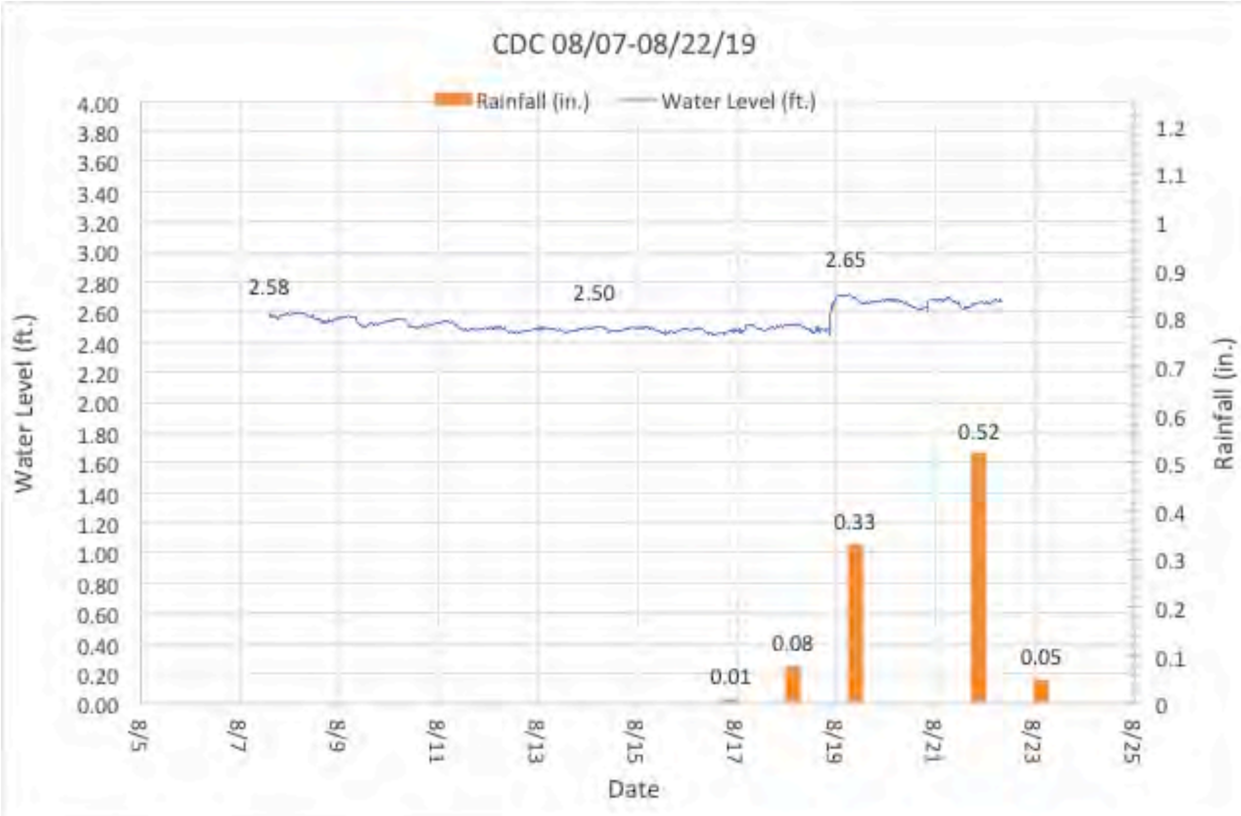


10 Totes in Series:

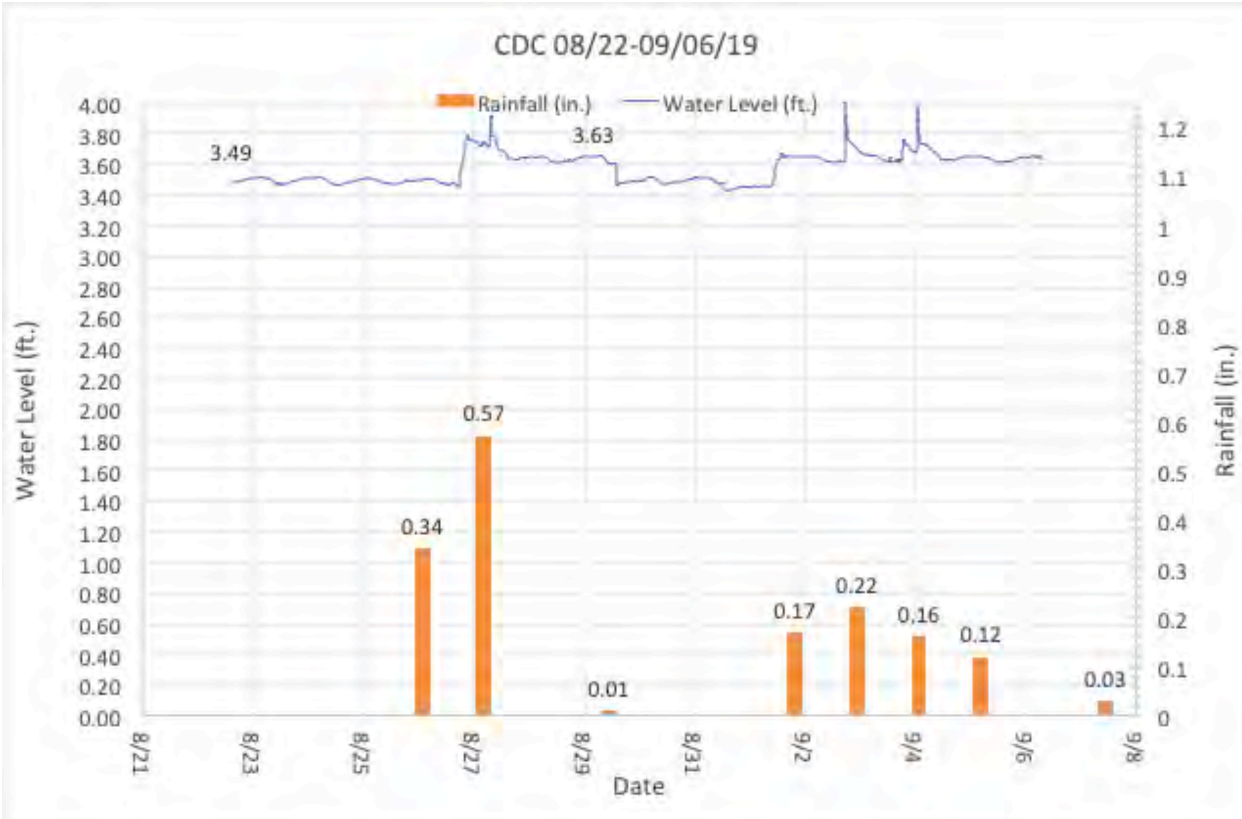
(3.51 ft.-2.38 ft.) x 12.14 sq.ft. x 7.48 gal./cu.ft. x 10 Totes = 1026.1 gal. Harvested



(3.63 ft.-2.34 ft.) x 12.14 sq.ft. x 7.48 gal./cu.ft. x 10 Totes = **1171.4 gal. Harvested**
(3.41 ft.-3.22 ft.) x 12.14 sq.ft. x 7.48 gal./cu.ft. x 10 Totes = **172.5 gal. Harvested**
(3.63 ft.-3.25 ft.) x 12.14 sq.ft. x 7.48 gal./cu.ft. x 10 Totes = **345.1 gal. Harvested**
(3.30 ft.-2.98 ft.) x 12.14 sq.ft. x 7.48 gal./cu.ft. x 10 Totes = **290.6 gal. Harvested**
(3.63 ft.-3.30 ft.) x 12.14 sq.ft. x 7.48 gal./cu.ft. x 10 Totes = **345.1 gal. Harvested**



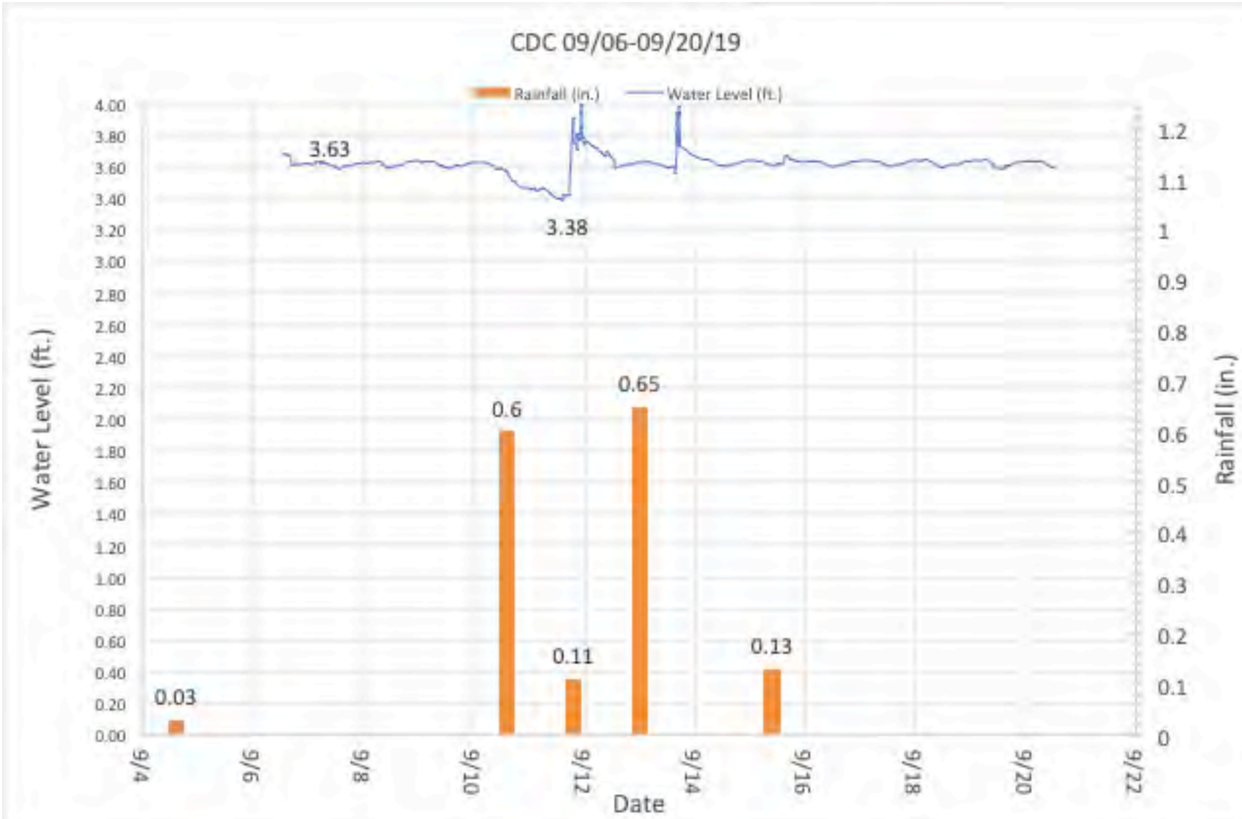
10 Totes in Series:
(2.65 ft.-2.25 ft.) x 12.14 sq.ft. x 7.48 gal./cu.ft. x 10 Totes = 363.2 gal. Harvested



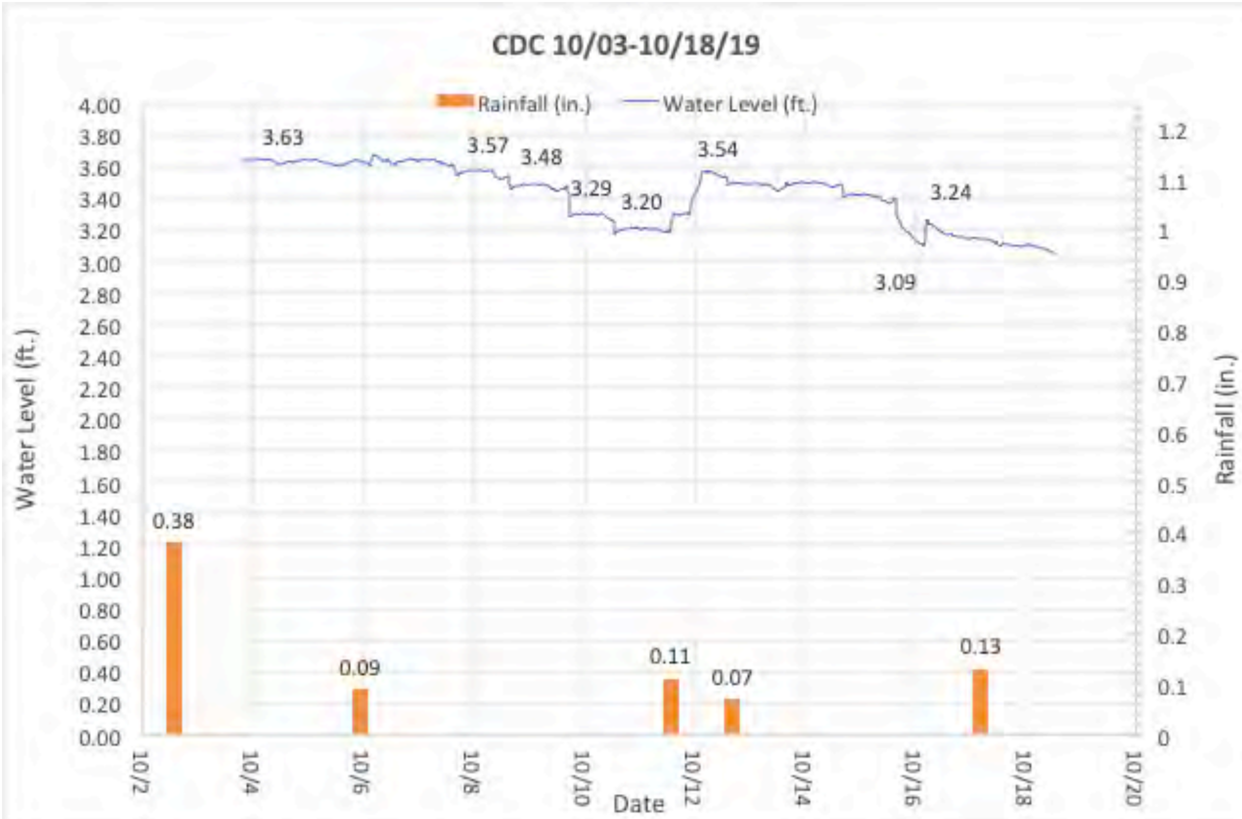
10 Totes in Series:

(3.63 ft.-3.49 ft.) x 12.14 sq.ft. x 7.48 gal./cu.ft. x 10 Totes = 127.1 gal. Harvested

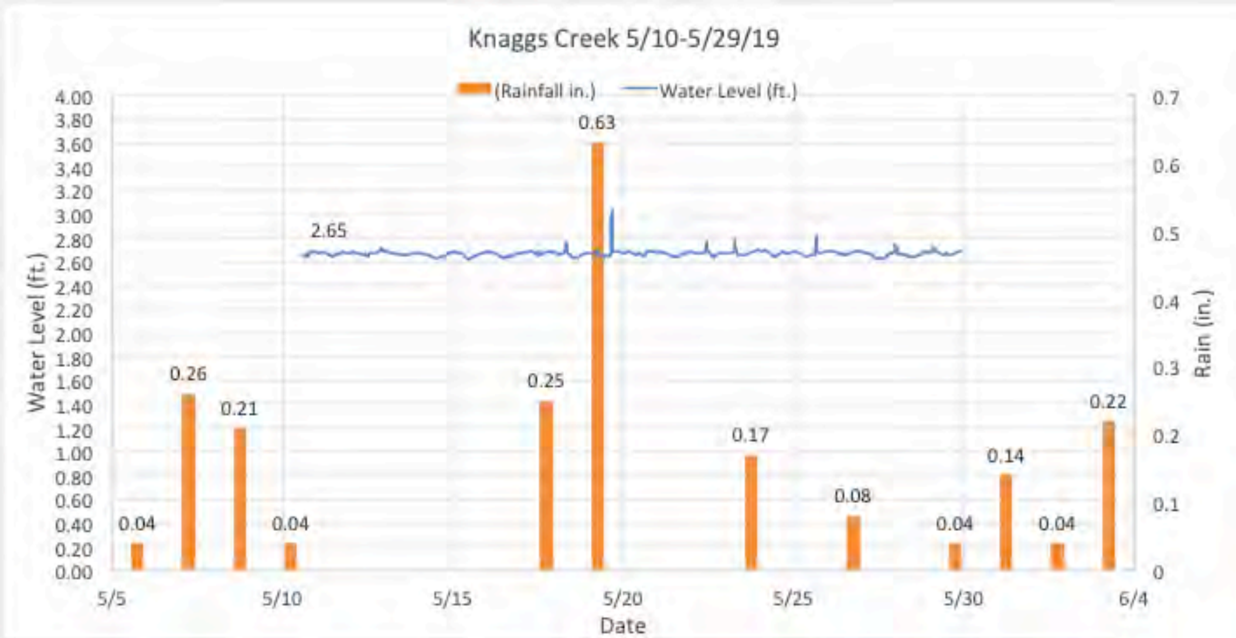
(3.63 ft.-3.49 ft.) x 12.14 sq.ft. x 7.48 gal./cu.ft. x 10 Totes = 127.1 gal. Harvested

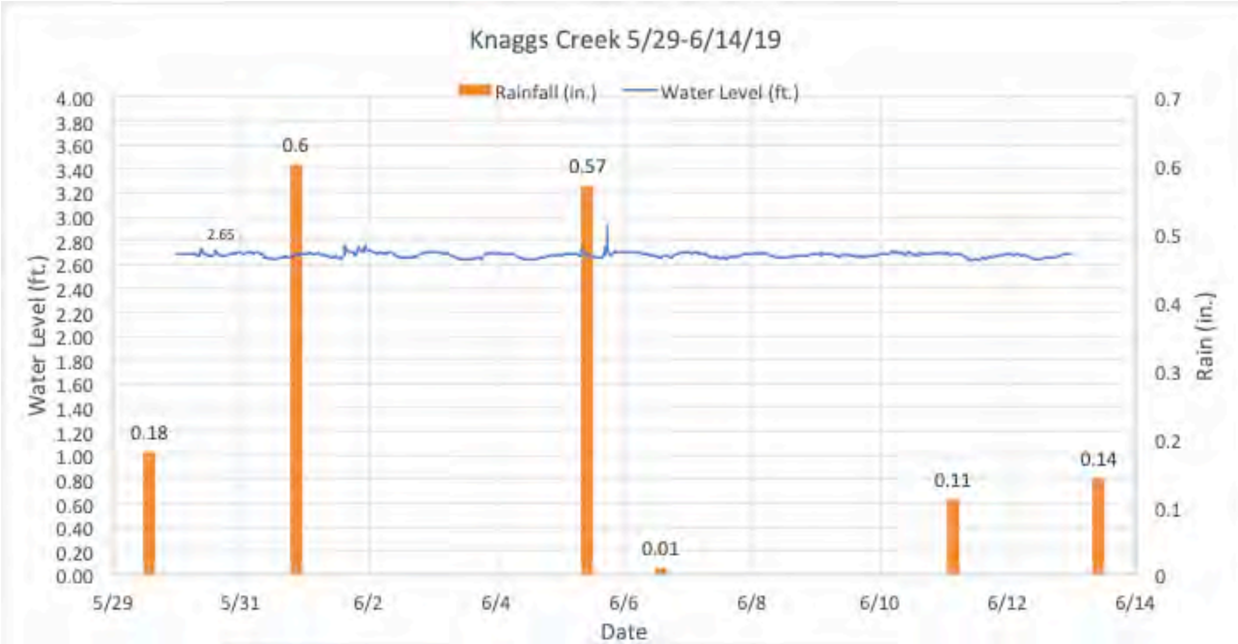


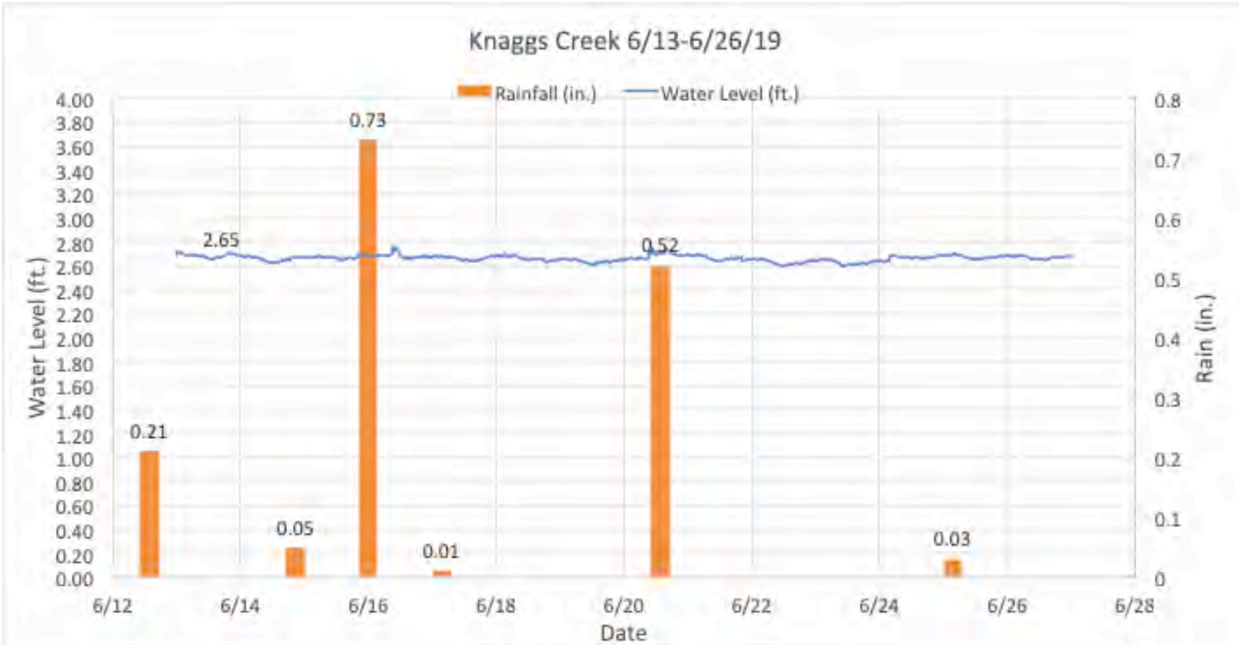
10 Totes in Series:
(3.63 ft.-3.38 ft.) x 12.14 sq.ft. x 7.48 gal./cu.ft. x 10 Totes = <u>227.0 gal. Harvested</u>

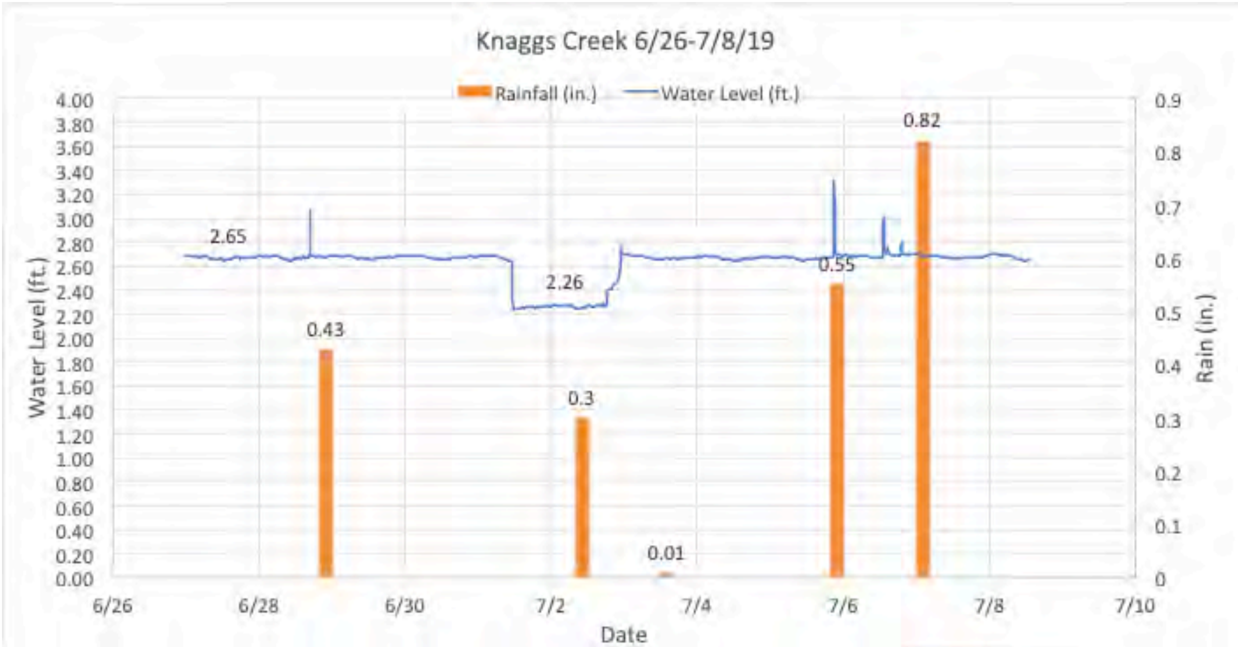


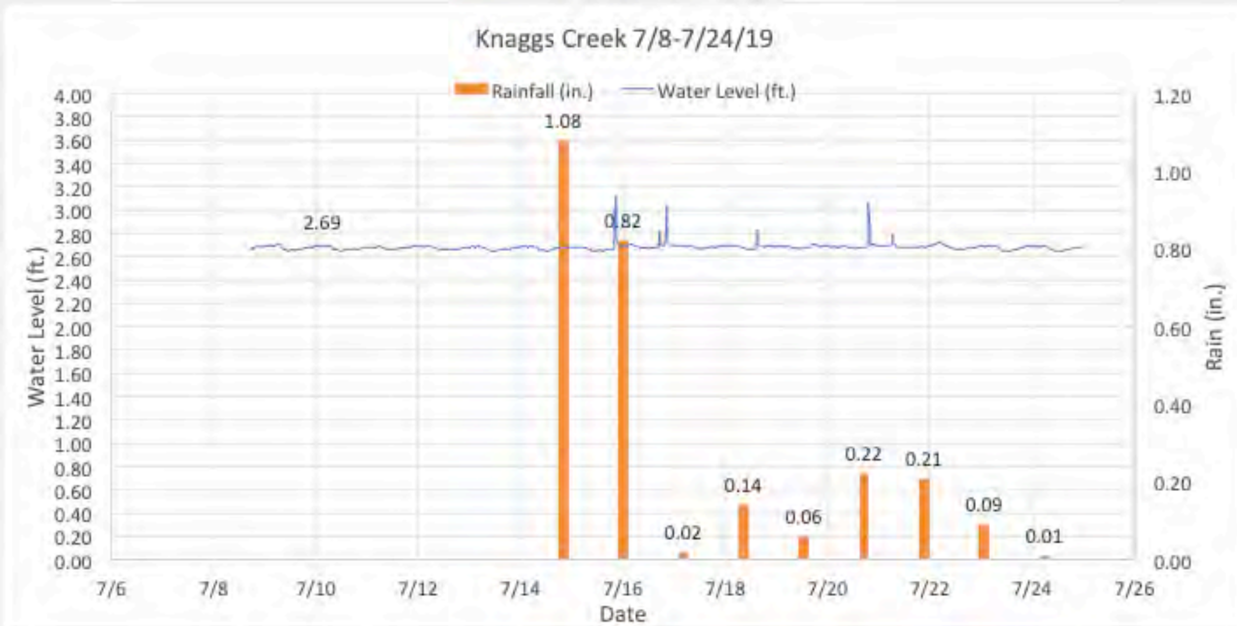
(3.54 ft.-3.20 ft.) x 12.14 sq.ft. x 7.48 gal./cu.ft. x 10 Totes = 308.5 gal. Harvested
(3.24 ft.-3.09 ft.) x 12.14 sq.ft. x 7.48 gal./cu.ft. x 10 Totes = 136.2 gal. Harvested


Knaggs Creek 5/10-5/29/19
(Rainfall in.)
Water Level (ft.)
Water Level (ft.)
Rain (in.)
Date
4.00
3.80
3.60
3.40
3.20
3.00
2.80
2.60
2.40
2.20
2.00
1.80
1.60
1.40
1.20
1.00
0.80
0.60
0.40
0.20
0.00
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
5/5
5/10
5/15
5/20
5/25
5/30
6/4
2.65
0.63
0.26
0.21
0.25
0.22
0.17
0.14
0.08
0.04
0.04
0.04
0.04

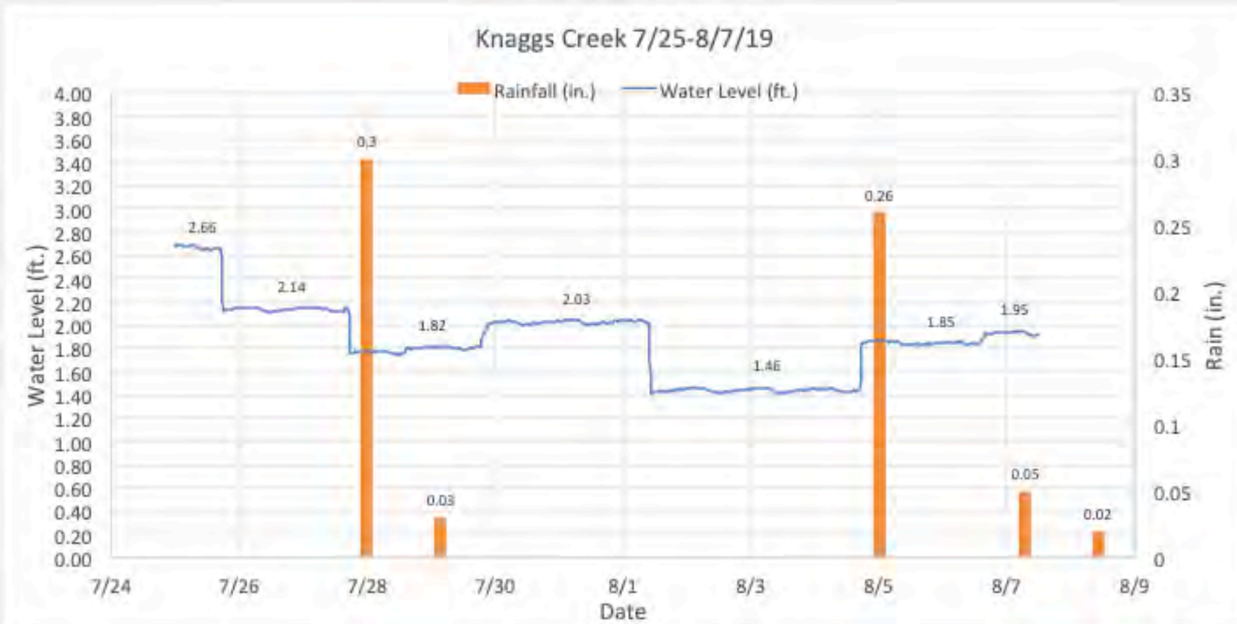

Knaggs Creek 5/29-6/14/19
Rainfall (in.)
Water Level (ft.)
Water Level (ft.)
Rain (in.)
Date
4.00
3.80
3.60
3.40
3.20
3.00
2.80
2.60
2.40
2.20
2.00
1.80
1.60
1.40
1.20
1.00
0.80
0.60
0.40
0.20
0.00
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
5/29
5/31
6/2
6/4
6/6
6/8
6/10
6/12
6/14
2.65
0.18
0.6
0.57
0.01
0.11
0.14


Knaggs Creek 6/13-6/26/19
Rainfall (in.)
Water Level (ft.)
Water Level (ft.)
4.00
3.80
3.60
3.40
3.20
3.00
2.80
2.60
2.40
2.20
2.00
1.80
1.60
1.40
1.20
1.00
0.80
0.60
0.40
0.20
0.00
Rain (in.)
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
0.21
2.65
0.05
0.73
0.01
0.52
0.03
6/12
6/14
6/16
6/18
6/20
6/22
6/24
6/26
6/28
Date

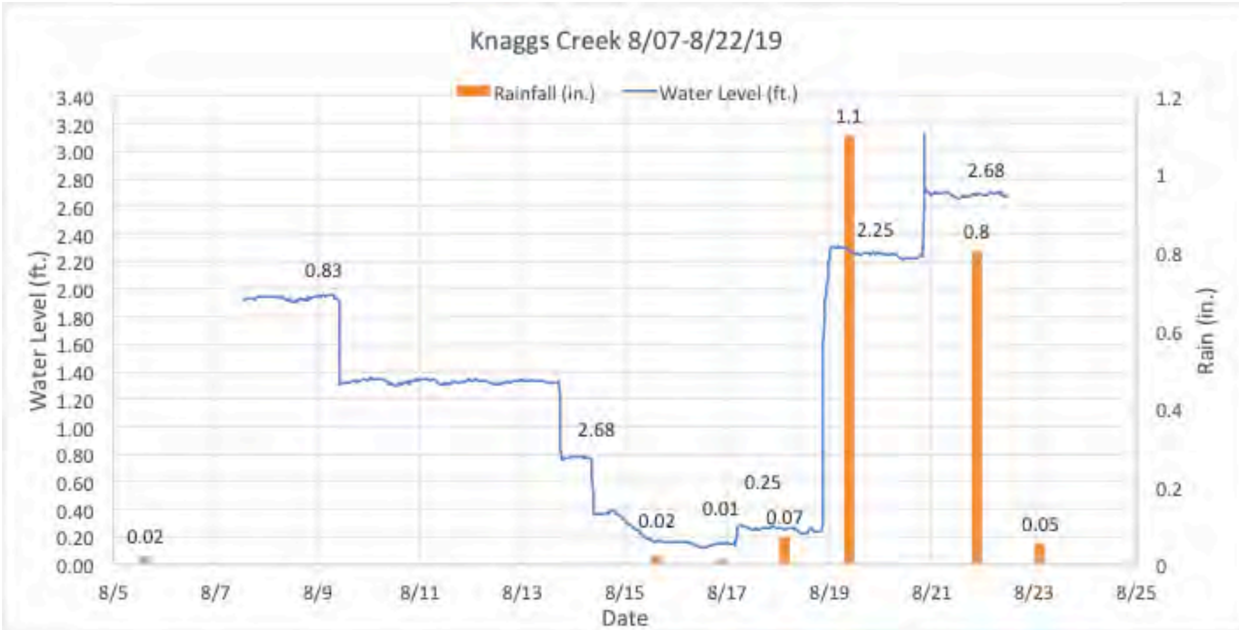

Knaggs Creek 6/26-7/8/19
Rainfall (in.)
Water Level (ft.)
Water Level (ft.)
Rain (in.)
Date
4.00
3.80
3.60
3.40
3.20
3.00
2.80
2.60
2.40
2.20
2.00
1.80
1.60
1.40
1.20
1.00
0.80
0.60
0.40
0.20
0.00
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
6/26
6/28
6/30
7/2
7/4
7/6
7/8
7/10
2.65
2.26
0.43
0.3
0.01
0.55
0.82



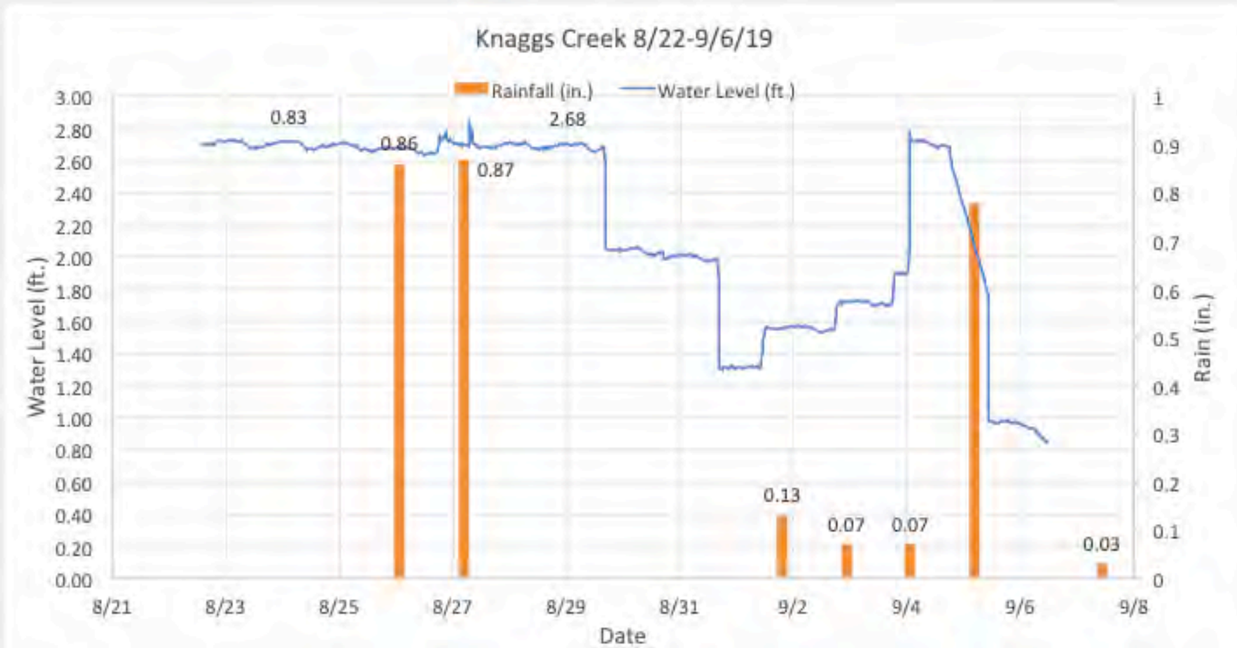
Knaggs Creek 7/8-7/24/19
Rainfall (in.)
Water Level (ft.)
Water Level (ft.)
Rain (in.)
Date
4.00
3.80
3.60
3.40
3.20
3.00
2.80
2.60
2.40
2.20
2.00
1.80
1.60
1.40
1.20
1.00
0.80
0.60
0.40
0.20
0.00
1.20
1.00
0.80
0.60
0.40
0.20
0.00
7/6
7/8
7/10
7/12
7/14
7/16
7/18
7/20
7/22
7/24
7/26
2.69
1.08
0.82
0.02
0.14
0.06
0.22
0.21
0.09
0.01



2 Totes in Series:
(2.03 ft.-1.82 ft.) x 12.14 sq.ft. x 7.48 gal./cu.ft. x 2 Totes = <u>38.1 gal. Harvested</u>
(1.85 ft.-1.46 ft.) x 12.14 sq.ft. x 7.48 gal./cu.ft. x 2 Totes = <u>70.8 gal. Harvested</u>

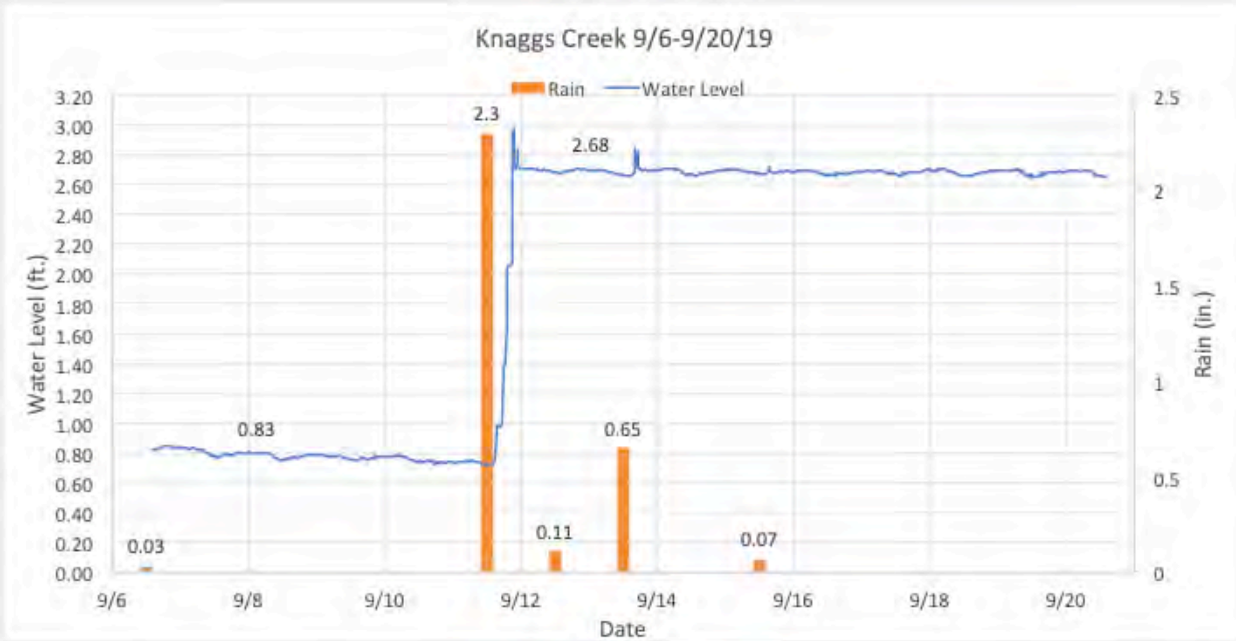


(2.25 ft.-0.07 ft.) x 12.14 sq.ft. x 7.48 gal./cu.ft. x 2 Totes = <u>395.9 gal. Harvested</u>
(2.68 ft.-2.25 ft.) x 12.14 sq.ft. x 7.48 gal./cu.ft. x 2 Totes = <u>78.1 gal. Harvested</u>

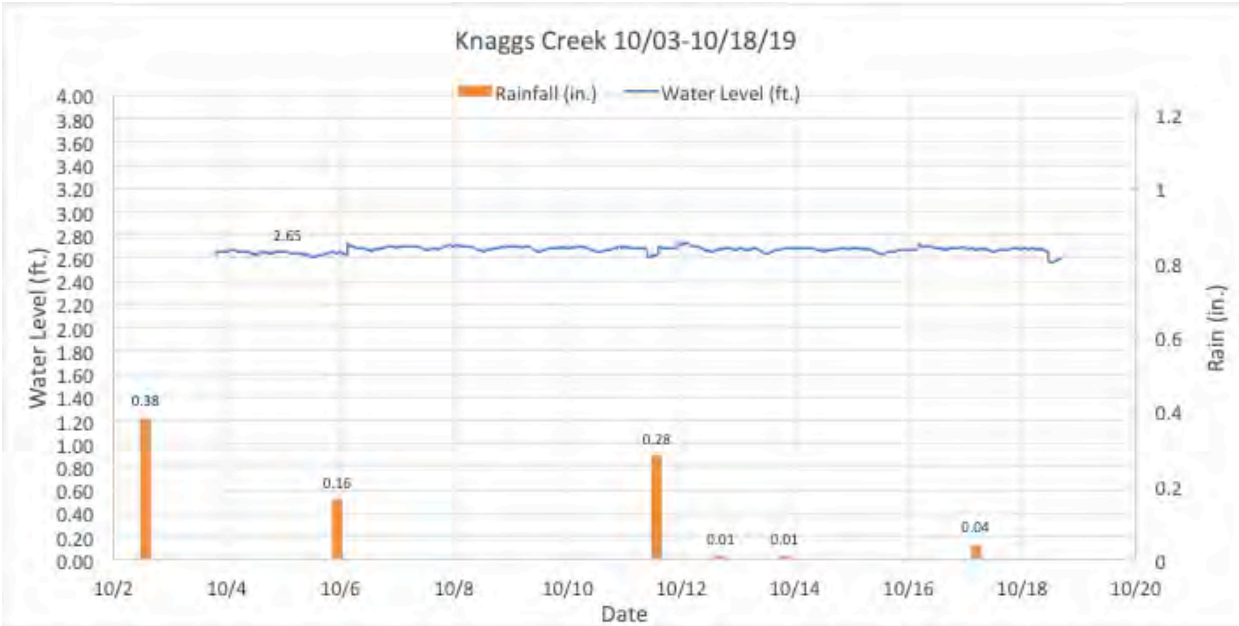


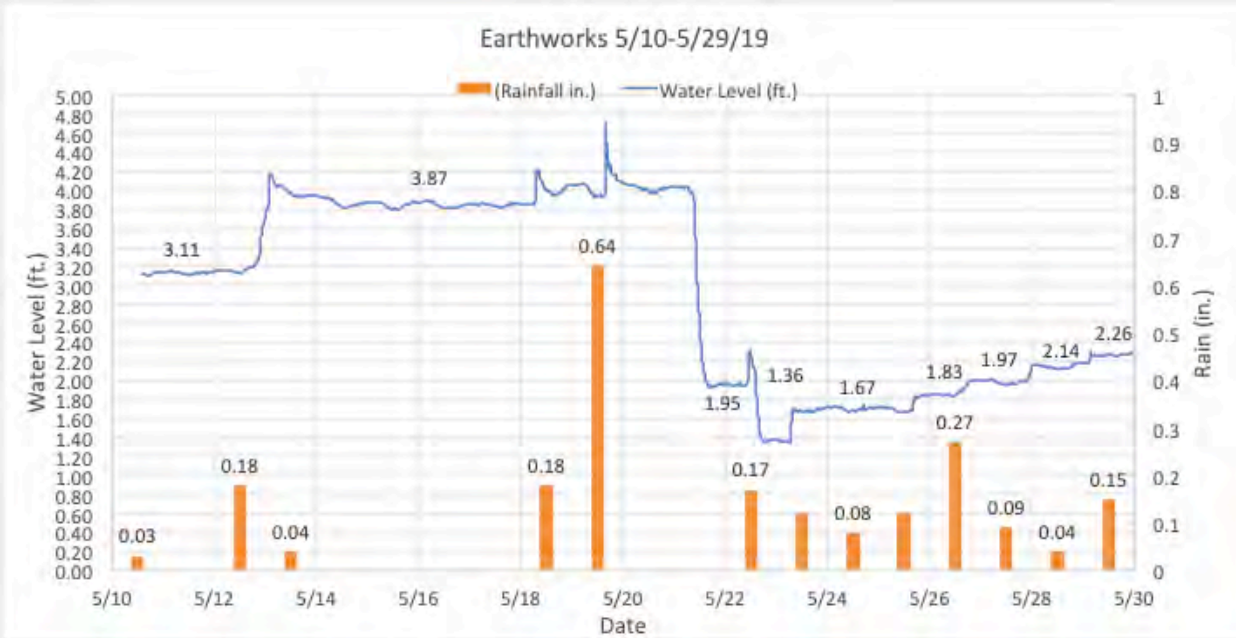
2 Totes in Series:

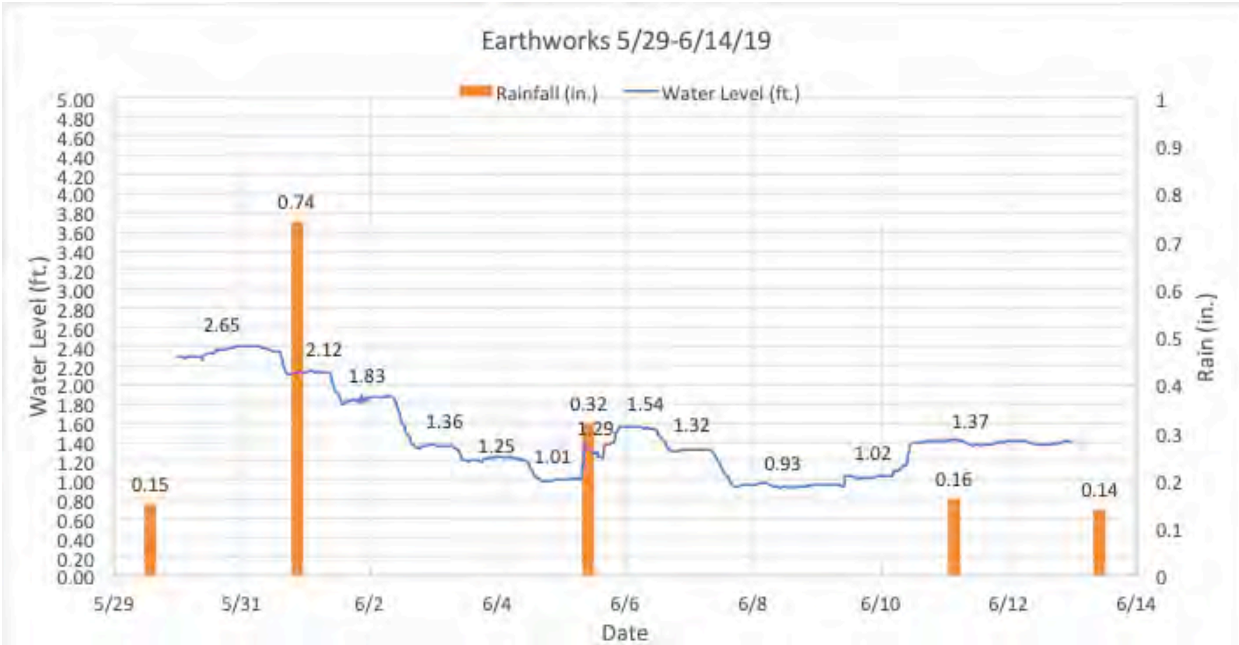
(2.68 ft.-1.31 ft.) x 12.14 sq.ft. x 7.48 gal./cu.ft. x 2 Totes = <u>248.8 gal. Harvested</u>

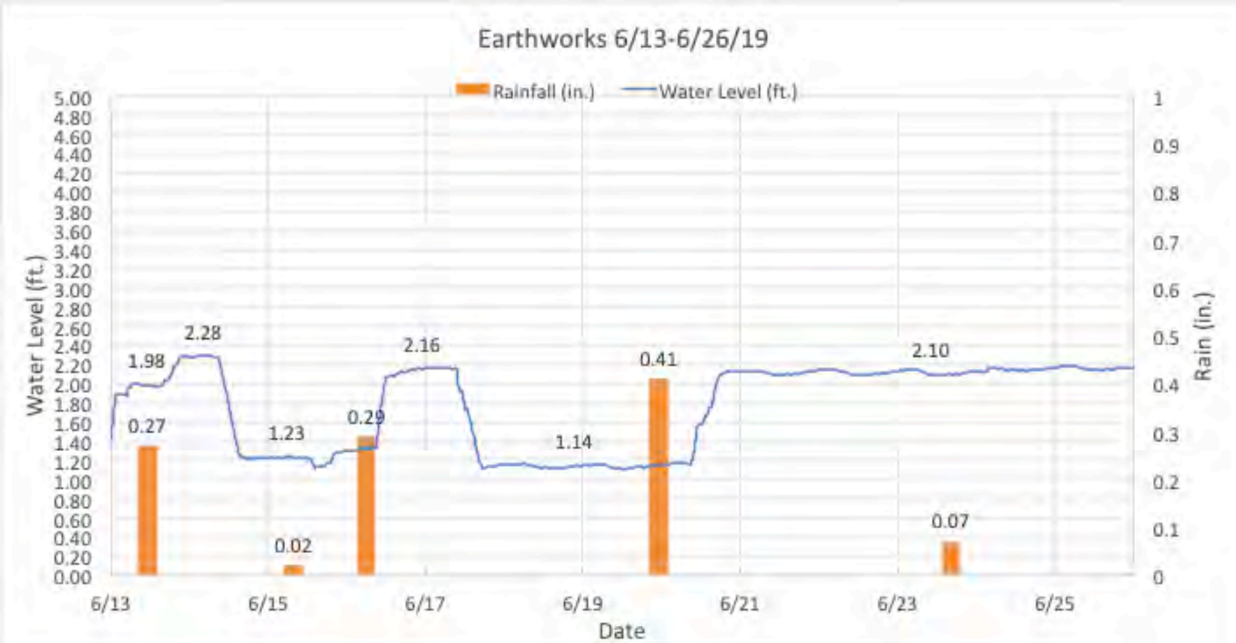


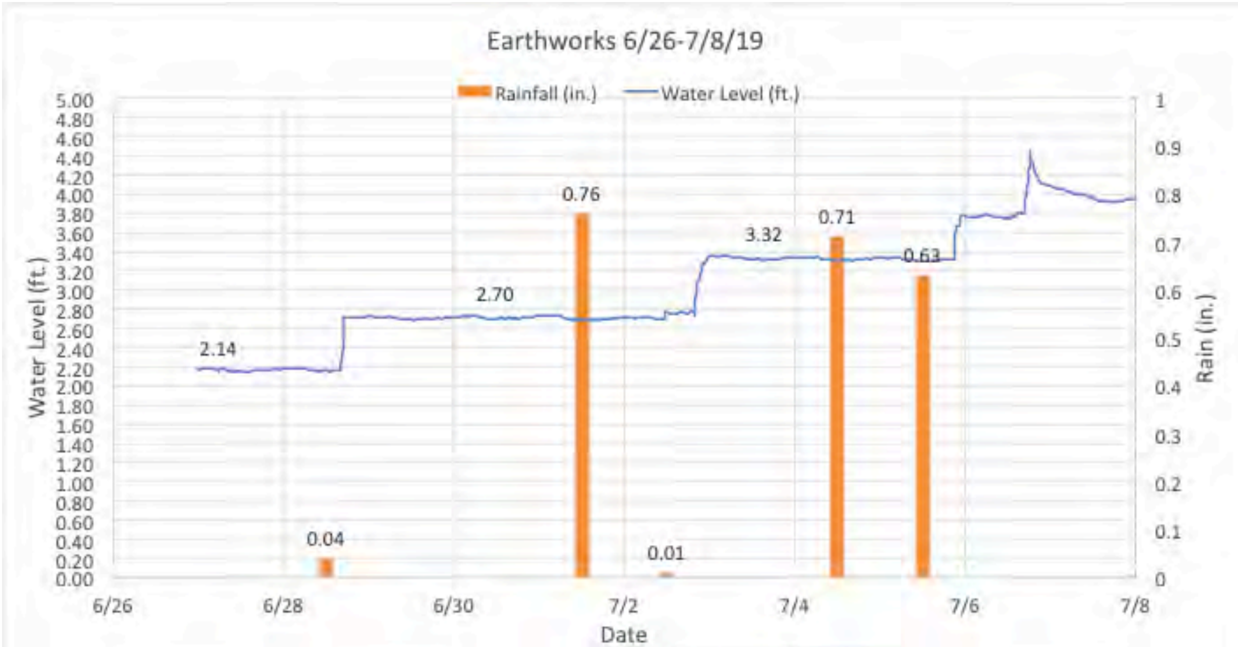
(2.68 ft.-0.83 ft.) x 12.14 sq.ft. x 7.48 gal./cu.ft. x 2 Totes = <u>336.0 gal. Harvested</u>

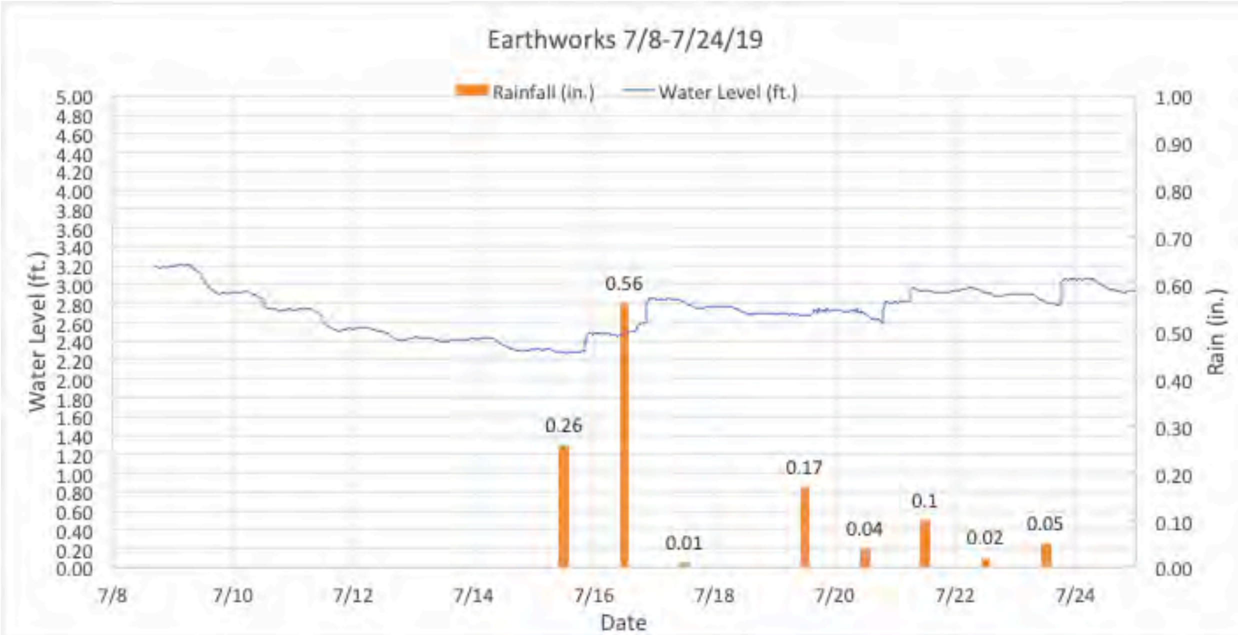

Knaggs Creek 10/03-10/18/19
Rainfall (in.)
Water Level (ft.)
Water Level (ft.)
Rain (in.)
Date
4.00
3.80
3.60
3.40
3.20
3.00
2.80
2.60
2.40
2.20
2.00
1.80
1.60
1.40
1.20
1.00
0.80
0.60
0.40
0.20
0.00
1.2
1
0.8
0.6
0.4
0.2
0
2.65
0.38
0.16
0.28
0.01
0.01
0.04
10/2
10/4
10/6
10/8
10/10
10/12
10/14
10/16
10/18
10/20

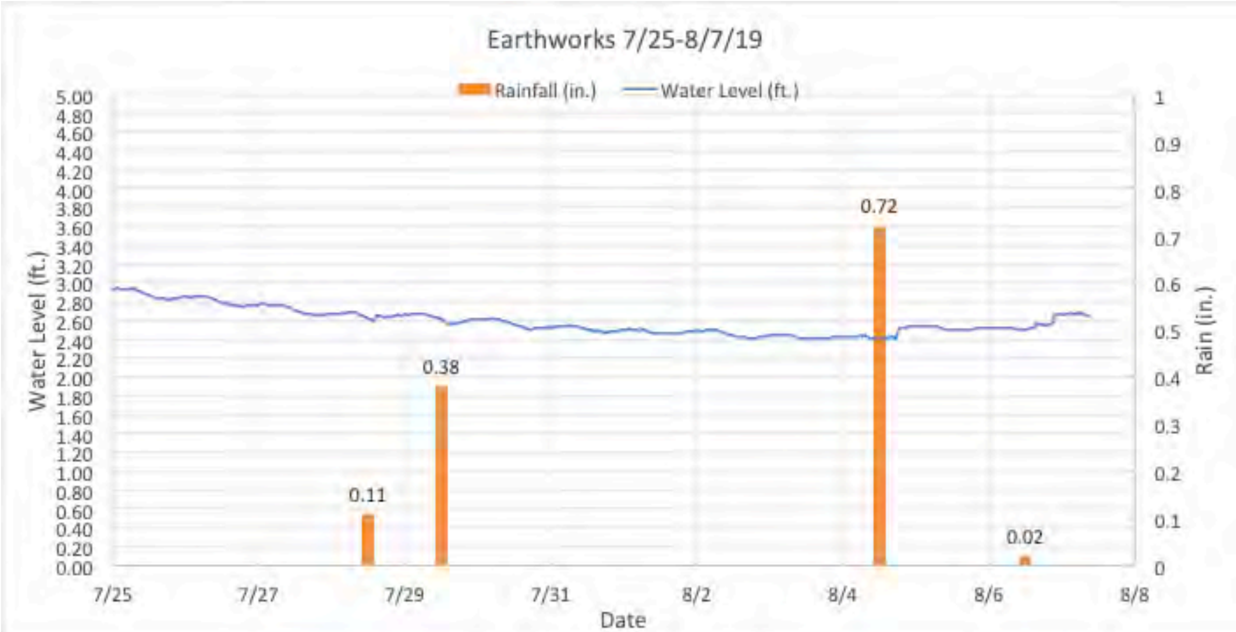

Earthworks 5/10-5/29/19
(Rainfall in.)
Water Level (ft.)
Water Level (ft.)
Rain (in.)
Date
5.00
4.80
4.60
4.40
4.20
4.00
3.80
3.60
3.40
3.20
3.00
2.80
2.60
2.40
2.20
2.00
1.80
1.60
1.40
1.20
1.00
0.80
0.60
0.40
0.20
0.00
1
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
5/10
5/12
5/14
5/16
5/18
5/20
5/22
5/24
5/26
5/28
5/30
3.11
3.87
0.64
1.95
1.36
1.67
1.83
1.97
2.14
2.26
0.03
0.18
0.04
0.18
0.17
0.08
0.27
0.09
0.04
0.15

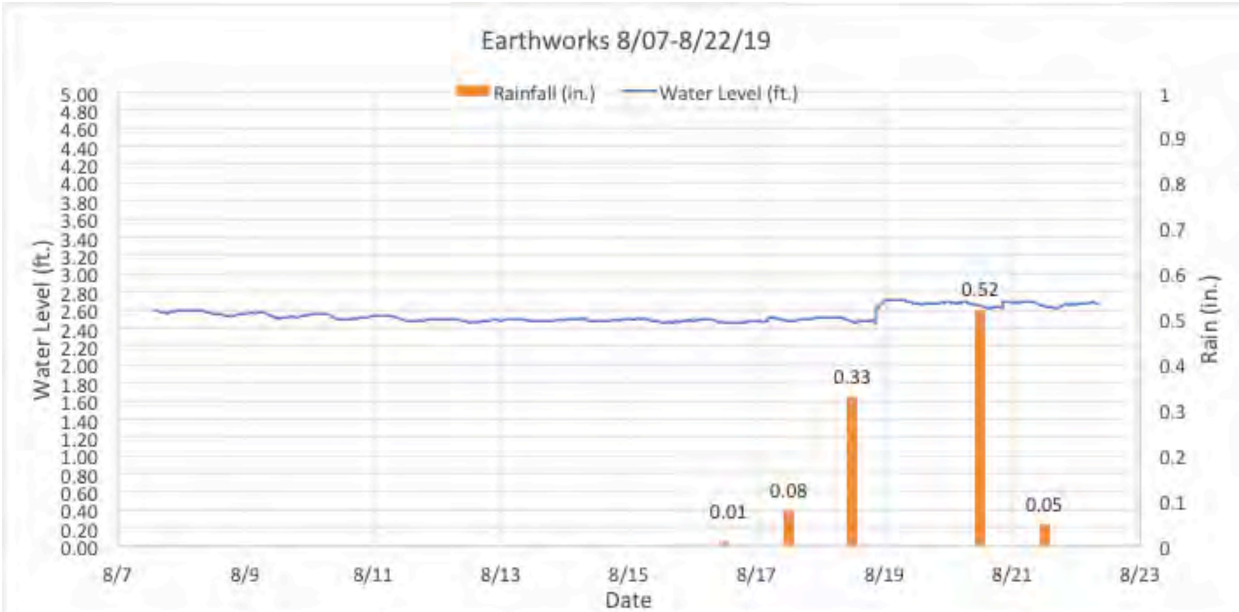

Earthworks 5/29-6/14/19
Rainfall (in.)
Water Level (ft.)
Water Level (ft.)
Rain (in.)
Date
5.00
4.80
4.60
4.40
4.20
4.00
3.80
3.60
3.40
3.20
3.00
2.80
2.60
2.40
2.20
2.00
1.80
1.60
1.40
1.20
1.00
0.80
0.60
0.40
0.20
0.00
1
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
5/29
5/31
6/2
6/4
6/6
6/8
6/10
6/12
6/14
0.15
0.74
2.65
2.12
1.83
1.36
1.25
1.01
0.32
1.29
1.54
1.32
0.93
1.02
1.37
0.16
0.14

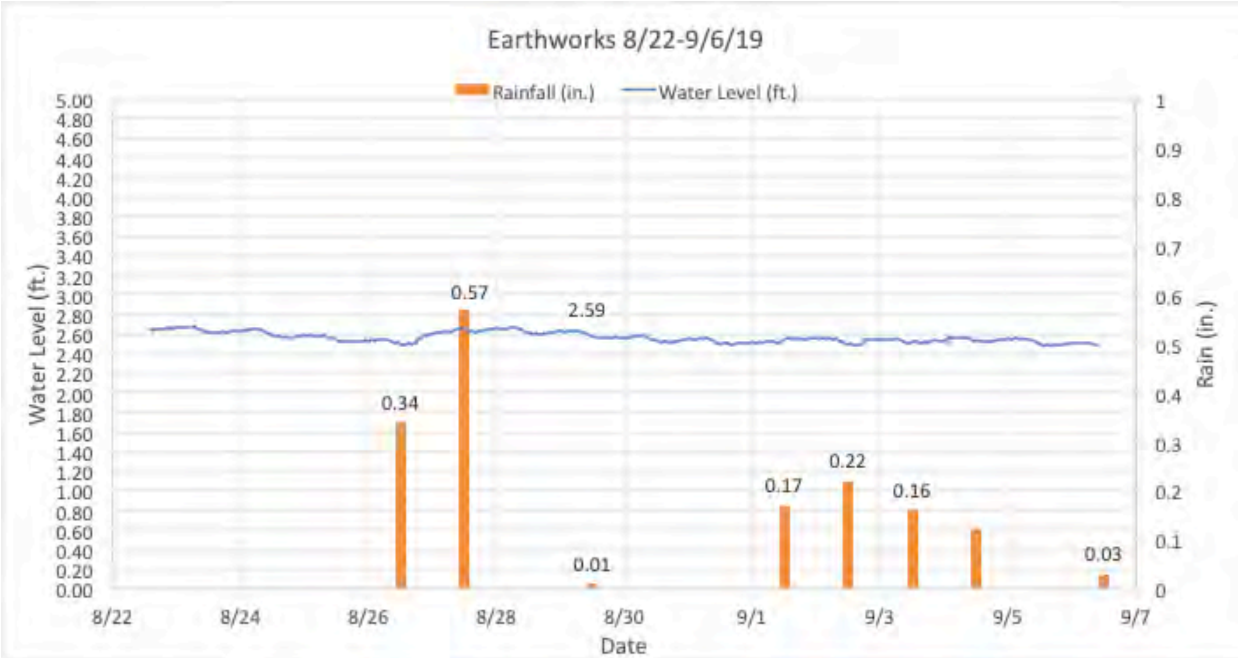

Earthworks 6/13-6/26/19
Rainfall (in.)
Water Level (ft.)
Water Level (ft.)
Rain (in.)
Date
5.00
4.80
4.60
4.40
4.20
4.00
3.80
3.60
3.40
3.20
3.00
2.80
2.60
2.40
2.20
2.00
1.80
1.60
1.40
1.20
1.00
0.80
0.60
0.40
0.20
0.00
1
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
6/13
6/15
6/17
6/19
6/21
6/23
6/25
1.98
2.28
0.27
1.23
0.02
0.29
2.16
1.14
0.41
2.10
0.07


Earthworks 6/26-7/8/19
Rainfall (in.)
Water Level (ft.)
Water Level (ft.)
Rain (in.)
Date
2.14
2.70
3.32
0.04
0.76
0.01
0.71
0.63
6/26
6/28
6/30
7/2
7/4
7/6
7/8

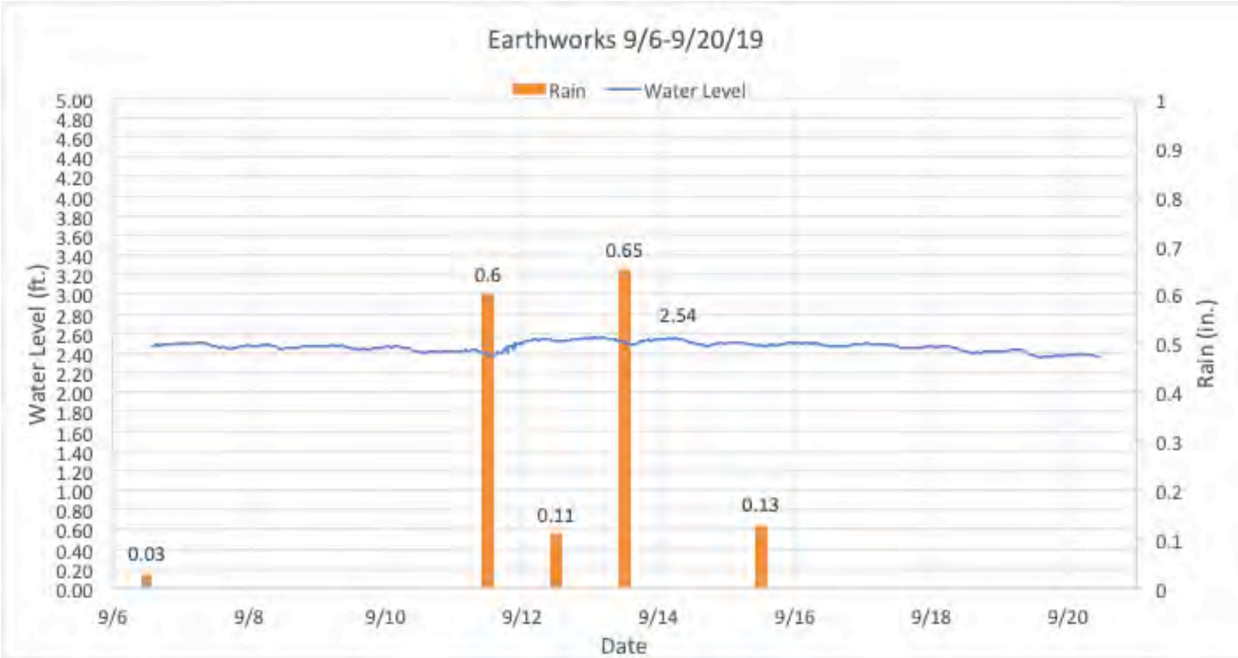

Earthworks 7/8-7/24/19
Rainfall (in.)
Water Level (ft.)
Water Level (ft.)
Rain (in.)
Date
5.00
4.80
4.60
4.40
4.20
4.00
3.80
3.60
3.40
3.20
3.00
2.80
2.60
2.40
2.20
2.00
1.80
1.60
1.40
1.20
1.00
0.80
0.60
0.40
0.20
0.00
1.00
0.90
0.80
0.70
0.60
0.50
0.40
0.30
0.20
0.10
0.00
0.26
0.56
0.01
0.17
0.04
0.1
0.02
0.05
7/8
7/10
7/12
7/14
7/16
7/18
7/20
7/22
7/24

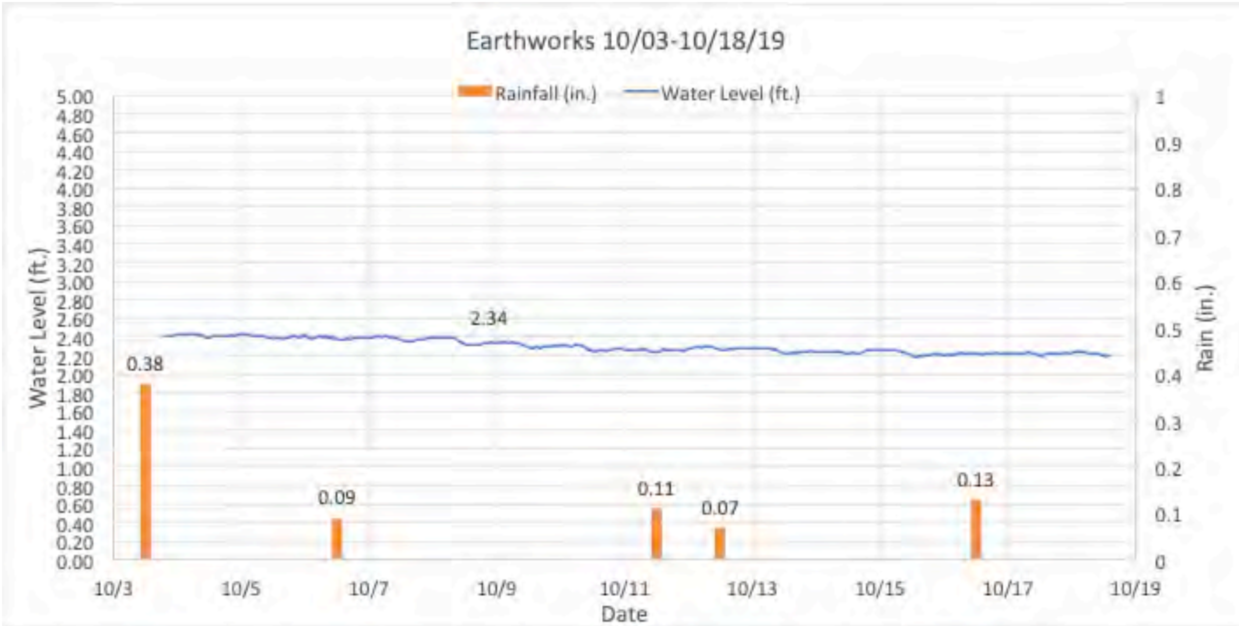

Earthworks 7/25-8/7/19
Rainfall (in.)
Water Level (ft.)
Water Level (ft.)
Rain (in.)
5.00
4.80
4.60
4.40
4.20
4.00
3.80
3.60
3.40
3.20
3.00
2.80
2.60
2.40
2.20
2.00
1.80
1.60
1.40
1.20
1.00
0.80
0.60
0.40
0.20
0.00
1
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
0.72
0.38
0.11
0.02
7/25
7/27
7/29
7/31
8/2
8/4
8/6
8/8
Date

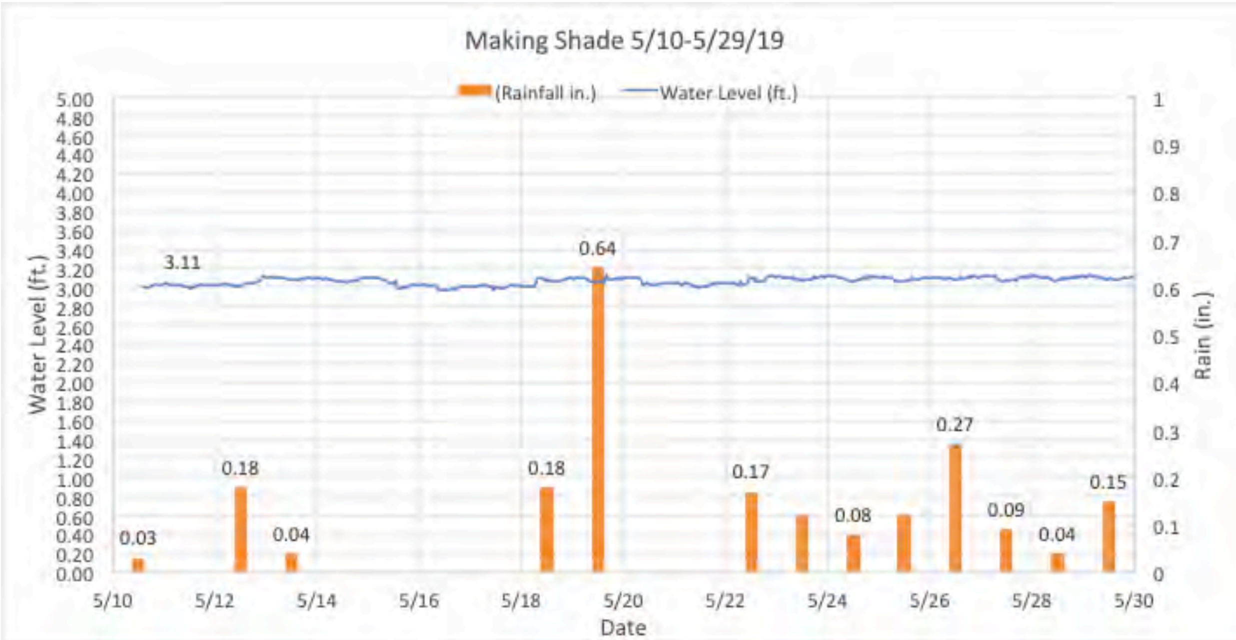

Earthworks 8/07-8/22/19
Rainfall (in.)
Water Level (ft.)
Water Level (ft.)
Rain (in.)
5.00
4.80
4.60
4.40
4.20
4.00
3.80
3.60
3.40
3.20
3.00
2.80
2.60
2.40
2.20
2.00
1.80
1.60
1.40
1.20
1.00
0.80
0.60
0.40
0.20
0.00
1
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
0.01
0.08
0.33
0.52
0.05
8/7
8/9
8/11
8/13
8/15
8/17
8/19
8/21
8/23
Date

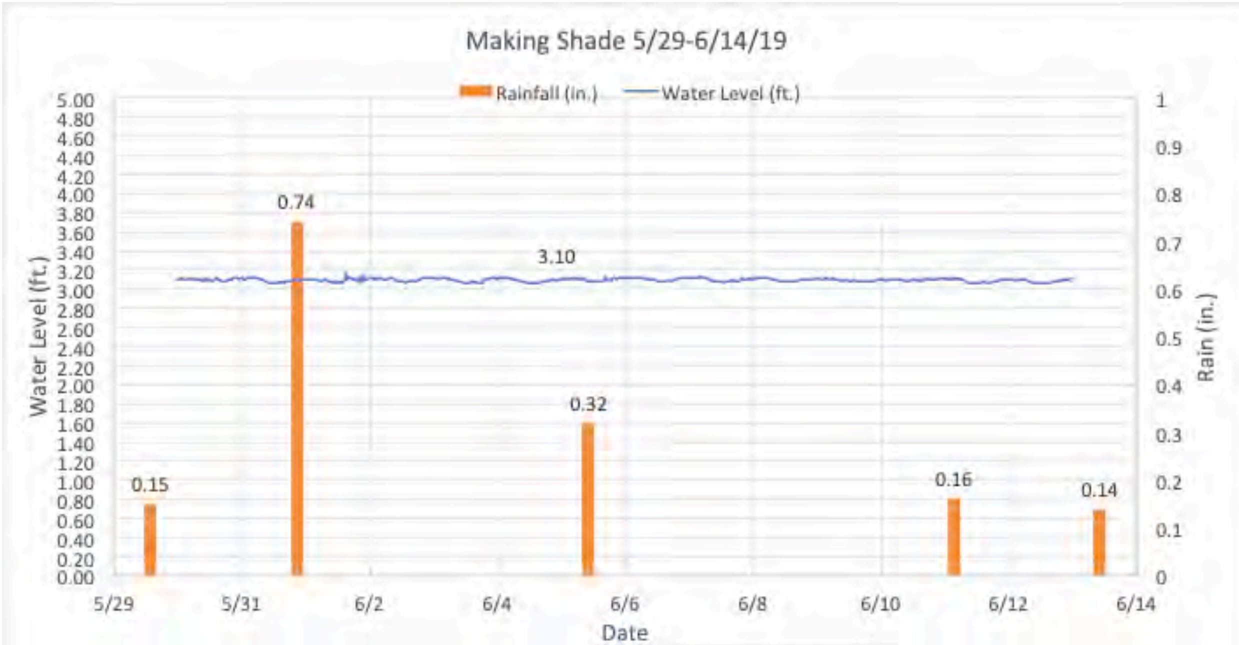


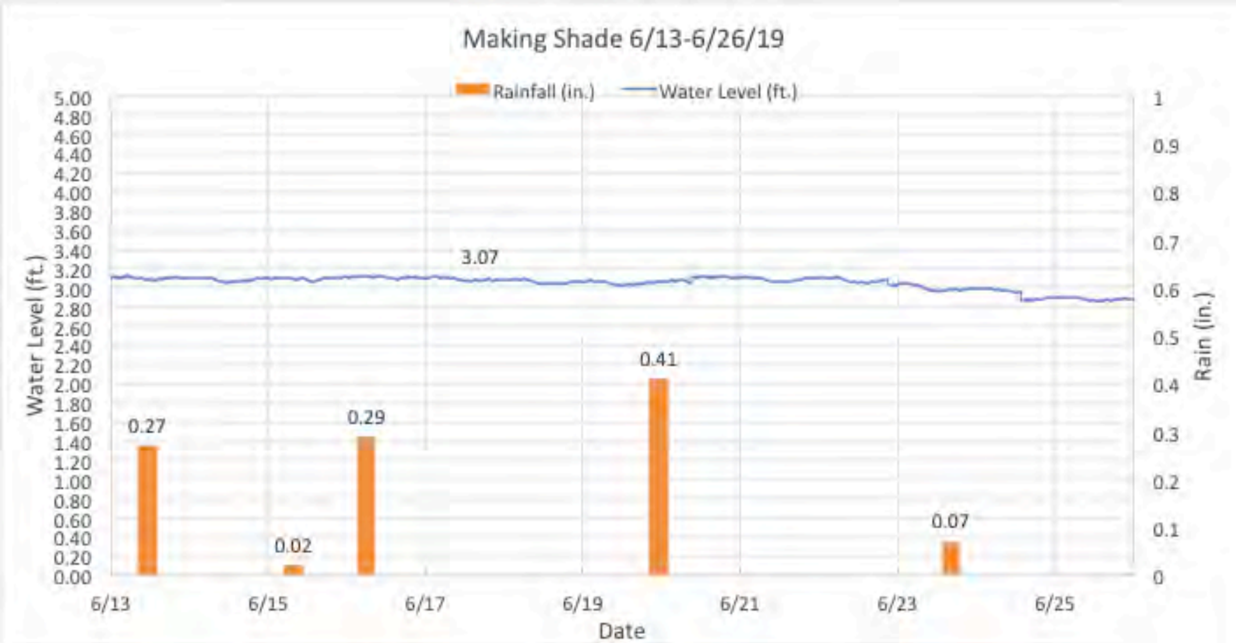
Earthworks 8/22-9/6/19
Rainfall (in.)
Water Level (ft.)
Water Level (ft.)
Rain (in.)
Date
5.00
4.80
4.60
4.40
4.20
4.00
3.80
3.60
3.40
3.20
3.00
2.80
2.60
2.40
2.20
2.00
1.80
1.60
1.40
1.20
1.00
0.80
0.60
0.40
0.20
0.00
1
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
8/22
8/24
8/26
8/28
8/30
9/1
9/3
9/5
9/7
0.34
0.57
2.59
0.01
0.17
0.22
0.16
0.03

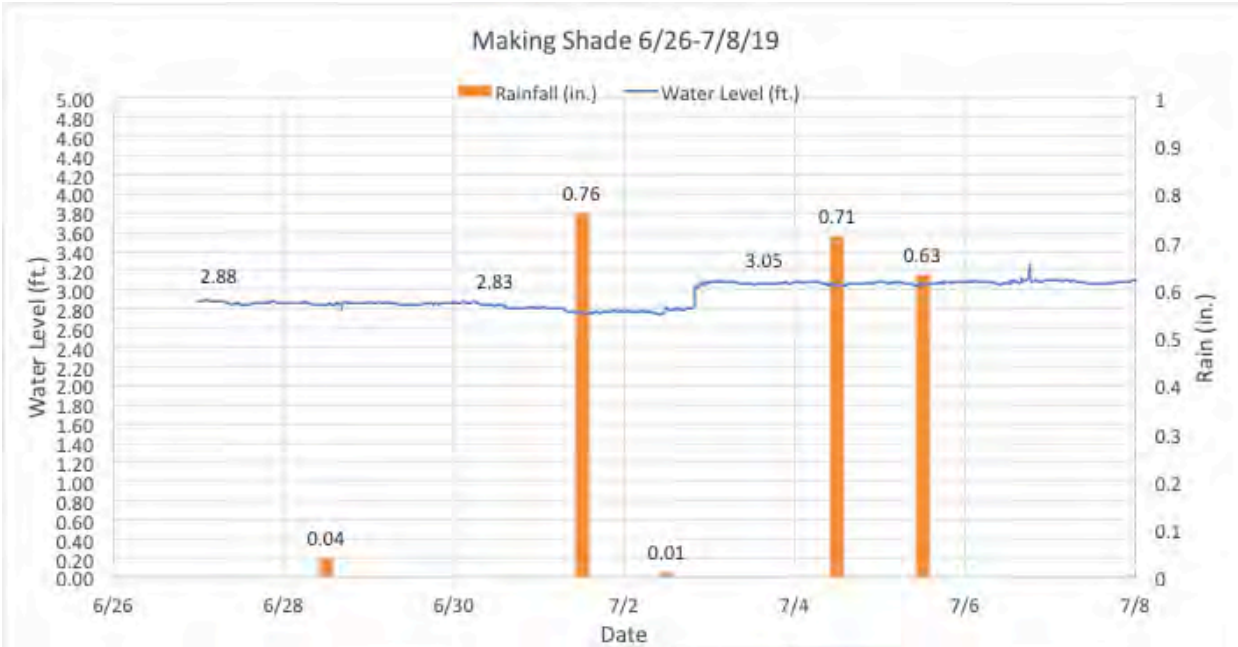

Earthworks 9/6-9/20/19
Rain
Water Level
Water Level (ft.)
Rain (in.)
Date
5.00
4.80
4.60
4.40
4.20
4.00
3.80
3.60
3.40
3.20
3.00
2.80
2.60
2.40
2.20
2.00
1.80
1.60
1.40
1.20
1.00
0.80
0.60
0.40
0.20
0.00
1
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
0.03
0.6
0.11
0.65
2.54
0.13
9/6
9/8
9/10
9/12
9/14
9/16
9/18
9/20

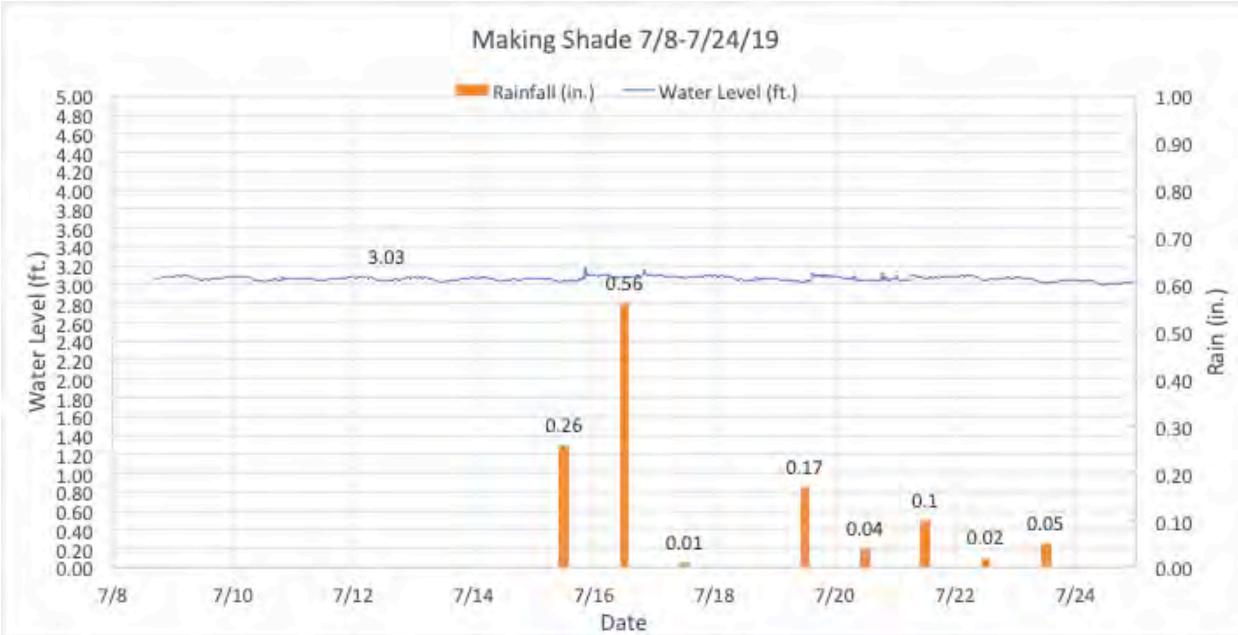

Earthworks 10/03-10/18/19
Rainfall (in.)
Water Level (ft.)
Water Level (ft.)
Rain (in.)
Date
0.38
0.09
0.11
0.07
0.13
2.34
5.00
4.80
4.60
4.40
4.20
4.00
3.80
3.60
3.40
3.20
3.00
2.80
2.60
2.40
2.20
2.00
1.80
1.60
1.40
1.20
1.00
0.80
0.60
0.40
0.20
0.00
1
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
10/3
10/5
10/7
10/9
10/11
10/13
10/15
10/17
10/19

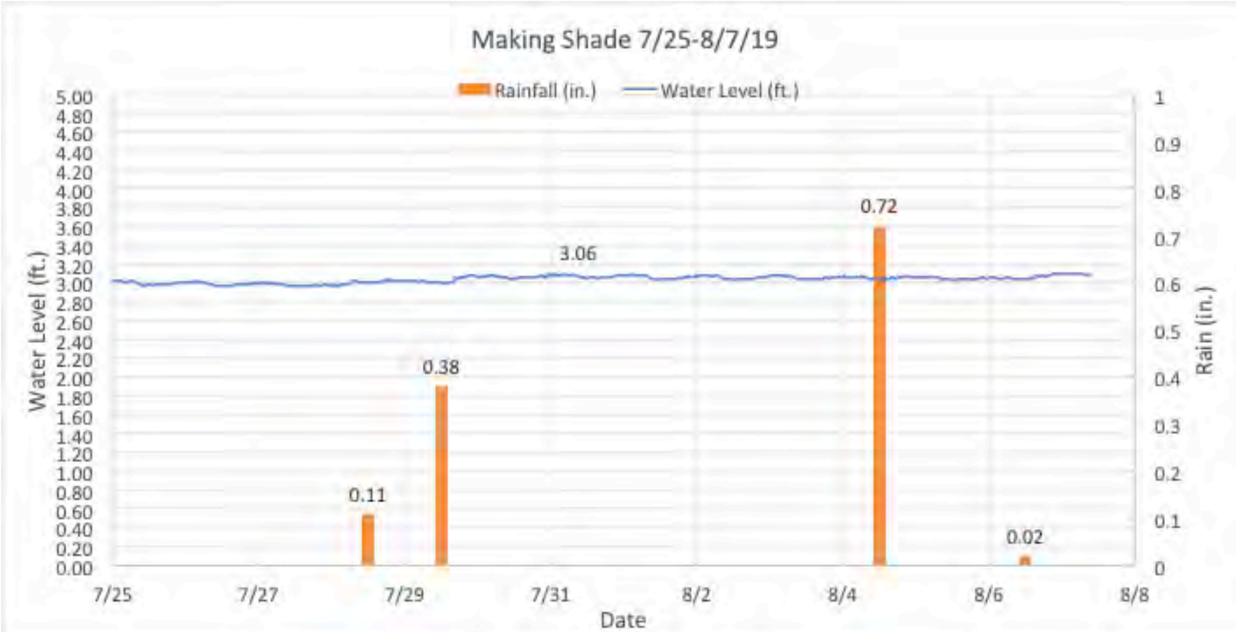

Making Shade 5/10-5/29/19
(Rainfall in.)
Water Level (ft.)
Water Level (ft.)
Rain (in.)
Date
5.00
4.80
4.60
4.40
4.20
4.00
3.80
3.60
3.40
3.20
3.00
2.80
2.60
2.40
2.20
2.00
1.80
1.60
1.40
1.20
1.00
0.80
0.60
0.40
0.20
0.00
1
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
5/10
5/12
5/14
5/16
5/18
5/20
5/22
5/24
5/26
5/28
5/30
3.11
0.03
0.18
0.04
0.18
0.64
0.17
0.08
0.27
0.09
0.04
0.15

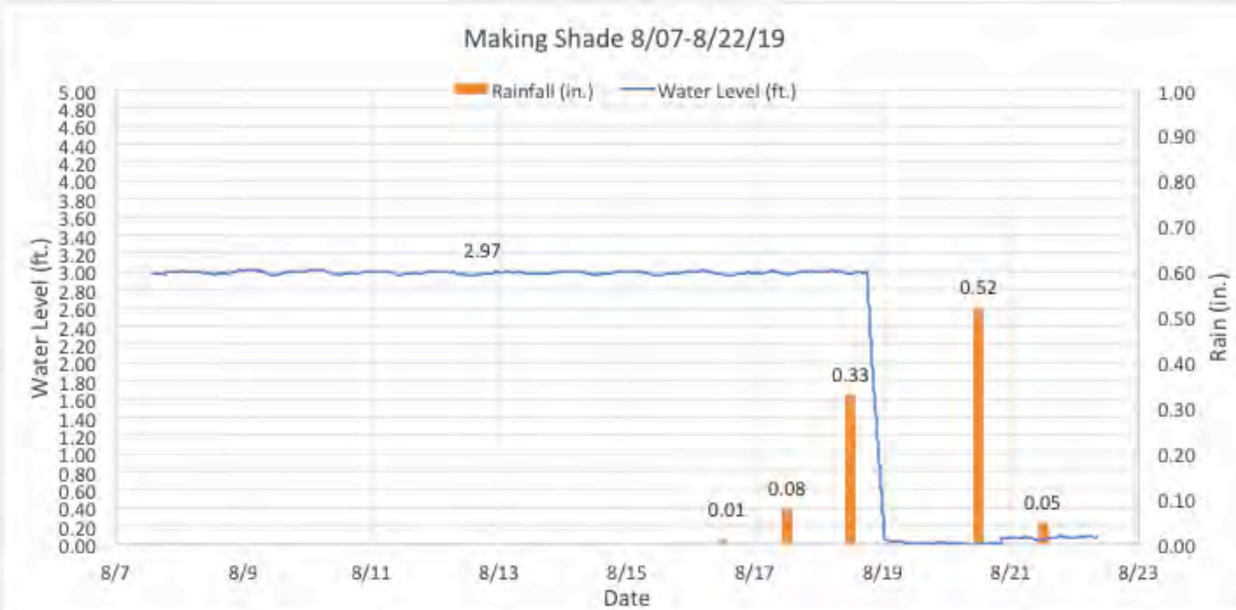

Making Shade 5/29-6/14/19
Rainfall (in.)
Water Level (ft.)
Water Level (ft.)
Rain (in.)
Date
0.74
3.10
0.32
0.15
0.16
0.14
5.00
4.80
4.60
4.40
4.20
4.00
3.80
3.60
3.40
3.20
3.00
2.80
2.60
2.40
2.20
2.00
1.80
1.60
1.40
1.20
1.00
0.80
0.60
0.40
0.20
0.00
1
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
5/29
5/31
6/2
6/4
6/6
6/8
6/10
6/12
6/14

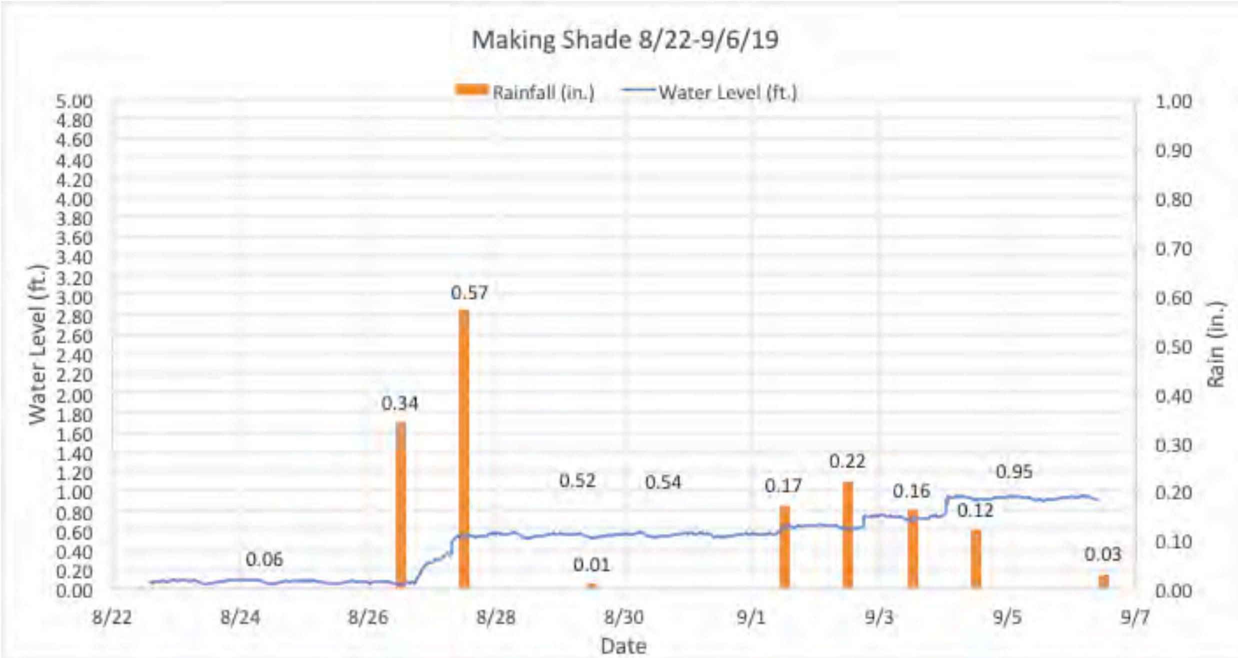

Making Shade 6/13-6/26/19
Rainfall (in.)
Water Level (ft.)
Water Level (ft.)
Rain (in.)
Date
3.07
0.27
0.02
0.29
0.41
0.07
6/13
6/15
6/17
6/19
6/21
6/23
6/25
5.00
4.80
4.60
4.40
4.20
4.00
3.80
3.60
3.40
3.20
3.00
2.80
2.60
2.40
2.20
2.00
1.80
1.60
1.40
1.20
1.00
0.80
0.60
0.40
0.20
0.00
1
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0

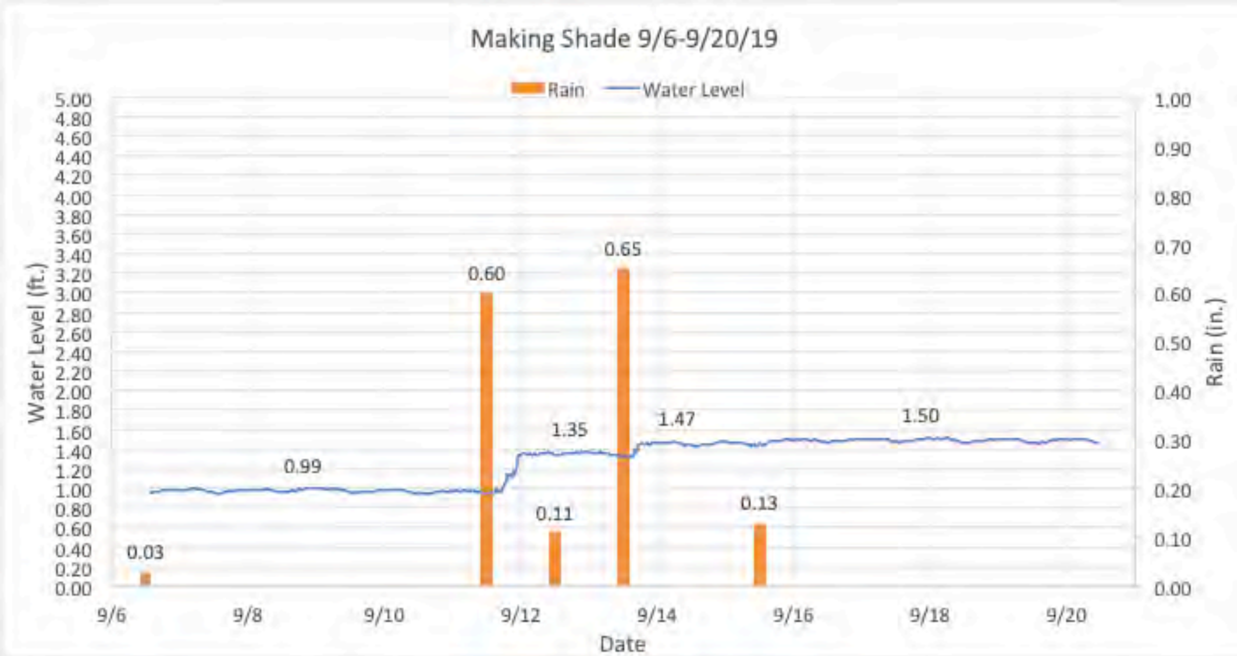

Making Shade 6/26-7/8/19
Rainfall (in.)
Water Level (ft.)
Water Level (ft.)
Rain (in.)
Date
2.88
2.83
3.05
0.76
0.71
0.63
0.04
0.01
6/26
6/28
6/30
7/2
7/4
7/6
7/8


Making Shade 7/8-7/24/19
Rainfall (in.)
Water Level (ft.)
Water Level (ft.)
Rain (in.)
Date
5.00
4.80
4.60
4.40
4.20
4.00
3.80
3.60
3.40
3.20
3.00
2.80
2.60
2.40
2.20
2.00
1.80
1.60
1.40
1.20
1.00
0.80
0.60
0.40
0.20
0.00
1.00
0.90
0.80
0.70
0.60
0.50
0.40
0.30
0.20
0.10
0.00
7/8
7/10
7/12
7/14
7/16
7/18
7/20
7/22
7/24
3.03
0.56
0.26
0.01
0.17
0.04
0.1
0.02
0.05

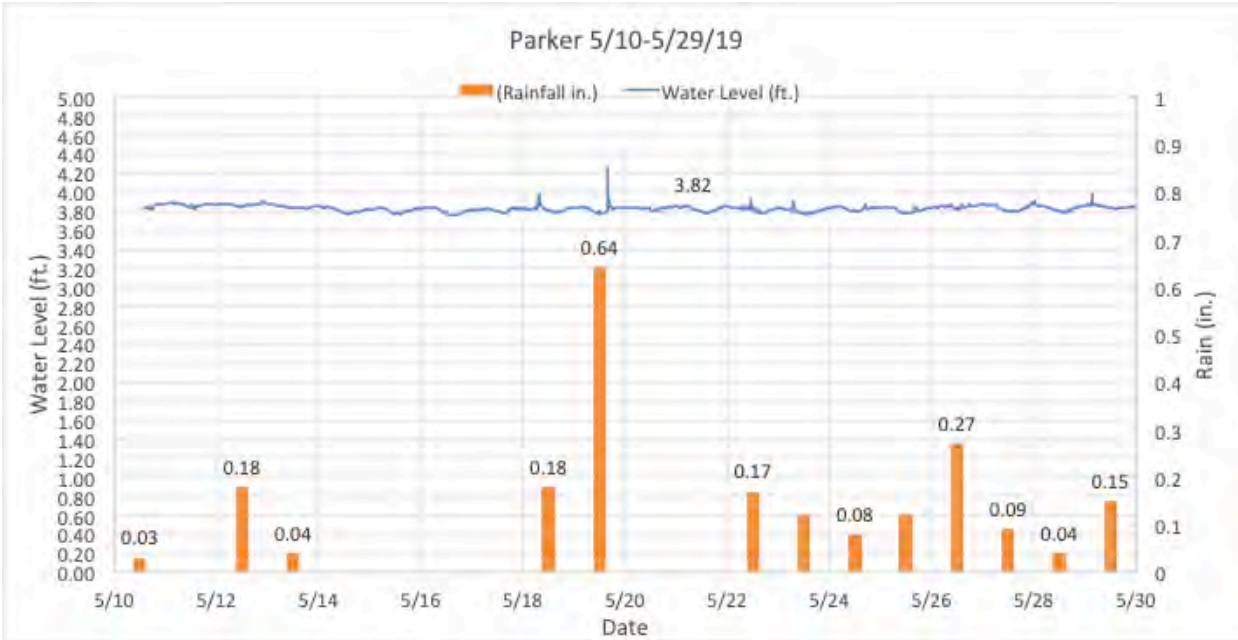

Making Shade 7/25-8/7/19
Rainfall (in.)
Water Level (ft.)
Water Level (ft.)
Rain (in.)
Date
5.00
4.80
4.60
4.40
4.20
4.00
3.80
3.60
3.40
3.20
3.00
2.80
2.60
2.40
2.20
2.00
1.80
1.60
1.40
1.20
1.00
0.80
0.60
0.40
0.20
0.00
1
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
7/25
7/27
7/29
7/31
8/2
8/4
8/6
8/8
0.72
3.06
0.38
0.11
0.02

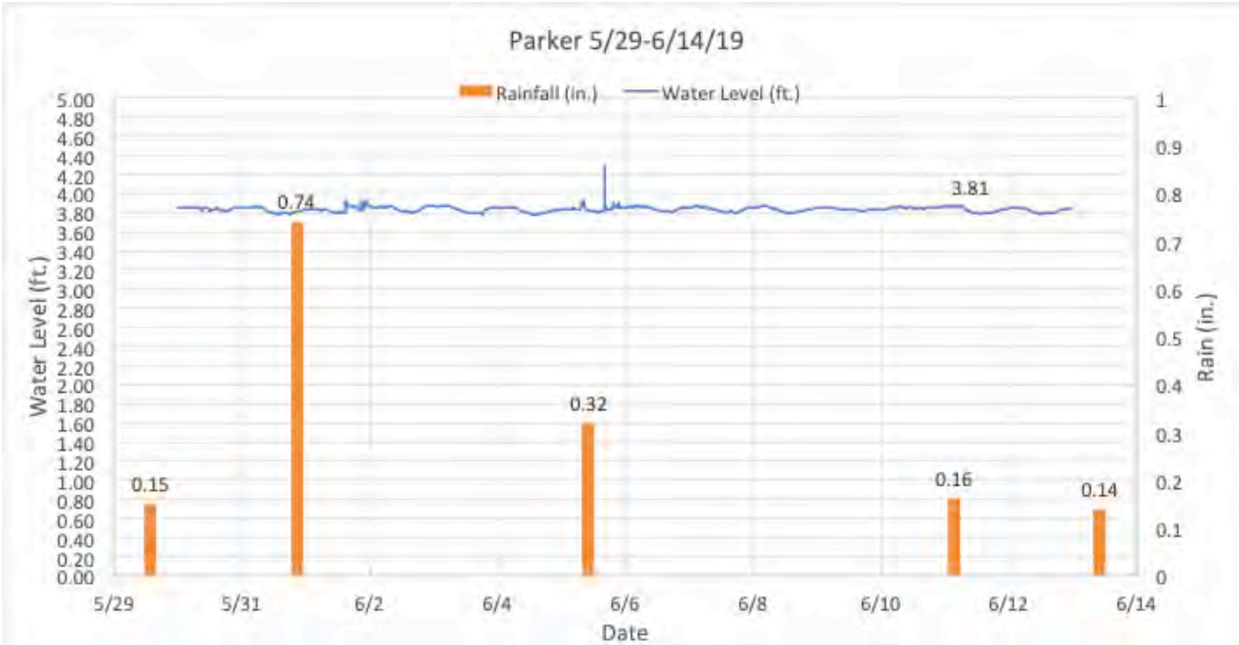

Making Shade 8/07-8/22/19
Rainfall (in.)
Water Level (ft.)
Water Level (ft.)
Rain (in.)
5.00
4.80
4.60
4.40
4.20
4.00
3.80
3.60
3.40
3.20
3.00
2.80
2.60
2.40
2.20
2.00
1.80
1.60
1.40
1.20
1.00
0.80
0.60
0.40
0.20
0.00
1.00
0.90
0.80
0.70
0.60
0.50
0.40
0.30
0.20
0.10
0.00
2.97
0.52
0.33
0.08
0.01
0.05
8/7
8/9
8/11
8/13
8/15
8/17
8/19
8/21
8/23
Date

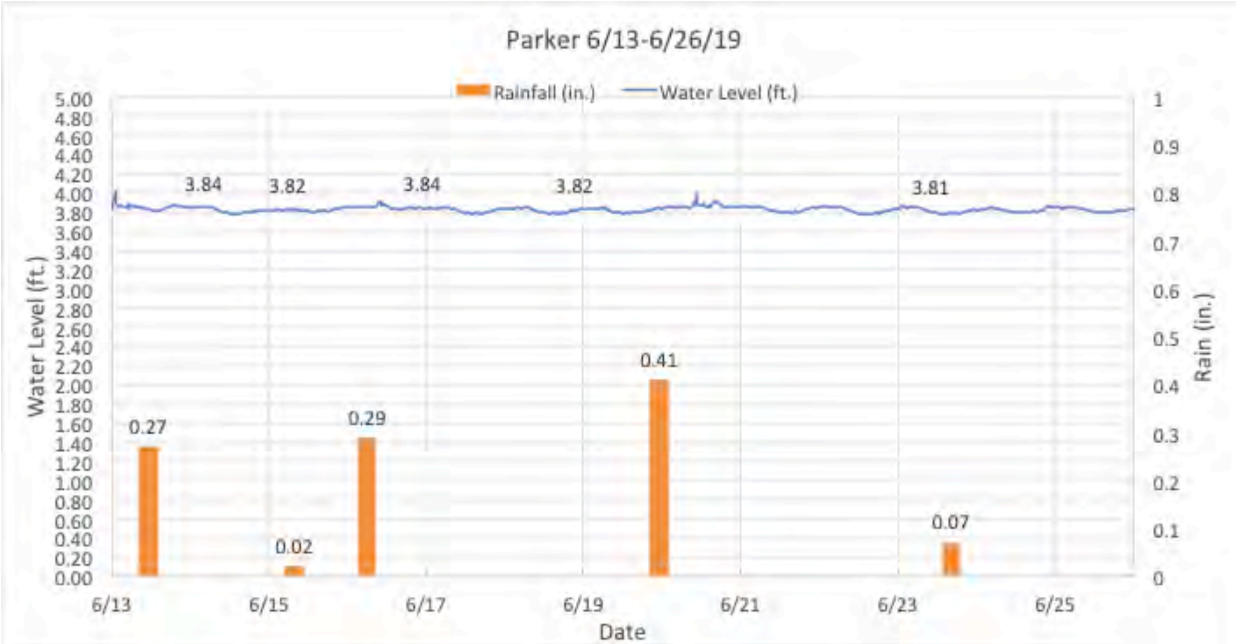

Making Shade 8/22-9/6/19
Rainfall (in.)
Water Level (ft.)
Water Level (ft.)
Rain (in.)
Date
5.00
4.80
4.60
4.40
4.20
4.00
3.80
3.60
3.40
3.20
3.00
2.80
2.60
2.40
2.20
2.00
1.80
1.60
1.40
1.20
1.00
0.80
0.60
0.40
0.20
0.00
1.00
0.90
0.80
0.70
0.60
0.50
0.40
0.30
0.20
0.10
0.00
8/22
8/24
8/26
8/28
8/30
9/1
9/3
9/5
9/7
0.06
0.34
0.57
0.52
0.01
0.54
0.17
0.22
0.16
0.12
0.95
0.03

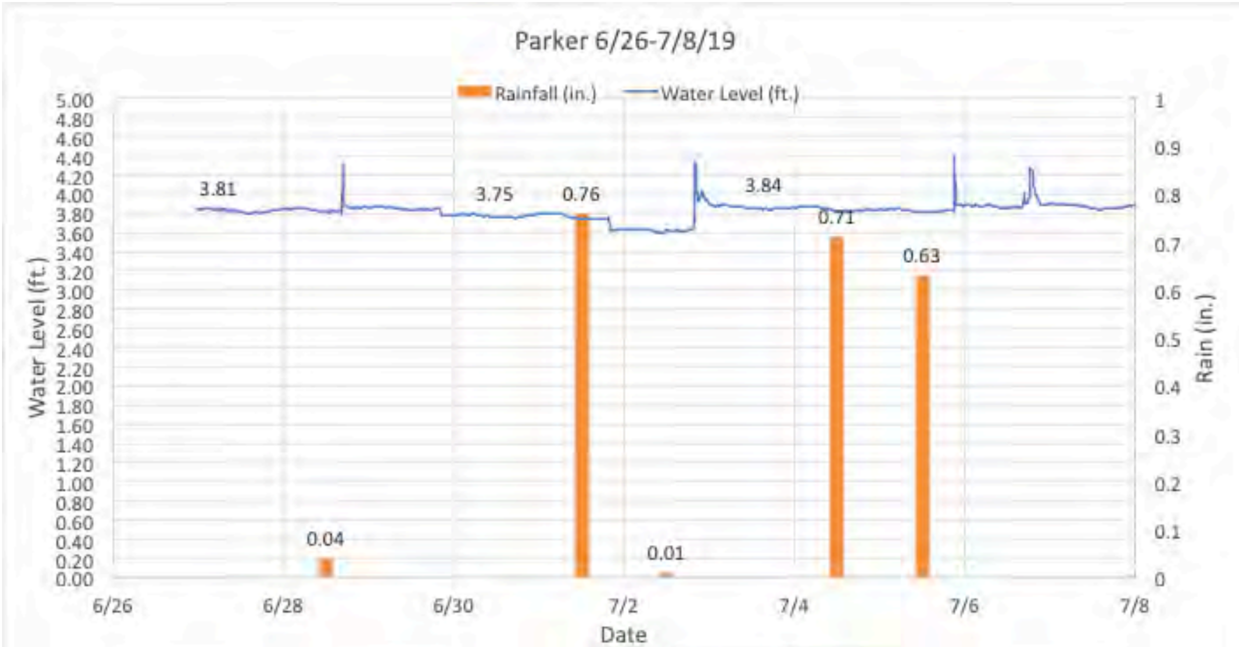

Making Shade 9/6-9/20/19
Rain
Water Level
Water Level (ft.)
Rain (in.)
Date
0.03
0.99
0.60
0.11
1.35
0.65
1.47
0.13
1.50
9/6
9/8
9/10
9/12
9/14
9/16
9/18
9/20

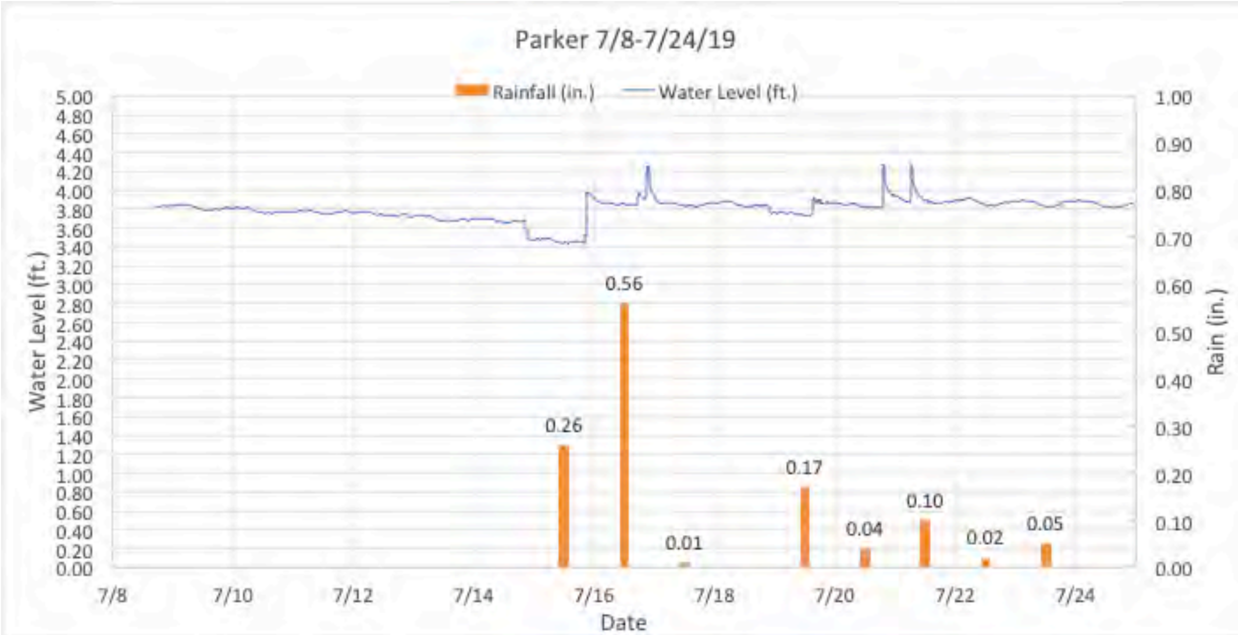

Making Shade 10/03-10/18/19
Rainfall (in.)
Water Level (ft.)
Water Level (ft.)
Rain (in.)
Date
0.38
2.07
1.69
1.95
1.28
1.13
1.48
0.09
0.11
0.07
0.13
10/3
10/5
10/7
10/9
10/11
10/13
10/15
10/17
10/19

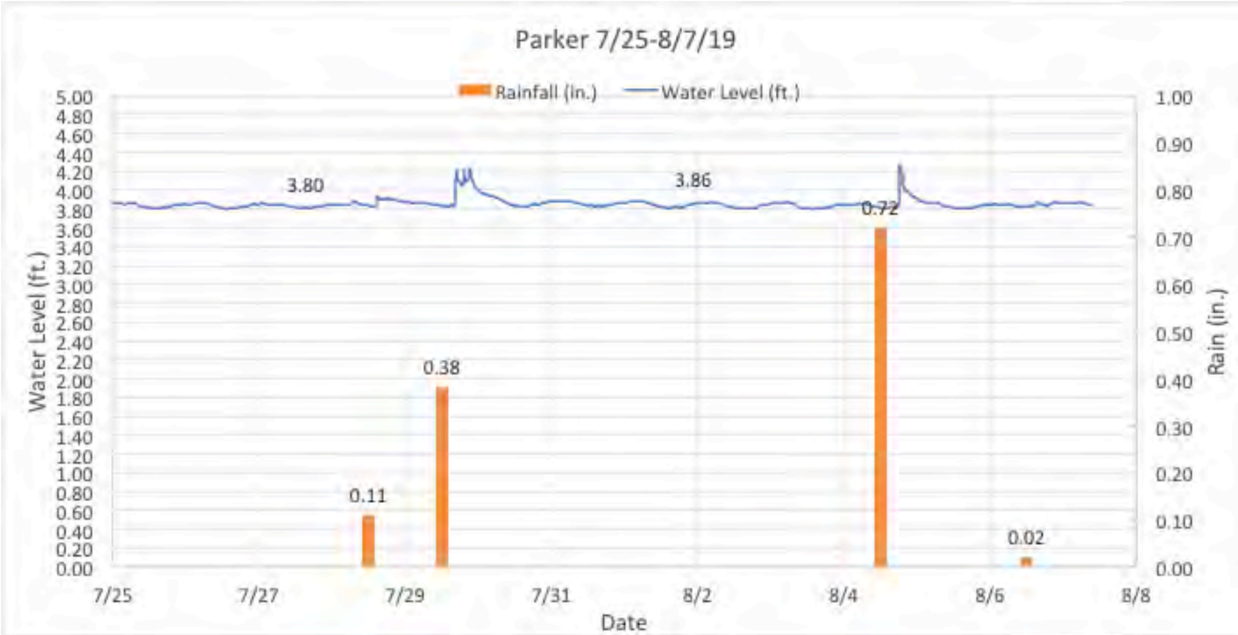

Parker 5/10-5/29/19
(Rainfall in.)
Water Level (ft.)
Water Level (ft.)
Rain (in.)
Date
5.00
4.80
4.60
4.40
4.20
4.00
3.80
3.60
3.40
3.20
3.00
2.80
2.60
2.40
2.20
2.00
1.80
1.60
1.40
1.20
1.00
0.80
0.60
0.40
0.20
0.00
1
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
5/10
5/12
5/14
5/16
5/18
5/20
5/22
5/24
5/26
5/28
5/30
3.82
0.03
0.18
0.04
0.18
0.64
0.17
0.08
0.27
0.09
0.04
0.15

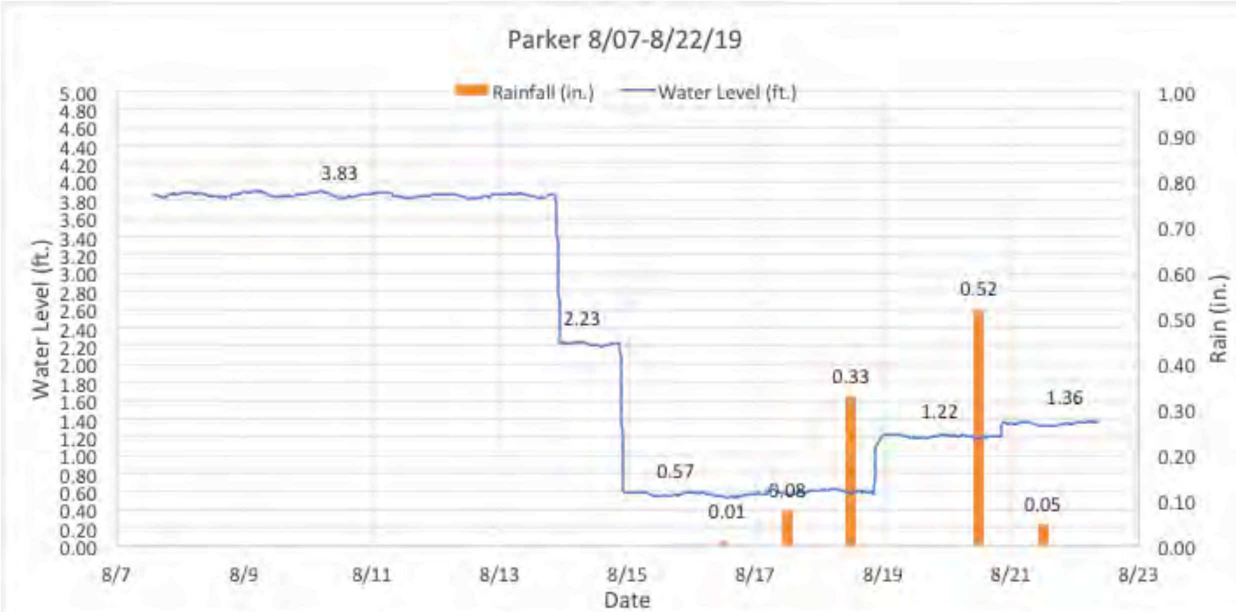

Parker 5/29-6/14/19
Rainfall (in.)
Water Level (ft.)
Water Level (ft.)
5.00
4.80
4.60
4.40
4.20
4.00
3.80
3.60
3.40
3.20
3.00
2.80
2.60
2.40
2.20
2.00
1.80
1.60
1.40
1.20
1.00
0.80
0.60
0.40
0.20
0.00
Rain (in.)
1
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
0.15
0.74
0.32
0.16
0.14
3.81
5/29
5/31
6/2
6/4
6/6
6/8
6/10
6/12
6/14
Date

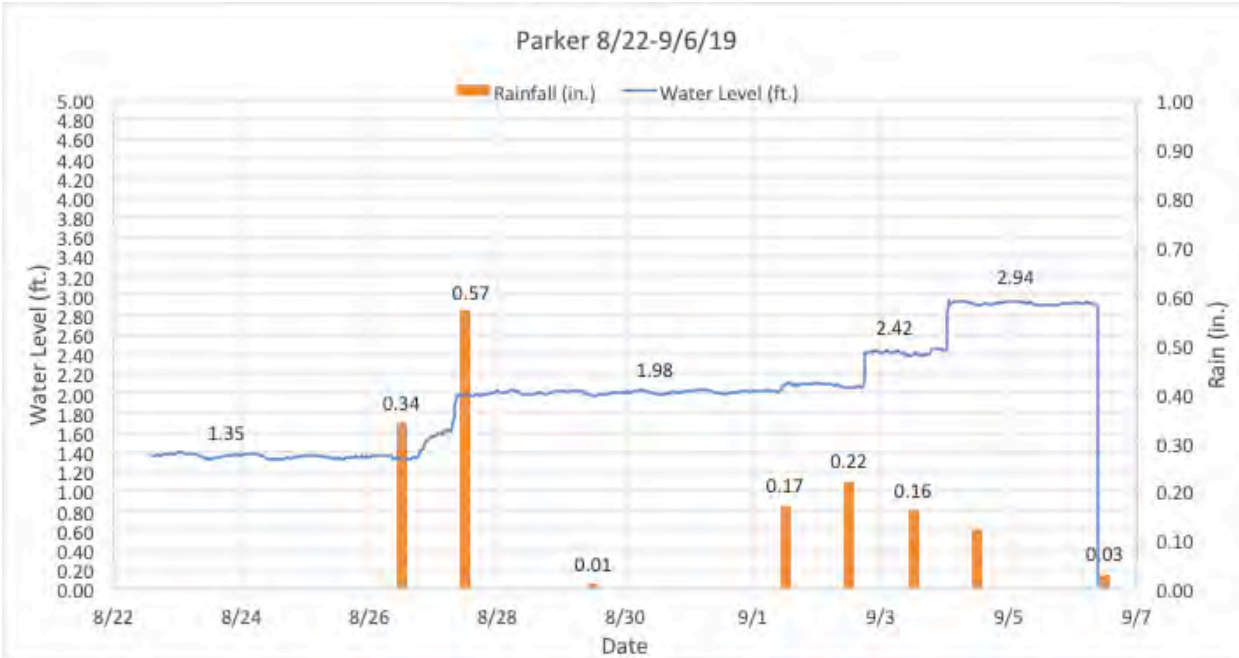

Parker 6/13-6/26/19
Rainfall (in.)
Water Level (ft.)
Water Level (ft.)
Rain (in.)
Date
3.84
3.82
3.84
3.82
3.81
0.27
0.02
0.29
0.41
0.07
6/13
6/15
6/17
6/19
6/21
6/23
6/25


Parker 6/26-7/8/19
Rainfall (in.)
Water Level (ft.)
Water Level (ft.)
Rain (in.)
Date
3.81
3.75
0.76
3.84
0.71
0.63
0.04
0.01
6/26
6/28
6/30
7/2
7/4
7/6
7/8


Parker 7/8-7/24/19
Rainfall (in.)
Water Level (ft.)
Water Level (ft.)
Rain (in.)
Date
0.26
0.56
0.01
0.17
0.04
0.10
0.02
0.05
7/8
7/10
7/12
7/14
7/16
7/18
7/20
7/22
7/24


Parker 7/25-8/7/19
Rainfall (in.)
Water Level (ft.)
Water Level (ft.)
Rain (in.)
Date
5.00
4.80
4.60
4.40
4.20
4.00
3.80
3.60
3.40
3.20
3.00
2.80
2.60
2.40
2.20
2.00
1.80
1.60
1.40
1.20
1.00
0.80
0.60
0.40
0.20
0.00
1.00
0.90
0.80
0.70
0.60
0.50
0.40
0.30
0.20
0.10
0.00
3.80
3.86
0.72
0.38
0.11
0.02
7/25
7/27
7/29
7/31
8/2
8/4
8/6
8/8


Parker 8/07-8/22/19
Rainfall (in.)
Water Level (ft.)
Water Level (ft.)
Rain (in.)
Date
5.00
4.80
4.60
4.40
4.20
4.00
3.80
3.60
3.40
3.20
3.00
2.80
2.60
2.40
2.20
2.00
1.80
1.60
1.40
1.20
1.00
0.80
0.60
0.40
0.20
0.00
1.00
0.90
0.80
0.70
0.60
0.50
0.40
0.30
0.20
0.10
0.00
8/7
8/9
8/11
8/13
8/15
8/17
8/19
8/21
8/23
3.83
2.23
0.57
0.01
0.08
0.33
1.22
0.52
0.05
1.36


Parker 8/22-9/6/19
Rainfall (in.)
Water Level (ft.)
Water Level (ft.)
Rain (in.)
Date
5.00
4.80
4.60
4.40
4.20
4.00
3.80
3.60
3.40
3.20
3.00
2.80
2.60
2.40
2.20
2.00
1.80
1.60
1.40
1.20
1.00
0.80
0.60
0.40
0.20
0.00
1.00
0.90
0.80
0.70
0.60
0.50
0.40
0.30
0.20
0.10
0.00
8/22
8/24
8/26
8/28
8/30
9/1
9/3
9/5
9/7
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0.34
0.57
1.98
0.01
0.17
0.22
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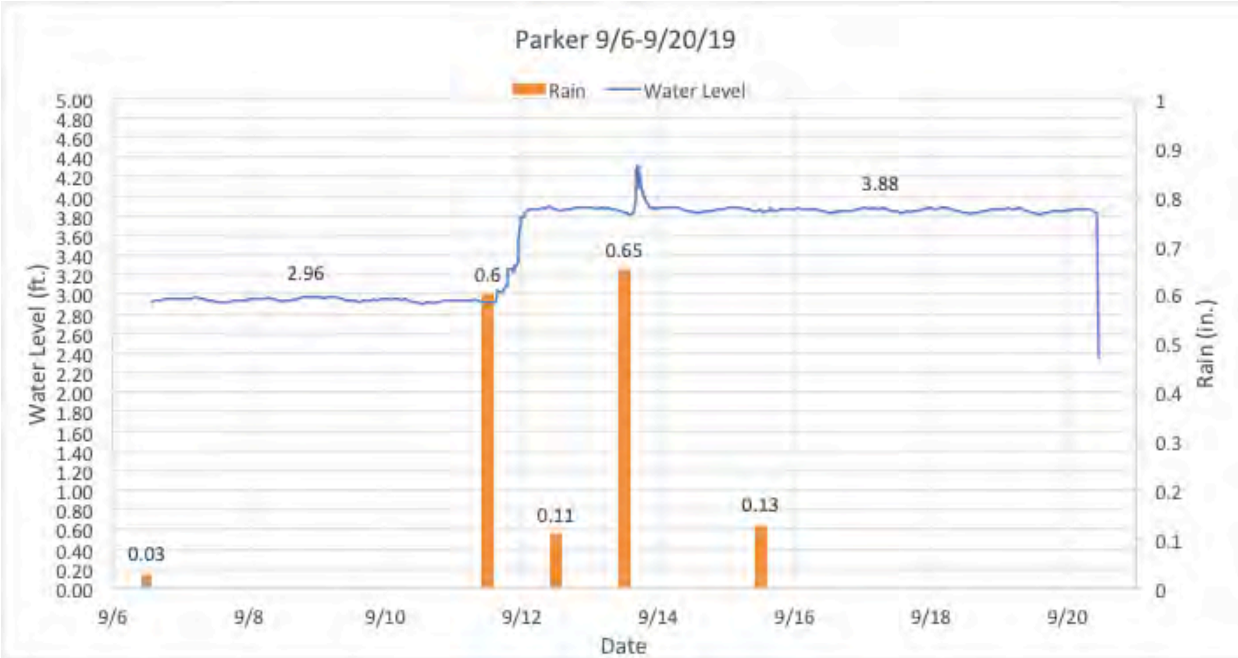
0.16
2.94
0.03


Parker 9/6-9/20/19
Rain
Water Level
5.00
4.80
4.60
4.40
4.20
4.00
3.80
3.60
3.40
3.20
3.00
2.80
2.60
2.40
2.20
2.00
1.80
1.60
1.40
1.20
1.00
0.80
0.60
0.40
0.20
0.00
Water Level (ft.)
1
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
Rain (in.)
2.96
0.6
0.65
3.88
0.03
0.11
0.13
9/6
9/8
9/10
9/12
9/14
9/16
9/18
9/20
Date


Parker 10/03-10/18/19
Rainfall (in.)
Water Level (ft.)
Water Level (ft.)
Rain (in.)
Date
5.00
4.80
4.60
4.40
4.20
4.00
3.80
3.60
3.40
3.20
3.00
2.80
2.60
2.40
2.20
2.00
1.80
1.60
1.40
1.20
1.00
0.80
0.60
0.40
0.20
0.00
1
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
10/3
10/5
10/7
10/9
10/11
10/13
10/15
10/17
10/19
3.84
0.38
0.09
0.11
0.07
0.13

Attachment D – KGD Citizen Journal

CITIZEN SCIENCE

Water Collection & Irrigation System Research Journal

KEEP GROWING DETROIT

Instructions

Each day that you're in your garden please record the following:

- Quality of Light While in the Garden (Full Sun, Partly Sunny, Cloudy)
- Daily Rainfall in Inches
- Temperature in the Garden in Farenheit

Also record if you used water from your collection system, what you used water for and for how long.

MAY 2019

WATERING ACTIVITY

Date/Notes:

Date/Notes:

Date/Notes:

Date/Notes:

SUN	MON	TUE	WED	THU	FRI	SAT
			1	2	3	4
5	6	7	8	9	10	11
12	13	14	15	16	17	18
19	20	21	22	23	24	25
26	27	28	29	30	31	1

WATERING ACTIVITY

Date/Notes:

Date/Notes:

Date/Notes:

WATERING ACTIVITY

Date/Notes:

Date/Notes:

Date/Notes:

Attachment E – Rainwater Harvesting Potential

Timbuktu Growing Season 2019					
Month	# of Days in the Month	# of Days With Rainfall	Rainfall Recorded (in.)	Estimated Runoff Available (gal.)	Estimated Volume of Water Collected (gal.)
May	31	20	3.98	9553	6456
June	30	10	2.46	5904	4032
July	31	14	3.81	9145	4824
August	31	10	2.65	6360	3408
September	30	14	2.95	7080	4752
October	31	12	3.72	8929	4800
2019 Season Totals		80	19.57	46971	28273

Timbuktu Growing Season 2020					
Month	# of Days in the Month	# of Days With Rainfall	Rainfall Recorded (in.)	Estimated Runoff Available (gal.)	Estimated Volume of Water Collected (gal.)
May	31	11	3.34	8017	4056
June	30	7	4.16	9985	2832
July	31	8	4.73	11353	3168
August	31	9	5.72	13729	4632
September	30	7	3.13	7512	3024
October	31	11	1.61	3864	3768
2020 Season Totals		53	22.69	54459	21480

CDC Urban Farms Growing Season 2019					
Month	# of Days in the Month	# of Days With Rainfall	Rainfall Recorded (in.)	Estimated Runoff Available (gal.)	Estimated Volume of Water Collected (gal.)
May	31	20	3.98	5459	5459
June	30	10	2.46	3374	3374
July	31	14	3.81	5225	5225
August	31	10	2.65	3635	3635
September	30	14	2.95	4046	4046
October	31	12	3.72	5102	5102
2019 Season Totals		80	19.57	26841	26841

CDC Urban Farms Growing Season 2020					
Month	# of Days in the Month	# of Days With Rainfall	Rainfall Recorded (in.)	Estimated Runoff Available (gal.)	Estimated Volume of Water Collected (gal.)
May	31	11	3.34	4581	4581
June	30	7	4.16	5706	5706
July	31	8	4.73	6487	6487
August	31	9	5.72	7845	7845
September	30	7	3.13	4293	4293
October	31	11	1.61	2208	2208
2020 Season Totals		53	22.69	31120	31120

Knaggs Creek Growing Season 2019					
Month	**# of Days in the Month**	**# of Days With Rainfall**	**Rainfall Recorded (in.)**	**Estimated Runoff Available (gal.)**	**Estimated Volume of Water Collected (gal.)**
May	31	20	3.98	595	595
June	30	10	2.46	368	368
July	31	14	3.81	570	570
August	31	10	2.65	396	396
September	30	14	2.95	441	441
October	31	12	3.72	557	557
2019 Season Totals		80	19.57	2928	2928

Knaggs Creek Growing Season 2020					
Month	**# of Days in the Month**	**# of Days With Rainfall**	**Rainfall Recorded (in.)**	**Estimated Runoff Available (gal.)**	**Estimated Volume of Water Collected (gal.)**
May	31	11	3.34	500	500
June	30	7	4.16	622	622
July	31	8	4.73	708	708
August	31	9	5.72	856	856
September	30	7	3.13	468	468
October	31	11	1.61	241	241
2020 Season Totals		53	22.69	3395	3395

Earthworks Urban Farm Growing Season 2019					
Month	# of Days in the Month	# of Days With Rainfall	Rainfall Recorded (in.)	Estimated Runoff Available (gal.)	Estimated Volume of Water Collected (gal.)
May	31	20	3.98	8424	8424
June	30	10	2.46	5207	5207
July	31	14	3.81	8064	8064
August	31	10	2.65	5609	5609
September	30	14	2.95	6244	6244
October	31	12	3.72	7873	7873
2019 Season Totals		80	19.57	41420	41420

Earthworks Urban Farm Growing Season 2020					
Month	# of Days in the Month	# of Days With Rainfall	Rainfall Recorded (in.)	Estimated Runoff Available (gal.)	Estimated Volume of Water Collected (gal.)
May	31	11	3.34	7069	7069
June	30	7	4.16	8805	8805
July	31	8	4.73	10011	10011
August	31	9	5.72	12106	12106
September	30	7	3.13	6625	6625
October	31	11	1.61	3408	3408
2020 Season Totals		53	22.69	48023	48023

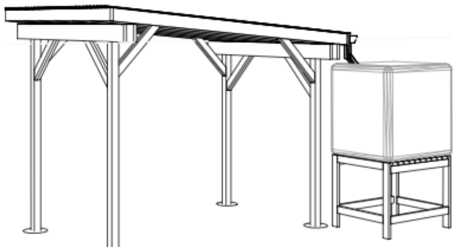
Making Shade Growing Season 2019					
Month	# of Days in the Month	# of Days With Rainfall	Rainfall Recorded (in.)	Estimated Runoff Available (gal.)	Estimated Volume of Water Collected (gal.)
May	31	20	3.98	159	159
June	30	10	2.46	98	98
July	31	14	3.81	152	152
August	31	10	2.65	106	106
September	30	14	2.95	118	118
October	31	12	3.72	148	148
2019 Season Totals		80	19.57	781	781

Making Shade Growing Season 2020					
Month	# of Days in the Month	# of Days With Rainfall	Rainfall Recorded (in.)	Estimated Runoff Available (gal.)	Estimated Volume of Water Collected (gal.)
May	31	11	3.34	133	133
June	30	7	4.16	166	166
July	31	8	4.73	189	189
August	31	9	5.72	228	228
September	30	7	3.13	125	125
October	31	11	1.61	64	64
2020 Season Totals		53	22.69	905	905

Parker Growing Season 2019					
Month	# of Days in the Month	# of Days With Rainfall	Rainfall Recorded (in.)	Estimated Runoff Available (gal.)	Estimated Volume of Water Collected (gal.)
May	31	20	3.98	1042	1042
June	30	10	2.46	644	644
July	31	14	3.81	998	998
August	31	10	2.65	694	694
September	30	14	2.95	772	772
October	31	12	3.72	974	974
2019 Season Totals		80	19.57	5124	5124

Parker Growing Season 2020					
Month	# of Days in the Month	# of Days With Rainfall	Rainfall Recorded (in.)	Estimated Runoff Available (gal.)	Estimated Volume of Water Collected (gal.)
May	31	11	3.34	875	875
June	30	7	4.16	1089	1089
July	31	8	4.73	1238	1238
August	31	9	5.72	1498	1498
September	30	7	3.13	820	820
October	31	11	1.61	422	422
2020 Season Totals		53	22.69	5941	5941

Attachment F – Rainwater Harvesting Fact Sheet



KEEP GROWING DETROIT'S RAINWATER CATCHMENT SAFETY & USE TIPS

WHY SHOULD YOU COLLECT RAINWATER?

Be a part of an ancient tradition! Whether you're growing food or just watering your lawn, collecting rainwater is a smart, economical, and environmentally beneficial practice. In Detroit, rainwater catchment systems provide residents and land based projects with the flexibility to grow plants on land without immediate access to city water. Collecting rainwater not only benefits plants, it also helps mitigate the impact of large rain events on the city's stormwater management systems; a win win for urban gardens and the broader community!

WHAT IS A RAINWATER CATCHMENT?

A rainwater catchment is any cistern or vessel connected to a downspout that is designed to catch and store rainwater that flows off of a catchment surface. Typical catchment surfaces include the roof of a house, shed, garage, or freestanding structure close to your garden or farm. Detroiters frequently use food-safe 55 gallon plastic barrels or 275 gallon IBC totes to store rainwater. Occasionally these vessels are elevated on bricks or a wood stand to help increase water flow. Depending on the size, growers may add a pump to push rainwater through a dripline or sprinkler irrigation system. Many growers choose to let gravity do the job!

ISN'T RAINWATER THE SAFEST OPTION?

Using untreated rainwater from a rainwater catchment when growing food crops carries some risk. Bacterial contamination from animal droppings and poor system monitoring is usually the culprit. With good practice and monitoring, collected rainwater from well maintained catchment systems is an excellent and affordable option. To keep consumers safe, the Food Safety Modernization Act (2011) set standards for growers using collected rainwater to irrigate crops meant for human consumption. For the same reasons growers must clean their harvest knives and keep their hands washed, collected rainwater must be used and monitored in ways that prevent the spread of food-born illness. Keep Growing Detroit recognizes that rainwater collecting is a big part of our agricultural tradition, and can help growers navigate best practice for using rainwater on their gardens!

JUST HOW MUCH WATER...

1 inch of rainfall over 1,000 square foot of roof = 623 gallons!

THAT'S A LOT OF WATER!

SELLING CROPS

In order to ensure that the produce sold to customers is both high quality and safe to eat, we strongly encourage all growers to adhere to these safe rainwater usage tips when growing and harvesting produce for sale. The checklist on the back of this sheet will help you get started!

KEEP GROWING DETROIT'S
RAINWATER CATCHMENT SAFETY CHECKLIST

Residents can benefit greatly from harvesting rainwater. When it's done correctly, it gives growers flexibility during times of drought or water scarcity. At the same time, actions must be taken to prevent the spread of harmful bacteria through the direct application of collected rainwater on food crops. Use the checklist below as a guide when setting up a catchment system and using collected rainwater on your land based project.

SET-UP AND SIGNAGE

- [ ] Location: Rainwater catchment systems must adhere to City of Detroit property set-backs. Make sure you build at least 5 feet away from all neighboring property and away from trees.
- [ ] Capacity/Sizing: Examine your roof size and determine your water needs to right-size your water catchment so that you don't end up with too little or too much water. See KGD's "Rainwater Catchment Calculations" document for guidance about how to calculate.
- [ ] Signage: All rainwater catchment tanks must have a clear sign or label that states that the water is not for drinking or for washing food.
- [ ] Painting/Filtering: Use spray paint that adheres to plastic to paint water storeage vessels dark to prevent bacteria/algae growth. Use window screen to prevent debris from entering the top of the vessel
- [ ] Permitting: For more information on securing a "catch basin permit" for your rainwater catchment system, go to the BSEED website: https://detroitmi.gov/forms/plumbing-permit-application.

USING WATER

- [ ] Separate City Water from Collected Rainwater: Irrigation systems can be fed with EITHER collected rainwater OR city water but NOT both to prevent backfeeding contaminated water into the city system.
- [ ] No Sprinklers: Use collected rainwater for drip or sub-surface irrigation ONLY, so that it contacts the soil directly and not the edible portion of the plant.
- [ ] Timing: Irrigating with collected rainwater should not happen directly before/on a harvest day where workers may come in direct contact with potential contaminants.
- [ ] Storing Water: Never store water for long periods of time. Try to use water within two weeks of collecting it. Use or dump water that's been standing for awhile the day before it rains to make room for fresh water.
- [ ] No Wash Water: Never use collected rainwater to wash produce. Use potable water only when washing produce, harvest tools, bins, and wash pack surfaces.

MAINTENANCE

- [ ] Treat As Needed: Add 1oz kitchen bleach per 55gal of rainwater/month to prevent algae and E. coli growth in your tanks. Let sit for 24 hours before using water. Treat more with frequent rainfall.
- [ ] Water Use Log: Keep good records! Document when you use collected rainwater, what you use water for, when you apply bleach treatments, change filter, test water, etc. Traceability is important!
- [ ] Testing: Plan to have your collected rainwater checked annually by a lab that can test for the presence of E. coli in your system.
- [ ] Watch for Contaminants! Check your catchment tanks weekly for algae, bird droppings, and other contaminants. Don't let a full tank sit for more than two weeks before flushing.
- [ ] Winterization: Remove and store all irrigation equipment for the winter ie November-April. Remember to empty the catchment tanks and leave valves open so that they don"t freeze!

Attachment G – DWSD Case Study Application

DWSD Credit Calculations for Urban Agriculture

DWSD allows for green stormwater infrastructure to be eligible for peak flow credit (based on percent capture of the 100-year 24-hour storm event) and volume credit (based on annual runoff volume). Research conducted during the Harvesting Sustainable Water Solutions project suggests urban agriculture is highly effective at managing both peak flow and annual volume. However, this memo only quantifies the use of urban agriculture plots in Detroit to treat impervious area using DWSD methodologies for volume control (*DWSD Drainage Program Guide (DPG); 2018*). The two methods used for quantifying volume credit are the DWSD Disconnected Impervious Method (*DPG pg 57*) and the Equivalent Water Depth (EWD) Method (*DPG pg 59*).

Disconnected Impervious Method

The Disconnect Impervious Method is valid for when impervious surfaces, such as roofs or parking lots, can sheet flow onto adjacent pervious surfaces; hence not directly connected to the combined sewer system. In this scenario, adjacent impervious surfaces would be directed onto urban agricultural beds instead of turf grass. The increased effective soil porosity of urban agricultural soils allows for a higher impervious area treated than a standard turf grass site.

For calculating disconnected impervious credit, the ratio of Stormwater Practice Area to impervious Drainage Area defines the Practice Ratio (Equation 1) which is then used to calculate the Volume Credit (Equation 2).

Equation 1

$$Practice\ Ratio = \frac{Stormwater\ Practice\ Area}{Drainage\ Area}$$

Equation 2

$$Volume\ Credit\ (\%) = 0.94 * \frac{Practice\ Ratio}{0.25 + Practice\ Ratio} * 100$$

Equation 2 assumes 0.8 inches of water retained on pervious surfaces (i.e. turf grass lawn). This is equivalent to an effective soil porosity of 0.2 in four inches of soil. Since urban agricultural soils have demonstrated the ability to retain several times that amount, it is necessary to adjust Equation 2 to calculate a Volume Credit for urban agricultural soils. Equation 2 was derived using continuous hydrologic simulations, but the exact approach was not available during this investigation. As such, it was not possible to derive a new version of Equation 2 for agricultural soils. Instead, a weighted Practice Ratio based on effective soil porosity was used to estimate Volume Credit for scenarios with increased water retention.

For calculating retention in urban agricultural soil, a depth of 6 inches was assigned as the top layer of planting soil even though in many agricultural beds the effective organic rich planting soil layer would be thicker. The water retained in the soil column, also referred to as equivalent water depth (EWD), was calculated for a range of effective soil porosities from 0.2 to 0.5 (Table 1).

The weighted Practice Ratio was calculated by multiplying the Practice Ratio by a ratio of EWD for different soil retention scenarios (Table 1). For example, using the DWSD Disconnected Impervious Ratio Method, a Practice Ratio of 1/1 would yield a Volume Credit of 75%. If that same scenario had urban agricultural soil with an effective soil porosity of 0.3 and six inches of depth, the resulting weighted Practice Ratio is 2.25/1 (1.8” ÷ 0.8” = 2.25) and the Volume Credit is 85%.

Table 1 – EWD for Various Soil Conditions

Soil Depth (inches)	**Soil Effective Porosity**	**EWD (inches)**	
4”	0.2	0.8”	DWSD Pervious Soil Assumption
6”	0.2	1.2”	
6”	0.3	1.8”	
6”	0.4	2.4”	Assumed Urban Agriculture Effective Soil Porosity
6”	0.5	3”	Assumed Effective Soil Porosity with High Organic Matter

Figure 1 provides credit curves for four different Practice Area ratios. Each line shows the DWSD Volume Credit for a range of EWDs based on a soil depth of six inches (except the DWSD Pervious Soil Assumption case which has an EWD of 0.8 inches on 4 inches of soil). The DWSD Disconnected Impervious Method calculates a Volume Credit of 62% for a 1/2 Practice Ratio but an urban agricultural soil with an EWD of 2.4 inches would achieve the same credit for a 1/6 Practice Ratio. In other words, the increased effective soil porosity of urban agricultural soil allows for three times as much impervious area to be treated for the same sized practice area. Another way to interpret Figure 1, for a Practice Ratio of 1/2, the DWSD Approach yields a 62% volume credit, but if the site was converted to urban agriculture, the Volume Credit would be 80%.

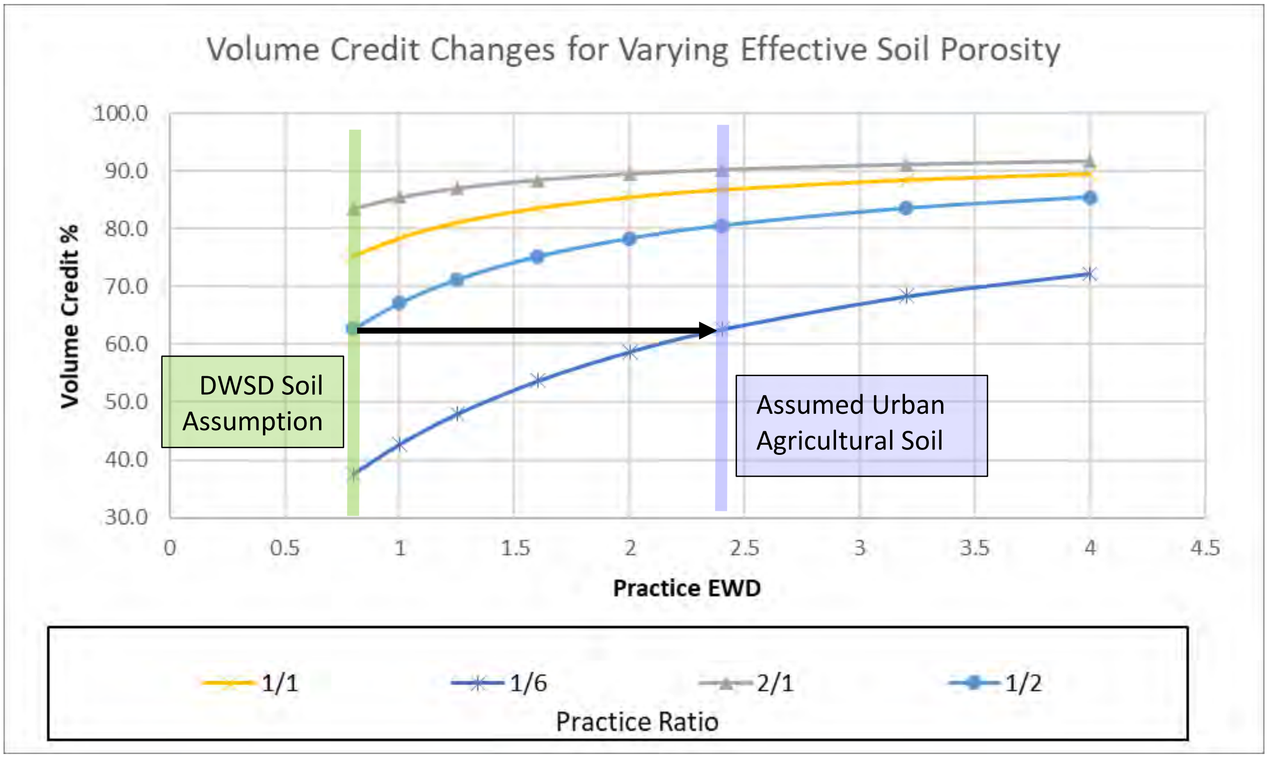


Figure 1 – Volume Credit (%) for Varying EWD

Equivalent Water Depth (EWD) Method

The EWD Method is used by DWSD for calculating Volume Credit for bioretention cells (i.e. rain gardens). For this approach, water is directed into the rain garden practice either through piped inlets or overland sheet flow. DWSD's EWD Bioretention calculation methodology (Equation 3) was applied assuming that urban agricultural soils function similar to a rain garden, but without surface ponding. The formula was applied to 6 inches of soil and a range of effective porosities described in Table 1.

Equation3

$$Volume\ Credit\ (\%) = (1 - 2.5^{-2.5r}) * 100$$
$$r = equivalent\ rainfall\ depth\ (inches)$$

As an example, Figure 2 provides volume credit for a range of EWDs from 0.8 inches to 2.4 inches for two Practice Ratios. The EWD Method calculates a Volume Credit of 84% for a Practice Ratio of 1/1 and an EWD of 0.8 inches. An urban agricultural soil with an EWD of 2.4 inches could achieve the same credit for a Practice Ratio of 1/3 (i.e. treat three times the amount of impervious drainage area).

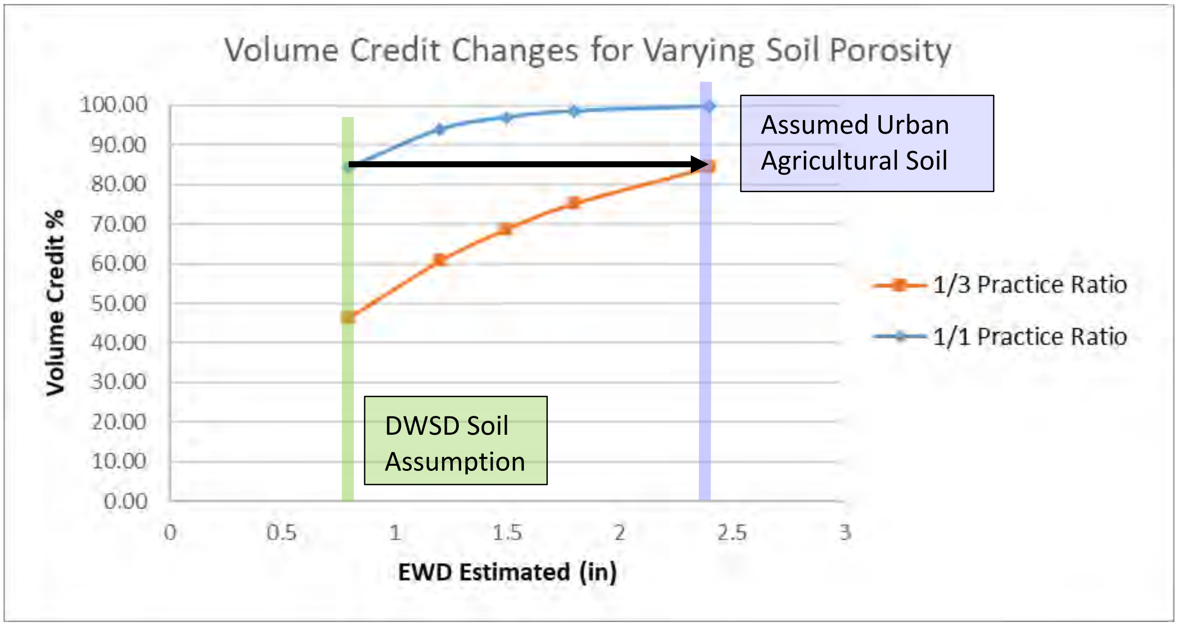


Figure 2 – Volume Credit for Varying EWD

<u>Case Study: 628 W. Philadelphia Street</u>

The two methods described above were applied to an urban agriculture site at 628 W. Philadelphia Street (Figure 3). The area for disconnected impervious treatment is turf grass (6000 square feet available) but could be converted to agriculture in the future. There were two scenarios considered: using 2,000 square feet of the available area and using the entire available area (Table 2).

Using the DWSD Soil Assumption of 0.8" EWD for a 2,300-sf roof and 2,000-sf of lawn, the Disconnect Impervious Method yields a Volume Credit of 73%. If converted to urban agricultural soil with an EWD of 2.4 inches, the Volume Credit is 86%. If the EWD Method is used instead (treating agricultural like rain gardens) the site would get a Volume Credit of 99%.

Figure 3 – Case Study Site at 628 W Philadelphia St

Table 2 – Case Study Results

Method	Volume Credit for 0.8" EWD (DWSD Soil)	Volume Credit for 2.4" EWD (Urban Ag Soil)
2,000 SF Practice Area Disconnected Impervious Method	73%	86%
2,000 SF Practice Area Equivalent Water Depth Method	80%	99%
6,000 SF Practice Area Disconnected Impervious Method	86%	91%
6,000 SF Practice Area Equivalent Water Depth Method	99%	100%