

Re-Store'N Station – Phase II – Water Usage Analysis dated 12/8/2015

1. Water usage for existing development (Phase I):

- a. Attached is the Commissioning Report – Water and Wastewater Systems for TM55B – 1 done by Old Dominion Engineering dated Feb 2, 2015. It states that for period Sept 12, 2014 to October 23, 2014, the average water usage was confirmed to be 204.4 gallons per day. For period October 23, 2014 to January 28, 2015, the average water usage was confirmed to be 243.4 gallons per day. The usage during the commissioning of the septic system reflects the first few months of the store opening. This period had less than the ultimate anticipated customer activity but does provide confirmation of the flows that were treated at that time. This report also provides the instructions for reading the water meter. After 6 months, the store achieved the anticipated customer activity.
- b. Attached is the water meter log sheets for the period 9/9/2014 through 12/1/15 which is a full year (52 weeks) plus 9 weeks into the second year of data. The actual readings are provided with the date of the reading. Written in the right side margin is the actual gallons per week/ gallons per day. The first 26 weeks of operation (9/9/14-3/10/15) average was 250 gpd. The second half of the year of operation (3/17/15-9/17/15) average was 408 gpd. The first 9 weeks of the 2nd year of operation average was 232 gpd.
- c. Analysis of actual Phase I data: In the months of June and July 2015, there was a seven week period (6/9 – 7/21) of higher meter readings. It was determined that the uninformed employees had been washing the sidewalk with the water house instead of broom cleaning as should have been done. Once this was corrected, the meter readings reflected water usage in the more normal range of 346 to 400 gpd. For purposes of this analysis, the higher average of 408 gpd is being used without factoring in the most recent couple month with the average of 232 gpd. All of this information does prove that the existing development can operate at a fraction of the water allowed for this site. The actual water usage is in the range of 25 to 14% of 1,625 gpd.

FUTURE ANALYSIS: For purposes of this analysis, the higher average of 408 gpd is being used which is 25% of the allowable water usage of 1,625 gpd. This leave 75% or 1,217 gpd available to serve the Phase II expanded development.

- A. The existing water usage for the 2,775sf convenience/retail store is proven with meter reading data (see above). The Phase II expansion water usage projections are presented below. It should be noted that calculations below may not completely reflect the high efficiency toilets (HET's) with 1.28 gallons per flush and the urinals flushes of 0.1 gallons per flush that are have been and will be installed. The two stage flush toilets now available even offer a greater measure of water conservation and will likely be installed in the 6 restrooms required by code (1 each tenant unit – 1st floor, 1 retail auto, 1 auto shop, 2/3 to serve the 2nd floor office space – total 6). In addition as typical in any commercial restroom (As in the County Office Bldg), the use of electronic auto timers valves on the hand wash sinks which provides a 3 – 6 second flow for hand washing saves even more water. Therefore, these calculations are higher than the anticipated water use so conservative. For instance the additional space being added to the existing convenience store that will increase the square footage from 2,775 sf to 5,497 sf will be served by the existing restroom facilities. Therefore, minimal additional water usage is anticipated. Regardless the new space is counted below in both calculations.
- B. The analysis below is based upon two different design manuals:
 1. USEPA Onsite Wastewater Treatment Systems Manual - Table 3 – 4 (attached) This table incorporates the effect of the 1994 EPA Act that limited toilets to 1.6 gpf – see note below the table.

The most applicable category now that the site will have convenience/retail, office, tenant rental spaces, and auto shop repair- the Shopping Center category reflects a mixture of uses. The category uses the number of employees (occupants) which is a reasonable basis for this type analysis. The table indicates a volume of 10 gpd per employee and 2 gpd per parking space to calculate the projected wastewater capacity flow rates for commercial sources = water consumption.

USE		EMPLOYEES
CONVENIENCE/RETAIL	EXISTING OPERATIONS	Included in meter data
	ADD FOR DRIVE THRU	2
RETAIL TENANT SPACES	2 PER RENTAL STORE X 2	4
AUTO RETAIL	2 COUNTER PEOPLE	2
AUTO REPAIR SHOP	4 MECHANICS	4
OFFICE USE – 9,175SF x .8	1 EMPLOYEE/200 NET SF	37
	Total employees	49

CALCULATE WATER USAGE: 49 Employees x 10 gpd/employee = 490 gpd
 106 spaces x 2 gpd/space = 212 gpd

The projected water usage based upon employees in Phase II is 702 gpd.

Peak usage for Phase I is 534 gpd added to this projection = 1,236 gpd. This is only 76% of the 1,625 gpd allowed. Using the average of 408 gpd the projected is 1,110 gpd or 68% of the allowable 1,625 gpd.

2. Second approach using Virginia Department of Health 12 VAC 5-690. Waterworks Regulations –Capacity of Water works states the design capacity “shall exceed the maximum daily water demand of the system”. This table incorporates a safety factor to meet this requirement. Page with table is attached. This regulation was adopted well before 1994 (around 1980) and has not been updated from when toilets used 3.5, 5, 7 gallons per flush (gpf).

Shopping Centers, per 1,000 sf of ultimate floor area usage is 200 – 300 gpd.

Service Stations, per vehicle served – 10 gallons

To calculate the Shopping Center ultimate floor area = net usable area 0.80 factor is used.

To adjust the water usage to take into account that these water consumption rates were adopted in 1980. The 1994 EPA Act federal regulation limited the amount of water per flush for toilets to a maximum of 1.6 gpf or 1.28 gpf for HET's (high efficiency toilets). When comparing the medium older flush toilet water volume of 5.0 gpf to the HET of 1.28 gpf – the HET uses 25.6% of the water consumption. (No adjustment is being made for the modern urinals which use 0.1 gpf when water consumption was 1.0 gpf which saves 90% on water usage)

Therefore, the 10 gpd per vehicle adjusted for installing HET's will be 2.56 gpd.

The shopping center consumption of 200 – 300 gpd is adjusted to be 51.2 – 76.8 gpd.

Shopping center including office and retail is a total of 16,022 SF X .8 to get ultimate floor area =12,818 sf (excludes auto shop & tire)	12,818 X 51.2 -76.8/1,000SF	656 gpd – 984 gpd
Auto repair shop	4 bays x .5 car/hr x 8 hrs/day = 16 cars per day x 2.56 gpv	41 gpd
	TOTAL GPD	RANGE OF 697 – 1025 GPD

The peak usage of Phase I is 534 gpd added to this range = 1231 – 1559 gpd

This is 93 to 96% of the 1,625 gpd allowed. Using the average of 408 gpd the projected is 1,105 - 1433 gpd or 68% - 88% of the allowable 1,625 gpd.

In conclusion, both the USEPA and the Virginia Department of Health, Waterworks Regulations provide a reasonable basis for analysis and both include a safety factor for the design of wastewater systems. The results based upon these calculations for the Phase II expansion are fairly close. Using the USEPA manual – the average is 68% of the allowable 1,625 gpd. Using the VDH manual, the average is 68 – 88% of the allowable 1,6245 gpd. Both converge at the 68% level with the VDH manual (which is the most out of date) giving a range. Therefore, the projected water usage is approx. 1,110 gpd or 68% of the 1,625 gpd allowed.

It should be acknowledged that water conservation is both an important environmental concern and cost saving measure and all new plumbing fixtures are subject to the USEPA regulations to reduce water consumption. The property owner in this case is very aware of the mandate to operate under the limit of 1,625 gpd which is all the system can physically withdraw from the well with the flow device limitation in place. The water withdrawal cannot be exceeded. These projections are to confirm that it is reasonable to allow for this property to be developed as proposed and not exceed the by-right limit for HC use in the rural areas of 400 gallons per day per acre limit.

Attachments:

Water meter reading log – 3 sheets

USEPA design Manual sheet – 1 page

VDH design Manual sheet – 1 page

Old Dominion Engineering

February 2, 2015

Jeff Sprouse
Jeffries II, LLC
P.O. Box 910
Crozet, VA 22932

SUBJECT: TM 55B-1 - COMMISSIONING REPORT - WATER AND WASTEWATER SYSTEMS

Property: TM 55B-1, 6099 ROCKFISH GAP TPKE Crozet, VA 22932 4.06 Acres

The convenience store started operations at the end of third quarter 2014. The wastewater treatment system was commissioned and started up from September 12, 2014 until October 23, 2014. Multiple visits were made to test and adjust the system during that time period. Process treatment systems had to be optimized to compensate for the lower influent wastewater flow rates from the store to keep effluent limits within permit guidelines and ensure plant survival in the recirculating vegetative gravel filter. Despite the lower flow rates encountered all systems operated within effluent tolerances.

The VDH permitted effluent strength limits are:

- BOD₅ < 30 mg/l
- TSS < 30 mg/l
- TN < 25.5 mg/l

Fourth quarter sample results were all within compliance:

- BOD₅ < 2 mg/l
- TSS = 2 mg/l
- TN = 3.68 mg/l

The fourth quarter inspection report and sample results have been submitted to VDH. A copy of the Field Abbreviated Inspection Certification is provided.

The VDH mandatory monitoring requirements of the system are:

- Quarterly Inspections
 - The next inspection is due first quarter 2015
- Once per Year Sample for BOD₅, TSS, and TN
 - The next round of compliance samples are due fourth quarter 2015

Water Usage

The water usage was monitored during the commissioning period (September 12, 2014 to October 23, 2014). The average water usage during that time was 204.4 gallons per day.

It would be anticipated that peak water usage would exceed the average water usage. However, both the wastewater system and water system have flow equalization components which serve to dampen the withdrawal of water from the aquifer and the ultimate release of treated effluent back into the soil.

To obtain a longer term view of the water usage we read the water meter again on January 28, 2015. The average water usage from the end of the commissioning period (October 23, 2014) to January 28, 2015 was 243.4 gpd. It is recommended to have the staff read the water meter once per week to develop long term weekly averages of water usage. A water meter reading guide and log sheet template is attached for your use.

The letter serves to confirm that the water usage (and withdrawal) is less than the maximum permitted amount of 1,624 gpd.



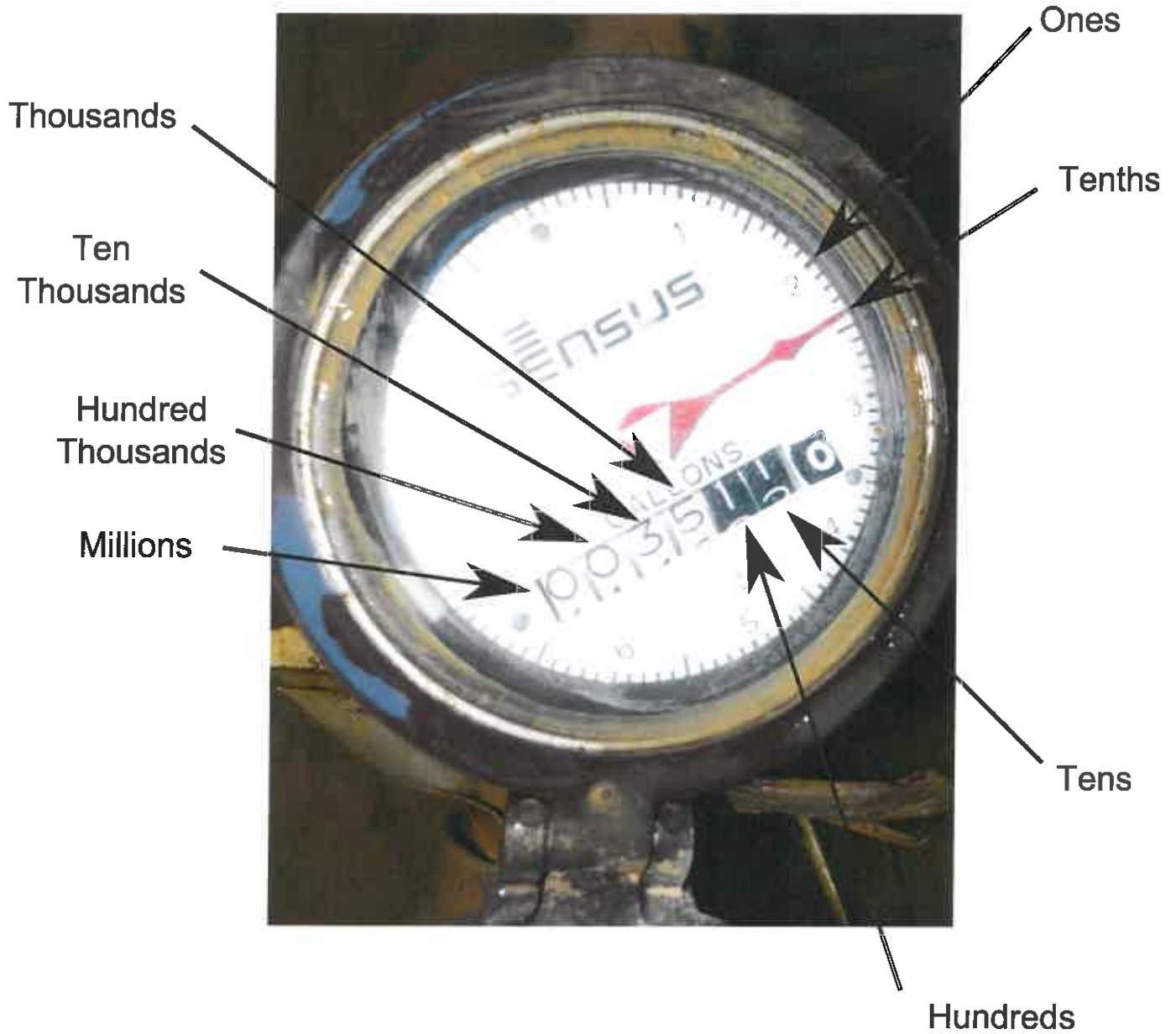
Sincerely,

A handwritten signature in black ink, appearing to read "Michael Craun".

Michael Craun PE

Old Dominion Engineering
2036 Forest Drive • Waynesboro, VA 22980
PHONE (540) 942-5600 • FAX (540) 213-0297

Meter Reading Guide



Meter Reading
0,035,112.4

1/3

Water Meter Log

TM 55 B-1
6099 Rockfish Gap Turnpike Crozet, VA 22932

Date	Time	Water Meter Reading (gallons)	Name
9/9/14	9:00 Am	2,520.0	J. Spurr
9/16/14	"	4,140.0	"
9/23/14	"	5,840.0	"
9/30/14	"	7,460.0	"
10/7/14	"	8,260.0	"
10/14/14	"	9,810.0	"
10/21/14	"	11,500.0	"
10/28/14	"	12,320.0	"
11/4/14	"	13,930.0	"
11/11/14	"	14,750.0	"
11/18/14	"	16,350.0	"
11/25/14	"	17,440.0	"
12/2/14	"	18,540.0	"
12/9/14	"	20,250.0	"
12/16/14	"	21,160.0	"
12/23/14	"	23,440.0	"
12/30/14	"	26,030.0	"
1/6/15	"	28,070.0	"
1/13/15	"	30,180.0	"
1/20/15	"	32,640.0	"
1/27/15	"	35,110.0	"
2/3/15	"	36,770.0	"
2/10/15	"	39,780.0	"
2/17/15	"	42,580.0	★
2/24/15	"	44,930.0	"
3/2/15	"	46,390.0	"
3/10/15	"	47,950.0	"

26 week period Average = 250 gpd
★ [1 week peak 430 gpd]

2/3

Water Meter Log

TM 55 B-1
6099 Rockfish Gap Turnpike Crozet, VA 22932

Date	Time	Water Meter Reading (gallons)	Name	gals per wk / gals per day
3/17/15	9:00	52,180.0	J. Spran	
3/24/15	"	54,520.0	"	2412/345
3/31/15	"	56,850.0	"	2330/333
4/7/15	"	59,250.0	"	2400/343
4/14/15	"	61,850.0	"	2600/371
4/21/15	"	64,370.0	"	2520/360
4/28/15	"	67,010.0	"	2640/377
5/5/15	"	69,760.0	"	2750/393
5/12/15	"	72,670.0	"	2910/416
5/19/15	"	75,620.0	"	2950/421
5/26/15	"	78,140.0	"	2520/360
6/2/15	"	80,780.0	"	2640/377
6/9/15	"	83,990.0	"	3210/459
6/16/15	"	87,620.0	"	3630/519
6/23/15	"	90,750.0	"	3130/447
6/30/15	"	94,380.0	"	3630/519
7/7/15	"	97,910.0	"	3530/504
7/14/15	"	101,650.0	★	3740/534
7/21/15	"	104,990.0	"	3340/477
7/28/15	"	107,806.0	"	2816/402
8/4/15	"	110,522.0	"	2716/388
8/11/15	"	113,272.0	"	2755/394
8/18/15	"	116,047.0	"	2775/396
8/25/15	"	118,847.0	"	2800/400
9/1/15	"	121,448.0	"	2601/372
9/8/15	"	123,970.0	"	2522/360
9/15/15	"	126,393.0	"	2423/346

26 week period Average = 408 gpd
 ★ [1 week peak 534 gpd]

Chapter 3 Establishing Treatment System Performance Requirements

Table 3-4. Typical wastewater flow rates from commercial sources^{a,b}

Facility	Unit	Flow, gallons/unit/day		Flow, liters/unit/day	
		Range	Typical	Range	Typical
Airport	Passenger	2-4	3	8-16	11
Apartment house	Person	40-80	50	150-300	190
Automobile service station ^c	Vehicle served	8-15	12	30-57	45
	Employee	9-15	13	34-57	49
Bar	Customer	1-5	3	4-19	11
	Employee	10-16	13	38-61	49
Boarding house	Person	25-60	40	95-230	150
Department store	Toilet room	400-600	500	1,500-2,300	1,900
	Employee	8-15	10	30-57	38
Hotel	Guest	40-60	50	150-230	190
	Employee	8-13	10	30-49	38
Industrial building (sanitary waste only)	Employee	7-16	13	26-61	49
Laundry (self-service)	Machine	450-650	550	1,700-2,500	2,100
	Wash	45-55	50	170-210	190
Office	Employee	7-16	13	26-61	49
Public lavatory	User	3-6	5	11-23	19
Restaurant (with toilet)	Meal	2-4	3	8-15	11
	Conventional Customer	8-10	9	30-38	34
	Short order Customer	3-8	6	11-30	23
	Bar/cocktail lounge Customer	2-4	3	8-15	11
Shopping center	Employee	7-13	10	26-49	38
	Parking space	1-3	2	4-11	8
Theater	Seat	2-4	3	8-15	11

^a Some systems serving more than 20 people might be regulated under USEPA's Class V Underground Injection Control (UIC) Program. See <http://www.epa.gov/safewater/uic.html> for more information.

^b These data incorporate the effect of fixtures complying with the U.S. Energy Policy Act (EPACT) of 1994.

^c Disposal of automotive wastes via subsurface wastewater infiltration systems is banned by Class V UIC regulations to protect ground water. See <http://www.epa.gov/safewater/uic.html> for more information.

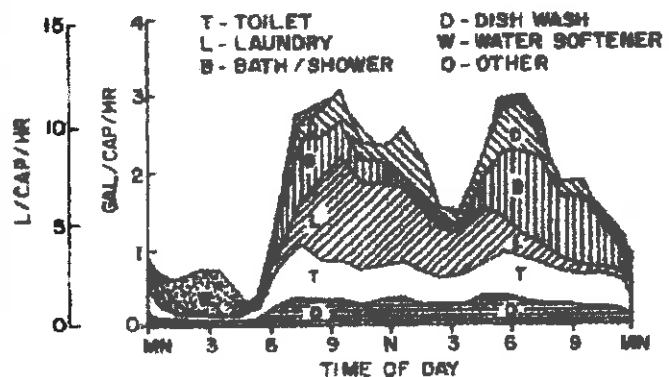
Source: Crites and Tchobanoglous, 1996.

3.3.3 Variability of wastewater flow

Variability of wastewater flow is usually characterized by daily and hourly minimum and maximum flows and instantaneous peak flows that occur during the day. The intermittent occurrence of individual wastewater-generating activities can create large variations in wastewater flows from residential or nonresidential establishments. This variability can affect gravity-fed onsite systems by potentially causing hydraulic overloads of the system during peak flow conditions. Figure 3-3 illustrates the routine fluctuations in wastewater flows for a typical residential dwelling.

Wastewater flow can vary significantly from day to day. Minimum hourly flows of zero are typical for

Figure 3-3. Daily indoor water use pattern for single-family residence



Source: University of Wisconsin, 1978

USEPA

*Pre 1994 USEPA Act per
 Crum*

The following shall be considered when selecting processes to achieve treatment goals:

- A. The quality and variability of the source water.
- B. Possible future changes in the quality of the source.
- C. Water quality goals, including the growing desire of the public for better water.
- D. When removal of contaminants for which BAT has been specified is necessary, processes classified as BAT shall be employed.
- E. When treatment technique requirements have been established in lieu of MCLs, processes specified by such requirements shall be employed.
- F. POE or POU devices shall not be utilized for long-term compliance with PMCLs. Such devices may be considered for short term, interim use, as a condition of a variance or exemption issued by the commissioner.

DESIGN CAPACITY

12 VAC 5-590-690. Capacity of waterworks.

The design capacity of the waterworks shall exceed the maximum daily water demand of the system. Waterworks shall normally be designed on the following basis of water consumption. If deviations are made, they shall be based on sound engineering knowledge substantiated in the designer's report and approved by the division.

A. Daily water consumption rates (annual daily water demand):

Dwellings, per person	100 gpd
High schools with showers, per person	16 gpd
Elementary schools without showers, per person	10 gpd
Boarding schools, per person	75 gpd
Motels at 65 gallons per person, minimum per room	130 gpd
Trailer courts at three persons per trailer, per trailer	300 gpd
Restaurants, per seat	50 gpd
Interstate or through highway restaurants, per seat	180 gpd
Interstate rest areas, per person	5 gpd
<u>Service stations, per vehicle served</u>	10 gpd
Factories, per person, per eight-hour shift	15-35 gpd
Shopping centers, per 1,000 sq.ft. of ultimate floor space	200-300 gpd
Hospitals, per bed	300 gpd
Nursing homes, per bed	200 gpd
Home for the aged, per bed	100 gpd
Doctor's office in medical center	500 gpd