Forensic Evaluation of materials collected at McMillan Pump Station, Jacksonville, Florida – March 12-13, 2019.

Kimberly-Clark Corporation, Neenah, WI

JEA, Jacksonville, FL

April 1, 2019

Executive Summary

Forensic evaluation of three separate sets of bar screen samples collected at McMillan Pumping Station on March 12-13, 2019 revealed similar results on average to those reported in 2016 NYC study [1].

In this JEA-KCC study, baby wipes made up 37% of all material counted on average, with flushable wipes totaling less than 1%.

During the three separate samplings, influent flow to the station varied by almost a factor of two due to an earlier rain event on March 11th, however this rain event appears to have had little impact on the outcome of the study.

This study fully supports going forward with the partnership education program between JEA and KC focused on a message of 'don't flush baby wipes'.

[1] "Forensic Evaluation of Non-Dispersables", New York City Law Department, Fuss& O'Neill. August 15, 2016. Appendix 5.1

Contents

1. Introduction

As part of the partnership between Kimberly-Clark Corporation (KCC) and JEA to run focused education in Jacksonville to educate JEA consumers 'not to flush baby wipes', this baseline evaluation was carried out as a first step to identify if JEA like other cities in US and UK had large quantities of baby wipes in their collection system as had been reported in the two most recent collection studies since 2016[2,3].

KCC staff members involved in the planning and execution of this work were Mr. David Powling and Mr. Peter Lortscher.

- Mr. Powling joined KCC in 2000, and has been a Technical Leader for the past 12 years where he has been central in development and publication of INDA/EDANA guidelines which released Edition 4 guidelines in May 2019. In addition to work with INDA, Mr. Powling has served as SME on ISO TC224 WG10 for flushable products which publishes their technical report TR24524 this spring. In addition to involvement with guideline development, Mr. Powling pioneered the first collection studies in Moraga (2010), Maine (2011, 2012, 2014, and 2015). Furthermore, Mr. Powling acted as a mentor to Ms. Aubrey Strause during the Maine Collection studies. Ms. Strause was technical lead, field lead and author of NYC DEP study in 2016.

Figure 1:Mr.Lortscher and Mr. Powling

- Mr. Lortscher joined KCC in 1988 and is a Senior Research Scientist at KCC where he has managed the Fate of Materials Flush lab in Neenah since 2005. Mr. Lortscher has been central in helping develop lab methods for Flushability and field work. The lab at KCC provides internal testing of nonwovens and has capability to run Flushability assessment using all INDA/EDANA Test methods, UKWIR Test Methods and IWSFG methods. Mr. Lortscher has provided training to NSF, CTP and SGS-IPS labs when they first started up labs to run INDA/EDANA methods. Mr. Lortscher is currently a member of ISO TC6 WG27 developing a water disintegration test standard.

JEA provided staff to support the collection and counting of materials, including the provision of tarps, buckets, gloves and PPE required to work on site at MacMillan. Mr. Kent Williamson, Manager at Cedar Bay WWTP along with Mr. Philip Maltese helped to identify MacMillan PS as the best sampling site and made available a safe area at Cedar Bay WWTP for all the sorting/counting of samples collected. Mr. Mike Chapman was the key dedicated support gathering flow data, overriding rake operation at Macmillan PS and assisting with transportation of samples between sites.

KCC purchased all sample materials to generate up to date wipe identification, folders to assist product identification, plus garbage pickers and shallow pans for cleaning and sorting samples.

[2] NYC Study. Appendix 5.1
[3] Water UK. Appendix 5.2

2. Overview of Forensic Evaluation

JEA provides wastewater treatment for Jacksonville (population 821,000 in 2018[4]) treating over 80 MGD[5]. With over 1400 pump stations in service throughout the network the annual costs associated with callouts to clogged pumps is estimated to be in the region of $200,000 annually. This forensic evaluation was designed to provide a baseline of the materials present in JEA collections, which in turn would provide basis for consumer education designed to reduce flushing of baby wipes which in turn could offer savings to annual pump maintenance costs.

2.1 Site selection

Site selection is important when attempting to obtain a representative snapshot of materials in a collection system, and also drives the logistics around physical material collection and time needed to obtain meaningful sample size. In previous collection studies in Maine (2011, 2014) the typical sample size was around 300 pieces or greater.

Prerequisites for collection site were:

- Influent of 2.5MGD or above to keep expected collection time under 2hours
- Sewer basin serving mostly domestic customers and significant gravity flow
- Vertical bar screens with safe access to intercept screenings with minimal handling to maintain sample integrity

2 additional locations were considered first before choosing MacMillan Pump Station.

Cedar Bay WWTP (8.5 MGD) head work screens was considered to be first choice. However, a short visit to the screens revealed a surprisingly low quantity of screened material being collected which was thought due to the high amount of pumping up stream which also resulted in screened materials arriving in poor condition for identification.

Following the decision not to use Cedar Bay, the headworks screen at the smaller **Nassau WWTP headwork screens (1.5MGD)** was considered. This smaller facility had a high proportion of gravity flow in the network, but photographs of screenings revealed once again heavily shredded screenings which could not be used for identification.

The other potential site recommend by JEA was the **McMillan Pump Station at 2304 McMillan Street** - see figure 2. Located in a residential neighborhood on the northwest side of downtown Jacksonville, it is a large pump station which provides easy, safe access to the 60" wide bar screens (5/8" inch bar spacing) which had recently been installed as part of a capital upgrade which was ongoing. The pump station is equipped with four 100HP pumps operated in a dry well receiving flow from two 36" interceptors and serving an extensive sewer basin –:

- Single Family = 25,349 connections
- Multi-family = 2,453 Units
- Commercial, institutional, and industry = 1,774 meters

[4] https://suburbanstats.org/population/florida/how-many-people-live-in-jacksonville
[5] https://www.jea.com/about/wastewater/

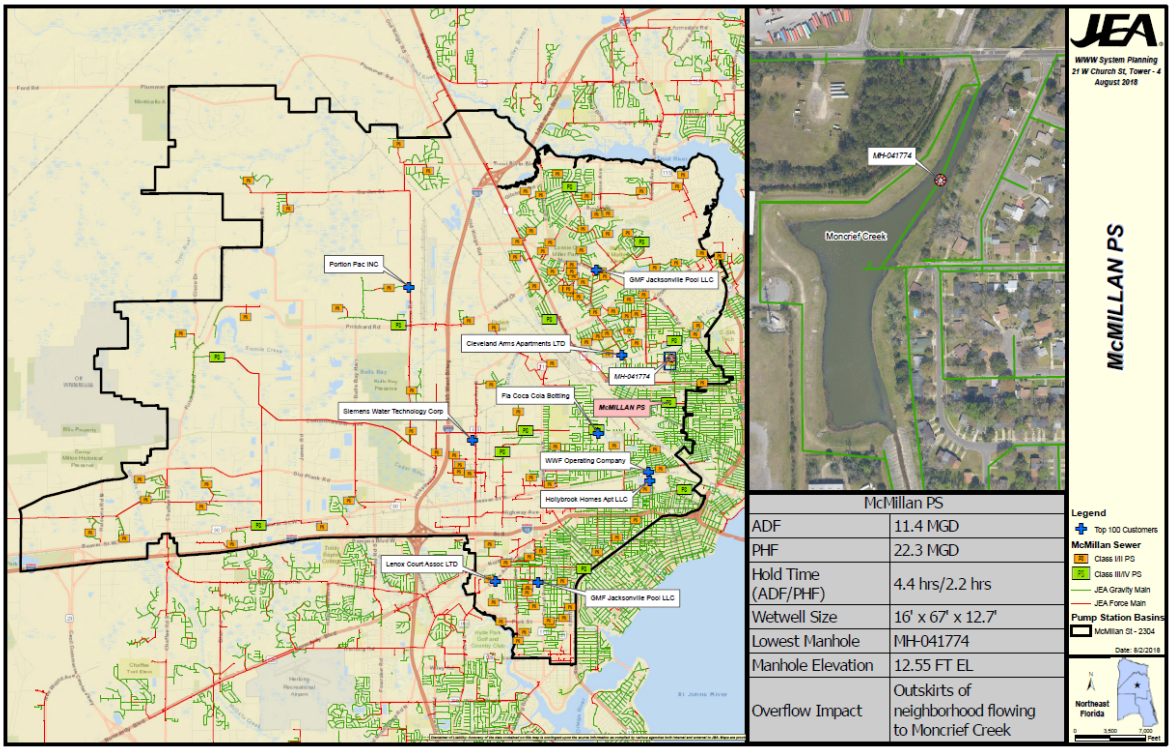


Figure 2: Map of McMillan PS sewer basin - courtesy JEA

2.2 Variation in flow see at McMillan PS

During the 2 days while collecting samples we saw average flows vary substantially between 3.6MGD to 7.1MGD. A thunderstorm hit Jacksonville on the evening of March 11th around 11pm. Rainfall records at Jacksonville International Airport recorded 0.4" of rainfall[6]. Average flows at the pump station were recorded during the collections and the delayed impact of the rainfall can clearly be seen in table 1.

Date	3/12/2019	3/12/2019	3/13/2019
Time start	7:55	2:30	7:45
Time End	9:15	3:30	9:45
Time elapsed -mins	80	60	120
Av hourly flow - GPM	6486	7100	3600
Av Daily Flow- MGD	9.3	10.2	5.2
Time after rain event - hrs.	8	14	32

Table 1: Flow rates at McMillan PS at the 3 different collections

At 5.2 MGD dry weather, McMillan is pumping ~7% of total daily flow treated by JEA (80MGD)

[6] https://w2.weather.gov/climate/xmacis.php?wfo=jax. See appendix 3

3. Sample collection

A sheet of plywood was cut to fit inside the access doors at the rear of the screen to intercept screenings which were swept off by the rake and during normal operation would fall down into an auger which delivers the screening to a dumpster for collection and subsequent disposal. The plywood barrier prevented material from entering the auger and allowed safe collection of material using long handled garbage pickers.

Samples collected from the rakes were transferred into shallow trays to be cleaned up prior to storing in large 5 gallon buckets which were used to transport the collected samples to Cedar Bay for final identification directly after. For the afternoon collection on 3/12/2019 the samples were stored overnight in buckets at McMillan and counted on 3/13/2019

Figure 3: Using garbage pickers to collect samples

Figure 4: Shallow rinsing tray use for sample clean up

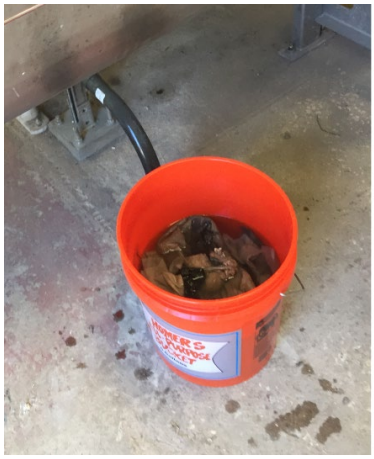


Figure 5: Samples stored in bucket prior to final ID and count

During sample collection, the rake operation was set to run continuously, with a rake being cleaned every 9-10 secs. Across the 3 collection periods a total of ~ 1700 rake cleanings were sampled.

3.1 'Boom of tampons'

During the afternoon collection on 3/12/2019 when the flow was at its highest – see figure 6, there appeared to be increased levels of tampons on the rakes compared to the morning collection. It was shown during collections in Maine that tampons which settle out in large interceptors under dry weather flow tend to re-suspend during higher flow. This phenomena appeared to provide one freak rake load in which the entire 60" wide rake was full of tampons in a roll which looked to be ~6" round creating what looked like a 'Boom of Tampons' – see figure 6.

This event was a considered an outlier for the study and the tampons were dropped into auger and not counted. However, this serves as a reminder of the aberrations which collection systems need to manage.

Figure 6: 'Boom of Tampons "3/12/2019

4. Objective and methodology

The objective of the study was to obtain an initial snapshot of materials in JEA collection systems during peak diurnal flow (between 7-10am) and also to obtain an off peak sample in the afternoon. This allowed comparison for any variation associated with flow to be captured.

4.1 Methodology

The methodology used for this study followed the method developed first in Maine 2011,2012 which became the basis for NACWA sewer collection methodology used in 2016 NYC Study.

All pieces of 1” or greater were carefully collected, cleaned and counted.

The additional cleaning step of using shallow trays of water to clean and remove organics at the point of collection was a significant improvement and helped maintain sample integrity for counting.

For sample identification folders, over 80 different wipes were purchased from Target, Walmart, Festival Foods, CVS, Walgreens and Dollar General close to KC offices in Neenah, Wisconsin. These samples were purchased in order to compile an up to date collection of wipes for the study.

Wipes were purchased against the broad categories illustrated in the NYC study infographic below. A total of 4 sample folders were prepared with dry wipe samples. Additional Ziploc bags with 3 wipes for each sample were taken along for additional reference material. There was no local purchasing of wipes in Jacksonville for this study.

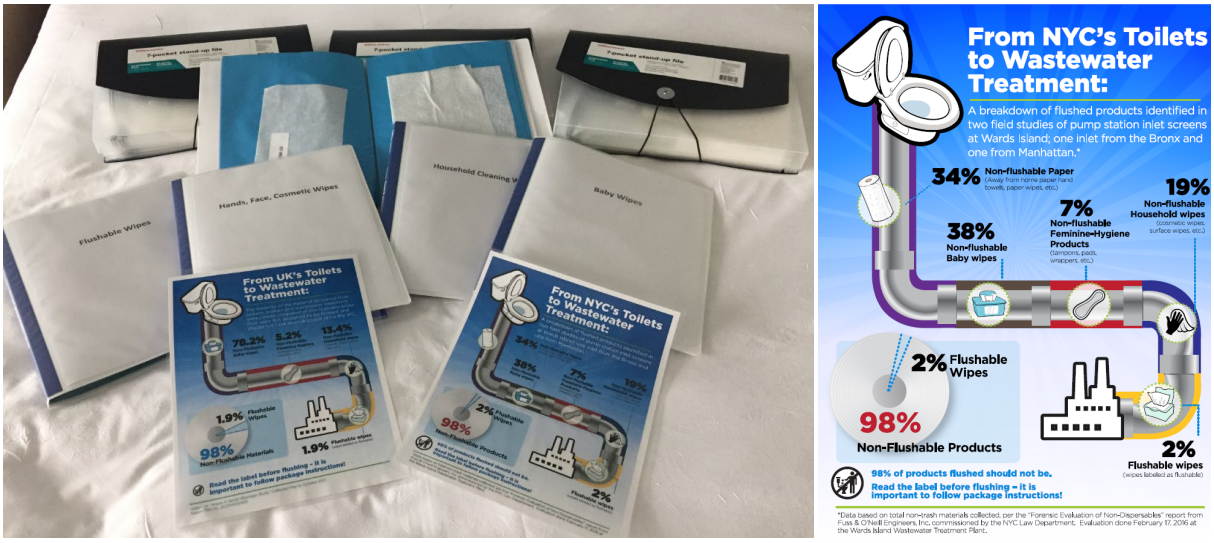


Figure 7: Sample ID folders and NYC Study Infographic

A summary tables of wipes, which showed wipe dimensions were prepared and used to help identify samples using size as well as texture. See appendix 2

Figure 8: Sample folders, soaking pans and wipe identification table at Cedar Bay WWTP awaiting identification of samples

5. Results

Any sample greater than 1” was counted as 1 sample.

Materials which could not be reasonably identified were collected in a pile labelled “Unidentified Flushed Object (UFO). These included several parts of undergarments and long elongated fibrous wipes which were too misshapen to identify .In total UFO only represented 5-10 % of the total sample count within a collection.

5.1 Photos of collections

Baby Wipes

March 12th AM collection

Flushable

Paper

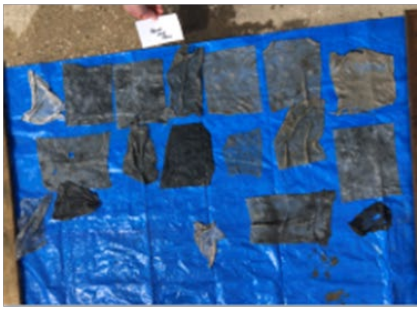
Household

Hand Face Body

Feminine Hygiene

“UFO”

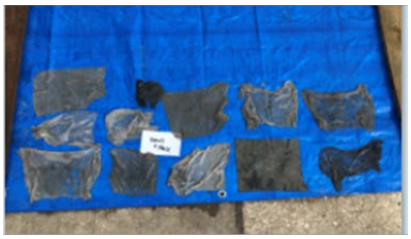
Baby Wipes	March 12th PM collection	Flushable
		

Paper	Household	Hand Face Body
No photo available		

Feminine Hygiene	"UFO"
	

Baby Wipes	March 13th AM collection	Flushable

Paper	Household	Hand Face Body



Feminine Hygiene	"UFO"

No photo available

5.2 Counts of collections

	Collection event		
	3/12 am	**3/12 pm**	**3/13 am**
Rainfall previous 24hrs	0.4"	0.4"	0"
Av flow -gpm	6486	7100	3600
Baby Wipes	118	76	65
Flushable Wipes	2	3	1
Fem Wipes	37	37	55
Hand,Face,Body	42	18	12
Household	15	4	11
UFO	37	8	10
Paper	89	48	60
Total	340	194	214

Table 2: Raw counts

5.3 Distribution of identified materials >1" consolidated into INDA infographic categories with UFO count removed.

INDA

Raw count consolidated to INDA categories

	Collection event		
	3/12 am	**3/12 pm**	**3/13 am**
Rainfall previous 24hrs	0.4"	0.4"	0"
Av flow -gpm	6486	7100	3600
Baby Wipes	118	76	65
Flushable Wipes	2	3	1
Fem Hygiene	37	37	55
Household	57	22	23
Paper	89	48	60
	303	186	204

	Sum of counts	**Study Average**	**NYC Study av.**
Baby Wipes	259	37.4%	38%
Flushable Wipes	6	0.9%	2%
Fem Hygiene	129	18.6%	7%
Household	102	14.7%	19%
Paper	197	28.4%	34%
	693	100%	100%

Table 3: Counts with UFO removed, and consolidated to INDA categories with % shown

5.4 Concentration of materials

Normalizing the material count against influent flow provides some insight into material concentration and impact of increased flow.

Concentration by category (articles / 100,000galls)

Collection	**3/12 am**	**3/12 pm**	**3/13 am**	**Average**
Rainfall previous 24hrs	0.4"	0.4"	0"	
Av flow -gpm	6486	7100	3600	
Baby Wipes	23	18	15	19
Flushable Wipes	0	1	0	0
Fem Hygiene	7	9	13	10
Household	11	5	5	7
Paper	17	11	14	14

Table 4: Material concentrations per 100,000galls influent

Baby Wipe concentrations recorded in Portland, Maine in 2014 averaged ~30 wipes per 100,000 galls[7], which is similar to level seen at McMillan PS. Directionally, there appears to be a slight reduction in concentration with flow, but certainly no suggestion that the rain event is significantly impacting the overall result of the study.

5.5 Discussion of results

The mix of materials identified across the 3 sampling periods is similar to the results seen in 2016 NYC study with Baby Wipes again close to 40% of material. It should be noted that majority of baby wipes were recovered fully intact. No brand specific count was recorded.

Very few flushable wipe pieces were found (<1%), all samples were weak and delicate to handle.

The relative impact of baby wipes and flushable wipes was reported in KC Wet well dosing study[8] clearly highlights the risk to smaller wet well pumps of baby wipes with high potency being present in high concentrations which the education program hopes to address.

In NYC Study report there were suggestions that the mix and count they obtained may have been influenced by the rain event a day earlier. This study suggests the rain event in Jacksonville was not disruptive of study outcome or material mix.

The increase in tampons reaching the bar screens during high flow (3/12/2019 PM) was not unexpected. This had been demonstrated experimentally in Maine in September 2011 when a 'rain event was simulated' and resuspension of the waterlogged items caused tampon numbers to double.

6. Conclusion

The results obtained at McMillan Pump Station fully supports JEA in partnership with Kimberly-Clark running a focused education program on not flushing baby wipes.

With ~ 40% of materials being baby wipes, a reduction in baby wipes flushed should translate to a measurable reduction in the baby wipe concentration which in turn should drive fewer pump call outs and associated costs.

Flushable wipe numbers continued to be very low in this study, consistent with both prior major collection studies since 2016[9], and with no significant change in proportion of baby wipes to flushable wipes seen as a result of increased flow due to a prior rain event.

[7] Maine Education Pilot – Report. Appendix 5.3
[8] KC Wet Well dosing study – Appendix 5.4
[9] Water UK Study 2017 – Appendix 5.2

Appendix

1. Photos of wipes in ID folders

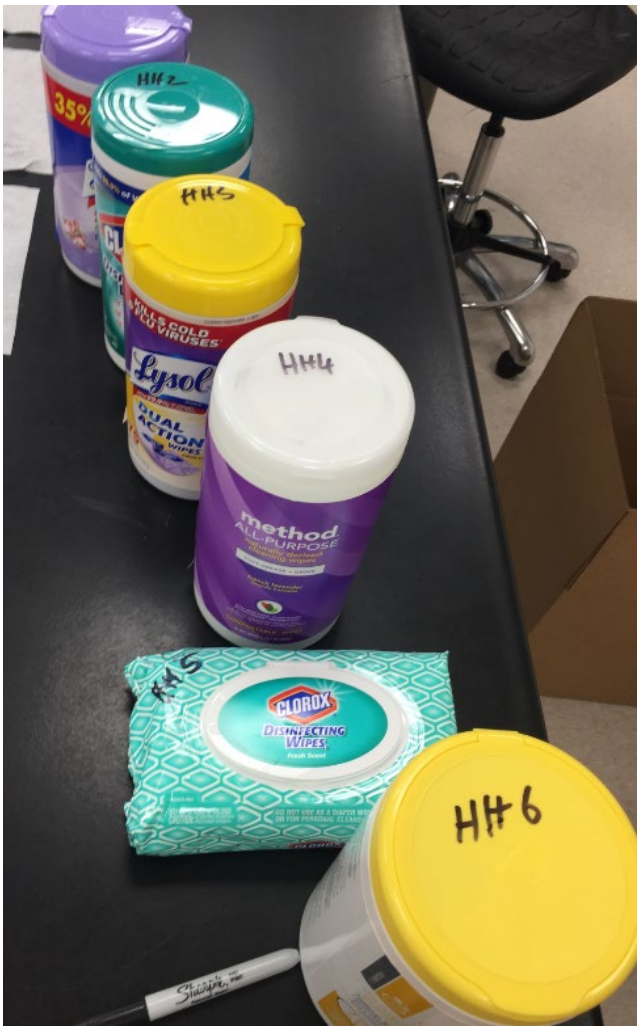
1.1 Baby Wipes

1.2 Flushable Wipes

1.3 Feminine Wipes

1.4 Hand Face Body

1.5 Household Wipes



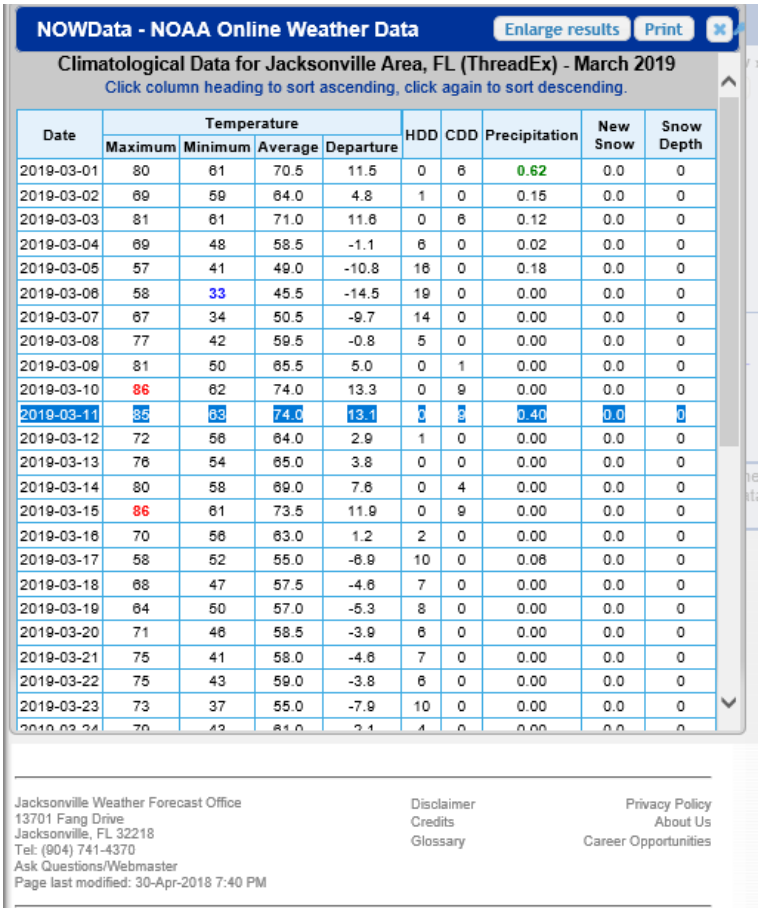
2. Table of Wipe dimensions

Category	Label	Brand	Sub Brand	L	W	Area
Flushable	FW-1	K-C	Cottonelle	7.25	5	36.3
Flushable	FW-2	K-C	Scott	6	5.5	33.0
Flushable	FW-3	K-C	Kids	6.8	5	34.0
Flushable	FW-4	PG	Kandoo	6.7	4.7	31.5
Flushable	FW-5	Equate	Personal Wipes	7.5	4.2	31.5
Flushable	FW-6	K-C	Cottonelle	7.8	4.5	35.1
Flushable	FW-7	PG	Charmin Freshmates	7.2	5	36.0
Flushable	FW-8	Nice	FMW	7	5	35.0
Flushable	FW-9	Up and Up	Flush Cleansing Cloths	6.75	5.25	35.4
Flushable	FW-10	Up and Up	Toddler FW	6.75	5.25	35.4
Flushable	FW-11	Equate	Flushable Wipes	7	5.25	36.8
Flushable	FW-12	Total Home	Flushable Moist Cleansing Cloths	6.8	5.25	35.7
Flushable	FW-13	Fresh n UP	FMW	6	5.25	31.5
Flushable	FW-14	Members Mark	Flushable Wipes	7	5.25	36.8
Flushable	FW-15	Walgreens	Flushable Cleansing Cloths	7	5.25	36.8
Flushable	FW-16	Great Value	Flushable Wipes	7	5.25	36.8
Flushable	FW-17	Costco	Kirkland Signature	6.8	5.3	36.0
Flushable	FW-18	Parents Choice	Flushable Wipes	6.8	5.3	36.0
Flushable	FW-19	Dude Wipes	Fragrance free	7	7	49.0
Baby	BW-1	Pampers	Complete Clean	7	6.8	47.6
Baby	BW-2	Pampers	Aqua Pure	7	6.8	47.6
Baby	BW-3	Huggies	Simpley Clean	7.7	6.6	50.8
Baby	BW-4	Huggies	One and Done	7.7	6.6	50.8
Baby	BW-5	Huggies	Natural Care	7.7	6.6	50.8
Baby	BW-6	Huggies	Simply Clean	7.7	6.6	50.8
Baby	BW-7	Huggies	Simply Clean	7.7	6.6	50.8
Baby	BW-8	Equate	Baby Everyday Clean	7.5	6.8	51.0
Baby	BW-9	Equate	Baby Wipes Refreshing	7.5	6.8	51.0
Baby	BW-10	Parents Choice	FF Baby Wipes	7.5	6.8	51.0
Baby	BW-11	Seventh Generation	Sensitive	7.4	6.7	49.6
Baby	BW-12	Up and Up	Cucmber Baby Wipes	7.5	6.75	50.6
Baby	BW-13	Up and Up	Fragrance free Baby Wipes	7.5	6.75	50.6
Baby	BW-14	Kirkland	Baby Wipes	8	7.1	56.8

Category	Label	Brand	Sub Brand	L	W	Area
Baby	BW-15	Smile and Save	Baby Wipes	8	6.3	50.4
Baby	BW-16	Cloud Island	Ultra Thick Baby Wipes	7	7	49.0
Baby	BW-17	Sesame Street	Baby Wipes	7	6	42.0
Baby	BW-18	Honest Wipes	Designer collection	8	7	56.0
Baby	BW-19	Well Beings	Shea Butter	7.5	7	52.5
Baby	BW-20	CVS	Ultra Soft Baby wipe	7.5	6.75	50.6
Baby	BW-21	CVS	Ultra Soft Toddler	6.2	5.3	32.9
Baby	BW-22	CVS	Ultra Soft Baby wipe	7.5	6.75	50.6
Baby	BW-23	Hello bello	Wipes	8	6.5	52.0
Baby	BW-24	Babyganics	Baby wipes	8	6	48.0
Baby	BW-25	Water Wipes	Baby wipes	7	6.5	45.5
Baby	BW-26	CVS	Baby Wipe Basics	7	6	42.0
Baby	BW-27	Pampers	Sensitive	7	6.8	47.6
Hands and Face	HF-1	Equate	Soft Wipes	7.7	6.7	51.6
Hands and Face	HF-2	Kleenex	germ removal	7.7	6.7	51.6
Hands and Face	HF-3	Kleenex	sensitive	7.7	6.7	51.6
Hands and Face	HF-4	Kleenex	gentle clean	7.7	6.7	51.6
Hands and Face	HF-5	Honest	premium plant based wipse	8	7.1	56.8
Hands and Face	HF-6	Equate	beauty	7.5	5.5	41.3
Hands and Face	HF-7	Wet ones	antibac	7.5	5.5	41.3
Hands and Face	HF-8	Germ x	Hand Sanitizing Wipes	7.9	5.5	43.5
Hands and Face	HF-9	Equate	Anti bacterial	7.5	5.7	42.8
Hands and Face	HF-10	assured	Anti bacterial	7.5	5.7	42.8
Hands and Face	HF-11	Huggies	Cleansing	7.7	6.6	50.8
Hands and Face	HF-12	Total Home	Antibac	8	5	40.0
Hands and Face	HF-13	Collagen	makeup cleaning	7.75	6.75	52.3
Hands and Face	HF-14	Yes to	Mask removing wipes	7.5	5.5	41.3
Hands and Face	HF-15	No name	makeup cleaning	7.4	7.2	53.3
Hands and Face	HF-16	Shea Moisture	facial wipes	7	6.75	47.3
Hands and Face	HF-17	Yes to	Detox facial	7.5	5	37.5
Hands and Face	HF-18	CVS	Ultrasoft Make up remoal	7.4	7.3	54.0
Hands and Face	HF-19	Pure and gentle	Make up remover wipes	7.8	5.5	42.9
Household	HH-1	Lysol	Disinfecting Wipes	7.5	7	52.5

Category	Label	Brand	Sub Brand	L	W	Area
Household	HH-2	Clorox	Disinfecting Wipes	7	7	49.0
Household	HH-3	Lysol	Dual Action	7.25	7	50.8
Household	HH-4	Method	All Purpose	7.75	7	54.3
Household	HH-5	Clorox	Disinfecting Wipes	7.5	7	52.5
Household	HH-6	Style Selection	Disinfecting Wipes	8	7	56.0
Fem	FEM-1	Always	Fem Wipes	7.4	5.6	41.4
Fem	FEM-2	Maxi thins	Fem Wipes	8	5.5	44.0
Fem	FEM-3	Playtex	Personal Wipes	7.8	5.7	44.5
Fem	FEM-4	Summers Eve	Cleansing Cloth	7.25	5.5	39.9
Fem	FEM-5	Up and UP	cleansing wipes	7.5	5.5	41.3
Fem	FEM-6	Assured	Soft and gentle	7.4	5.5	40.7
Fem	FEM-7	Goodwipes	Down there (flushable)	7.5	5.5	41.3
Fem	FEM-8	Prep H	for women (flushable)	6	5.5	33.0
Fem	FEM-9	Prep H	Medicated	6	5	30.0
Fem	FEM-10	Well at Walgreens	Medicated	6	5	30.0
Fem	FEM-11	Walgreens	Adult Washcloth	12	8	96.0
Fem	FEM-12	At Ease	Adult Washcloth	11.8	7.9	93.2
HH Paper	Paper Towel	Bounty	Paper Towel	11	10.2	112.2
HH Paper	Paper Towel	Up and Up	Full sheet	11	10.2	112.2
HH Paper	Paper Towel	Bounty	Essentials	11	10.2	112.2
HH Paper	Paper Towel	Scott	Paper Towels	11	6	66.0
HH Paper	Paper Towel	Viva	2 ply	11	5.9	64.9
HH Paper	Paper Towel	Viva	1 ply cloth	11	6	66.0

3. Rain event data



NOWData - NOAA Online Weather Data

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Climatological Data for Jacksonville Area, FL (ThreadEx) - March 2019

Click column heading to sort ascending, click again to sort descending.

Date	Temperature				HDD	CDD	Precipitation	New Snow	Snow Depth
	Maximum	Minimum	Average	Departure					
2019-03-01	80	61	70.5	11.5	0	6	0.62	0.0	0
2019-03-02	69	59	64.0	4.8	1	0	0.15	0.0	0
2019-03-03	81	61	71.0	11.6	0	6	0.12	0.0	0
2019-03-04	69	48	58.5	-1.1	6	0	0.02	0.0	0
2019-03-05	57	41	49.0	-10.8	16	0	0.18	0.0	0
2019-03-06	58	33	45.5	-14.5	19	0	0.00	0.0	0
2019-03-07	67	34	50.5	-9.7	14	0	0.00	0.0	0
2019-03-08	77	42	59.5	-0.8	5	0	0.00	0.0	0
2019-03-09	81	50	65.5	5.0	0	1	0.00	0.0	0
2019-03-10	86	62	74.0	13.3	0	9	0.00	0.0	0
2019-03-11	85	63	74.0	13.1	0	9	0.40	0.0	0
2019-03-12	72	56	64.0	2.9	1	0	0.00	0.0	0
2019-03-13	76	54	65.0	3.8	0	0	0.00	0.0	0
2019-03-14	80	58	69.0	7.6	0	4	0.00	0.0	0
2019-03-15	86	61	73.5	11.9	0	9	0.00	0.0	0
2019-03-16	70	56	63.0	1.2	2	0	0.00	0.0	0
2019-03-17	58	52	55.0	-6.9	10	0	0.06	0.0	0
2019-03-18	68	47	57.5	-4.6	7	0	0.00	0.0	0
2019-03-19	64	50	57.0	-5.3	8	0	0.00	0.0	0
2019-03-20	71	46	58.5	-3.9	6	0	0.00	0.0	0
2019-03-21	75	41	58.0	-4.6	7	0	0.00	0.0	0
2019-03-22	75	43	59.0	-3.8	6	0	0.00	0.0	0
2019-03-23	73	37	55.0	-7.9	10	0	0.00	0.0	0
2019-03-24	70	43	61.0	-2.1	4	0	0.00	0.0	0

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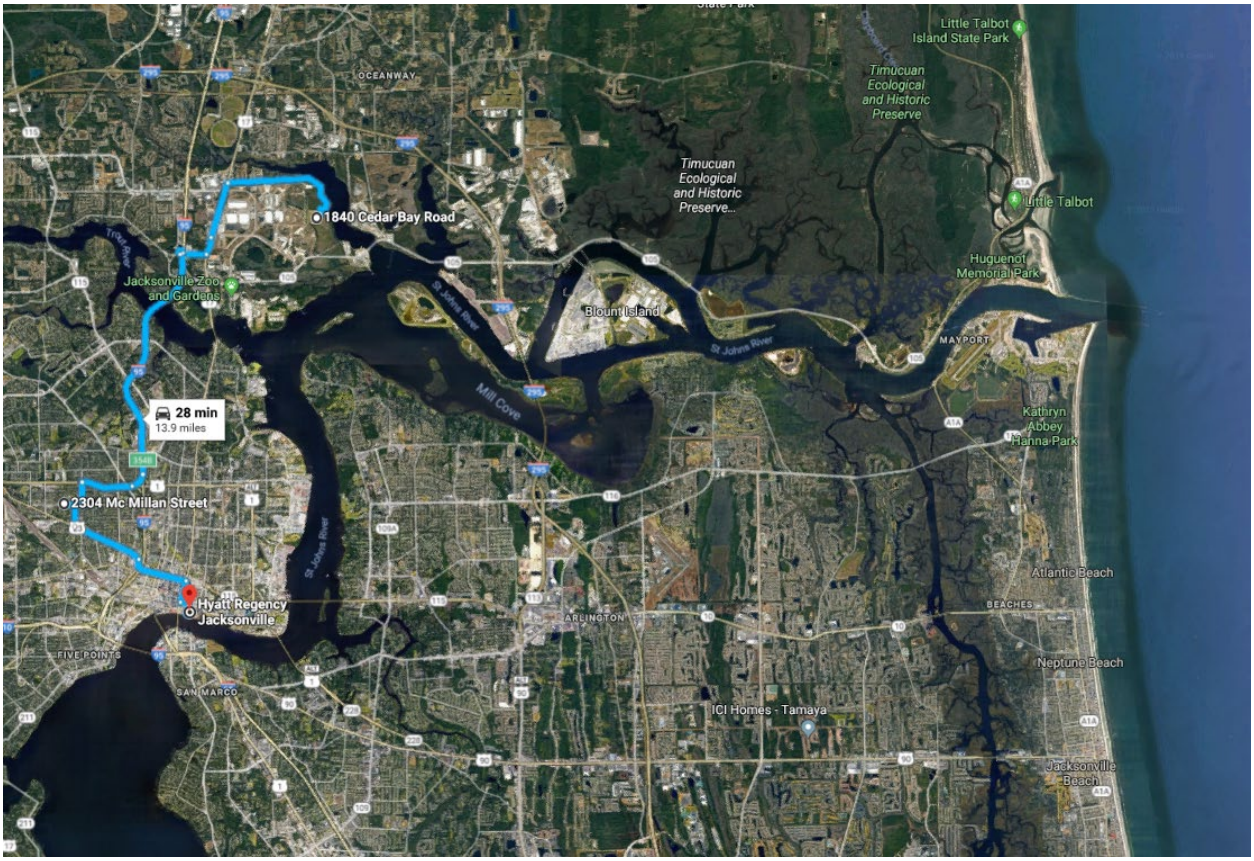
4. Map showing Jacksonville with Cedar Bay WWTP and McMillan PS location



5. Supporting reports

5.1 NYC Study Report 2016

Forensic Evaluation of Non-Dispersables

New York City Law Department
New York, NY

August 15th 2016

146 Hartford Road
Manchester, CT 06040

20150124.A10

FUSS & O'NEILL

Tables

List of Figures

Appendices

Attachments

1. Archived Recovered Items (Under Separate Cover)

1 Introduction

Fuss & O'Neill Engineers, Inc. (Fuss & O'Neill), with headquarters in Manchester, Connecticut, performed the scope of work described in this Report under Agreement with the New York City Law Department (the Department). The Agreement for Sanitary Sewer Forensic Consulting Services, effective September 1, 2015, is described as follows in Department files:

- Matter #2014-0316398L
- PIN 02516X000762
- E-PIN 02516N0011001

Fuss & O'Neill staff members involved in the work described in this Report include Mr. Virgil Lloyd, Ms. Aubrey Strause, Mr. Daniel Iannicelli, and Ms. Tenzin Lama.

- Mr. Lloyd is a Senior Vice President and partner with Fuss & O'Neill, with over 37 years of experience in wastewater systems engineering, serving municipalities, state agencies and private clients. He is a registered Professional Engineer in Connecticut, Rhode Island, Massachusetts, New Hampshire and Maine. He holds a Master's Degree in Environmental Engineering from the University of New Haven and a BS degree in Civil Engineering from the University of Connecticut. He is a longtime member of the New England Water Environment Association (NEWEA), where he is currently the Council Director of the Collection Systems & Water Resources Council, providing liaison and guidance for eight technical committees in the collection systems and water resources fields. He is a member of the Board of Directors of the Connecticut Water Pollution Abatement Association (CWPAA), where he is responsible for development and coordination of training programs. He is currently the co-chair of the Connecticut PA12-155 Phosphorus Non-Point Source Workgroup. He is also a member of the Water Environment Federation (WEF) and the American Public Works Association (APWA). He serves as Principal on this project and provided technical review of this report.

- Ms. Strause is an Associate with Fuss & O'Neill and the owner of the consulting firm Verdant Water, PLLC. She is recognized nationally for her work since 2009 to reduce the burden of non-dispersible wipes in sewer systems, with both the Maine Water Environment Association and Verdant Water. She has two BS degrees in Bioresource Engineering from Rutgers University (1998), and is a licensed Professional Engineer in New Hampshire, Massachusetts, and Maine. Ms. Strause is a member of NEWEA, WEF, the National Association of Clean Water Agencies (NACWA), and APWA. She is the author of many articles about the impact disposal of non-dispersible items has, and was the team leader for the Maine Water Environment Association's "Save Your Pipes: Don't Flush Baby Wipes" campaign, implemented jointly with the Association of the Nonwoven Fabrics Industry (INDA). She has been maintaining a reference database of nonwoven fabrics since 2009 and copyrighted this resource through Verdant Water in 2015. She served as technical lead, field leader, and primary author of this report.

- Mr. Iannicelli is a Project Engineer in the Wastewater Department of Fuss & O'Neill. He is primarily involved with the planning, design, and construction oversight of water and

wastewater projects. He provided assistance during the field operations described in this report, as he has done on a similar forensics evaluation.

- Ms. Lama was an Environmental Engineer (Engineer) with Fuss & O'Neill. She separated from the firm shortly after this forensic event was completed. She provided assistance during the field operations described in this report.

Fuss & O'Neill staff members were compensated at the rates shown in *Table 1*.

Table 1
Fuss & O'Neill Compensation Schedule

Billing Category	Hourly Rate
Engineer, Scientist, Analyst I (Ms. Lama)	$117
Engineer, Scientist, Analyst II (Mr. Iannicelli)	$127
Associate (Ms. Strause)	$227
Senior Officer (Mr. Lloyd)	$247

2 Overview of the Forensic Evaluation

The New York City Department of Environmental Protection's (NYC DEP's) Wards Island Wastewater Treatment Facility is located on Wards Island in the East River (between Manhattan and the Astoria section of Queens). Fuss & O'Neill met in the Administration Building of the facility with NYC DEP Division Chief of Operations, Jerry Fragias, and NYC DEP Wards Island Process Engineer Yu-Tung Chan on the afternoon of Tuesday, February 16.
The facility has a design capacity to provide full treatment of 275 million gallons of wastewater per day (MGD) and is presently required to maintain the ability to pump 320 MGD, per Mr. Chan. Although the facility is required to maintain a pump capacity of 320 MGD, some storm events cause the plant to reach over 400+ MGD. We understand that this facility is continuously struggling to manage the increasing volumes of non-dispersible materials present in influent. These materials cause operational challenges at points in the treatment process from headworks (screening and material disposal) through secondary treatment (interfering with valves and blocking channels) and sludge management (pump clogging).

The purpose of this forensic evaluation was to identify the materials present in a "snapshot" of influent to this facility from a combined system (i.e., both sanitary sewer and storm drain flows). The "snapshot" would compare items entering the facility through two separate channels: one conveying flow from Manhattan, and one conveying flow from the Bronx.

The Manhattan channel and the Bronx channel are each served by three functional mechanical screens (a fourth screen at each of the two locations is presently being replaced). The screens use automatic raking mechanisms to scrape debris from evenly spaced bars and deposit the debris into dumpsters, which are emptied manually. The Fuss & O'Neill team had the opportunity to visit the screening system associated with the Bronx channel the afternoon of Tuesday, February 16, but did not see the Manhattan facility. This process is nearly continuous: one dumpster is nearly full in the short time it's taken the operator to empty the other two dumpsters.

3 Sample Collection

At approximately 7:30 AM on Wednesday, February 17, 2016, NYC DEP Wards Island staff collected materials from each of the two channels, filling one five-gallon bucket with material from the three operating screens serving the Bronx channel and another five-gallon bucket with material from the three operating screens serving the Manhattan channel.

A storm event delivered 0.44 inch of rain on February 15 and another 1.01 inches of rain during an intense storm on February 16, the day Fuss & O'Neill arrived on site. This precipitation was measured at station KNYC (Central Park, New York), which is located approximately two miles from the Wards Island facility (Weather Underground; www.wunderground.com/history/airport/KNYC/2016/2/16/DailyHistory.html et al).

Flows at the time of collection on February 17 were approximately 146 MGD through the Bronx channel and 79 MGD through the Manhattan channel, with a total of 225 MGD entering the Wards Island treatment facility.

One week earlier, on February 10, 2016, flows at the same time of day (7:30 AM) at these locations were 136 MGD through the Bronx channel and 73 MGD through the Manhattan channel, with a total of 209 MGD entering the Wards Island facility. On February 8 and 9, 0.05 and "trace" inch of precipitation were recorded, respectively, more closely representing a dry weather scenario. Flows during the sample collection period were approximately 7.3% higher than flows the previous week as the system responded to the February 15/16 storm event.

All data related to facility flows were provided by Mr. Chan.

4 Preparing the Wards Island Evaluation Location

NYC DEP Wards Island operators delivered two five-gallon buckets, one from each the Bronx and Manhattan channels, to the garage of the Sharon Heat Exchanger building shortly after the samples were collected on Wednesday, February 17, 2016.

The Fuss & O'Neill team met with Marcus Entenza, NYC DEP Wards Island Health and Safety Officer, in the morning for a site-specific safety orientation, which augmented the Job Hazard Analysis that Fuss & O'Neill staff had prepared in advance. Mr. Entenza, Mr. Fragias, and NYC DEP Wards Island Deputy Plant Chief Malak Shafik would serve as on-site contact people for Fuss & O'Neill staff for the duration of the project. Cell phone numbers for all Fuss & O'Neill staff were provided to NYC DEP Wards Island staff.

After the NYC DEP safety orientation, Fuss & O'Neill staff mobilized to the Sharon Heat Exchanger building garage, where sorting, evaluation, and archiving activities would be performed. Substantial personal protective equipment (PPE) were utilized during the forensic evaluation to mitigate or eliminate exposure to biological, physical, and chemical hazards.

The Fuss & O'Neill team prepared floor and elevated work areas in the Sharon Heat Exchanger building garage at which to sort the materials that had been collected by NYC DEP staff, as well as areas to archive materials once they were identified.

All critical activities performed by Fuss & O'Neill (including sorting, identification, archiving, and documentation of recovered items) were recorded using a SONY Handycam (model DCR-SX45). All videos have been provided on a portable WD "My Passport" Ultra hard drive. See *Appendix C*.

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5 Objective and Methodology

5.1 Objective

As stated previously, the general objective of this forensic evaluation was to identify the materials present in a "snapshot" of influent to this facility from two service areas.

The evaluation was specifically designed to gather information on the quantity and variety of consumer products made from a variety of nonwoven fabrics. These items, commonly referred to as wipes, fall into a number of consumer product categories and are marketed in different ways, including "flushable", "disposable", and "biodegradable".

Limited studies of the wipes recovered in influent have been completed to quantify the exact wipe product(s) found in sewage. As a result, many media reports and complaints commonly refer to them as "flushable" due to the disposal method, whether they are marketed as such or not.

The objective of this evaluation was to determine, to the maximum extent possible, what specific wipes were recovered, including the brand.

5.2 Methodology

The methodologies used by Fuss & O'Neill to sort, identify, and archive recovered wipes are consistent with those described in the Draft "*Methodology for Forensics of Products in Wastewater*" (the Methodology), a standard operating procedure (SOP) being developed by Ms. Strause for the National Association of Clean Water Agencies (NACWA). *(Note: This document is due to be published in early 2017- the title and contents are subject to change. This document will be made available by NACWA when it has been finalized.)*

The approach defined in the Methodology uses characteristics of the recovered wipe, including the following general observations:

1. Dimensions (length and width)
2. General ratio of length to width
3. Presence of an embossed pattern on one or more side of the wipe
4. Presence of pinking (i.e., a zigzag edge)
5. Presence of raised lines (i.e., ribs) on one or more side of the wipe
6. Consistency of ribs (i.e., parallel and evenly spaced vs. variable spacing)
7. Uniformity of ribs (i.e., of equal thickness vs. variable thickness)
8. Orientation of ribs (i.e., crossing the product in its direction of length vs. direction of width)
9. Difference in ribs on the two sides of wipe
10. Location and number of folds on the wipe
11. Absence of folds on the wipe
12. Perforated edges of the wipe, indicating delivery in cylindrical canister
13. Orientation of fibers (i.e, parallel or random)

14. Length of fibers, and uniformity and consistency in fiber length
15. Presence of apparent synthetic fibers
16. Opacity when backlit, reflecting the thickness of the wipe
17. Consistency of density of fiber web when backlit
18. Consistency of density of fiber web when placed on a dark surface
19. Texture of wipe as it dried

Fuss & O'Neill staff used observations about these characteristics in conjunction with the reference samples maintained by Ms. Strause. Reference samples of more than 200 wipes, in a wide variety of product categories were available during this evaluation in two formats:

1. Laminated in clear plastic, allowing the Fuss & O'Neill team to observe the characteristics.
2. Loose samples in small zippered plastic bags, allowing the team to supplement observations by handling a clean sample of the wipe, and comparing the tear strength of the reference sample to a recovered item.

A numbering, organizational, and labeling system used by Ms. Strause allowed staff to quickly find the loose reference sample matching the laminated reference sample.

This reference sample set is copyrighted by Ms. Strause. (as Verdant Water, PLLC) It was used by Fuss & O'Neill with permission for this project. It will not be provided to the New York City Law Department.

6 Evaluating Recovered Samples

6.1 Forensics of Materials Recovered from the Bronx Channel

Fuss & O'Neill began the evaluation of materials recovered from the Bronx Channel at approximately 10:00 AM on Wednesday, February 17. The evaluation process continued all day and consisted of separating various items from the five-gallon bucket provided by Wards Island staff.

Assessment of the samples included the following steps:

- Separation of trash from possible wipes materials.
- Detailed visual separation of remaining materials into various piles including paper towels, flushable wipes, baby wipes, surface cleaning wipes, feminine hygiene products, hygiene wipes, other wipes, bath/medical wipes, mechanic/shop towels.
- Brand identification of various wipes from each category.
- Archiving brand identified wipes for future reference.

Mr. Iannicelli and Ms. Lama performed the initial sort of recovered items larger than 1-inch square, placing easily identifiable products into piles, by category. Items considered trash were counted but not identified. Materials identified as paper towels were placed into piles of roughly equivalent size; these were not identified by brand. Woven mats consisting of primarily hair were counted as trash. All non-wipe items recovered were disposed of after being counted.

Materials that were not immediately identifiable or that were very small were placed in a separate location for evaluation by Ms. Strause.

All members of the team assigned unique identification numbers to each item as it was archived or identified, working from a sheet of pre-printed labels to avoid duplication. The identification number format was "WI-BX-###", where:

- WI indicates Wards Island,
- BX indicates the Bronx Channel, and
- ### is the unique number of the item recovered from the Bronx Channel sort.

Products were archived as they were identified. Items confirmed to be wipes but that could not be identified by brand were also archived. At least one of each unique item was archived via non-thermal lamination, with duplicates of that item placed in zippered plastic bags, due to a finite number of lamination sleeves on site (see *Section 8* for materials and methods). Recovered items that were determined to be wipes but that were highly deformed (i.e., stretched to a length that exceeded the size of the lamination sleeve, or twisted into a rope that could not be laminated) were also placed in zippered plastic bags.

Ms. Strause identified materials that were unidentified by the initial sort, using the reference samples as a resource.

Ms. Lama and Mr. Iannicelli archived recovered items and photographed items that had been archived.

Some items recovered from the Bronx sort were not identified before the team left the site the evening of Wednesday, February 17. These materials were placed in a separate part of the work area, and Ms. Strause resumed evaluating these the morning of Thursday, February 18.

6.2 Forensics of Materials Recovered from the Manhattan Channel

Mr. Iannicelli and Ms. Lama began the evaluation of materials recovered from the Manhattan Channel at approximately 9:00 AM on Thursday, February 18.

Mr. Iannicelli performed the initial sort of recovered items, placing easily identifiable products into piles, by category. The same rules for categorization used in the sort of materials from the Bronx Channel were followed for the materials from the Manhattan Channel.

Materials that were not immediately identifiable were placed in a separate location for evaluation by Ms. Strause.

All members of the team assigned unique identification numbers to each item as it was archived or identified, working from a sheet of pre-printed labels to avoid duplication. The identification number format was "WI-M-###", where:

- WI indicates Wards Island,
- M indicates the Manhattan Channel, and
- ### is the unique number of the item recovered from the Manhattan Channel sort.

Ms. Lama archived recovered items and photographed materials that had been archived.

Ms. Strause identified materials that were unidentified by the initial sort, using the reference samples as a resource.

The process continued until 7:00 PM, when the Fuss & O'Neill team had to demobilize. At this time, the Fuss & O'Neill team placed all items from both the Bronx and Manhattan sorts that had been archived into a box and sealed it with packing tape and a custody seal. Custody of this box was formally transferred to the operator on duty in the process building, with instructions to keep it in a refrigerated area. Wipes recovered from the Manhattan channel that were not identified on Thursday, February 18 were separated by layers of clean paper towel and placed into three large zippered plastic bags. Ms. Strause kept custody of these items and later performed identification of them back in Maine at another facility. These items were kept refrigerated until Ms. Strause performed the identification.

7 Identifying Recovered Items

7.1 Summary of Bronx Channel Sort

Figure 1 shows the breakdown of all materials recovered from the Bronx Channel Sort on February 17, 2016. The breakdown primarily shows the majority of items as Paper Towels, Baby Wipes, and Trash. 77% of all sorted items included these three categories. *Table 2* shows the count and percentage breakdown of all materials recovered.

Figure 1 - All Materials Recovered
Wards Island - Bronx Sort - Feb 17, 2016

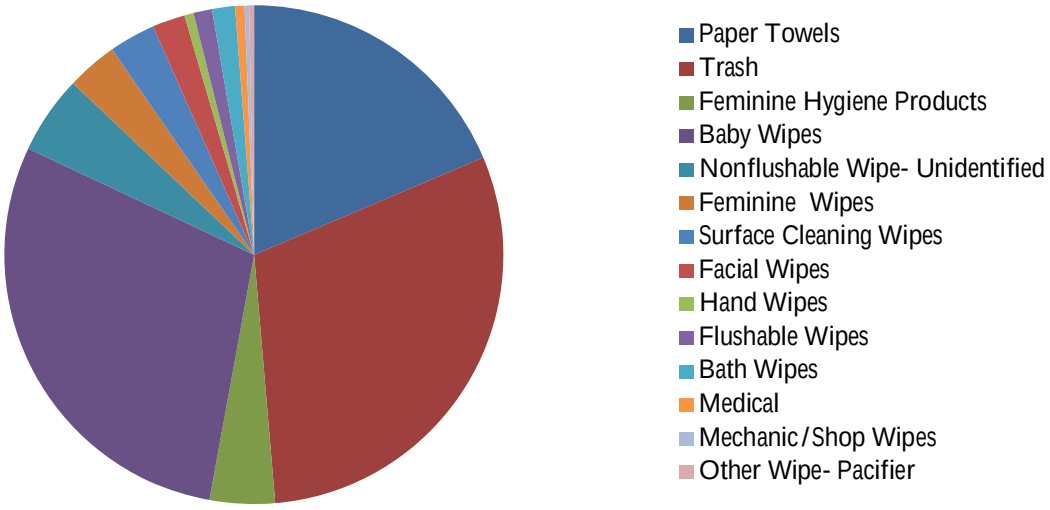

Figure 2 shows the breakdown of wipe materials recovered from the Bronx Channel Sort on February 17, 2016. This breakdown does not include trash or paper towels. 62% of wipe materials recovered were various brands of Baby Wipes. *Table 3* shows the count and percentage breakdown of wipe materials recovered. *Appendix A* shows an overview of specific brands of each type of wipe found during the sort of items recovered from the Bronx channel.

Table 2:
All Materials Recovered – Bronx Channel Sort

All Materials Recovered	Count	%
Trash	100	30.0%
Baby Wipes	97	29.1%
Paper Towels	62	18.6%
Nonflushable Wipe	17	5.1%
Feminine Hygiene Products	14	4.2%
Feminine Wipes	11	3.3%
Surface Cleaning Wipes	10	3.0%
Facial Wipes	7	2.1%
Bath Wipes	5	1.5%
Flushable Wipes	4	1.2%
Hand Wipes	2	0.6%
Medical	2	0.6%
Mechanic/Shop Wipes	1	0.3%
Other Wipe- Pacifier	1	0.3%
Totals	333	100.0%

Figure 2 - Breakdown of Wipes Recovered
Wards Island - Bronx Sort - Feb 17, 2016

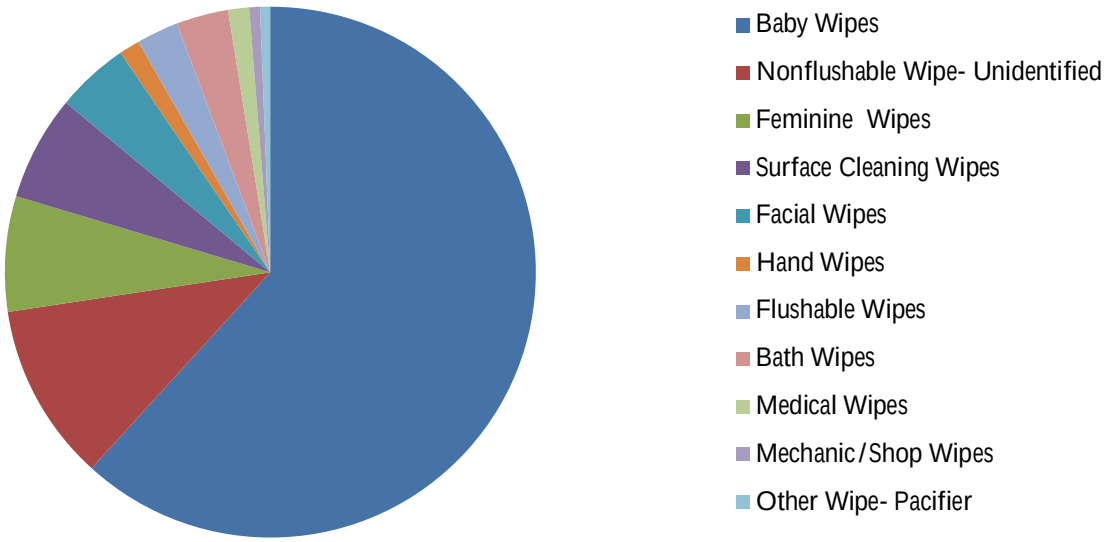

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Table 3

Breakdown of Wipes Recovered – Bronx Channel Sort

Wipe Materials Recovered	Count	%
Baby Wipes	97	61.8%
Nonflushable Wipe	17	10.8%
Feminine Wipes	11	7.0%
Surface Cleaning Wipes	10	6.4%
Facial Wipes	7	4.5%
Hand Wipes	2	1.3%
Flushable Wipes	4	2.5%
Bath Wipes	5	3.2%
Medical Wipes	2	1.3%
Mechanic/Shop Wipes	1	0.6%
Other Wipe - Pacifier	1	0.6%
Totals	157	100.0%

For the Bronx sample, a summary of recovered wipes is as follows:

Wipes Identified by Brand=	126
Total Wipes Recovered=	157
% Identified=	80.3%
# of Unique Category/Brands Identified=	33

7.2 Summary of Manhattan Channel Sort

Figure 3 shows the breakdown of all materials recovered from the Manhattan Channel Sort on February 18, 2016. The breakdown primarily shows the majority of items as Paper Towels, Baby Wipes, and Trash. 80% of all sorted items included these three categories. *Table 4* shows the count and percentage breakdown of all materials recovered.

Figure 3
All Materials Recovered
Wards Island - Manhattan Sort - Feb 17, 2016

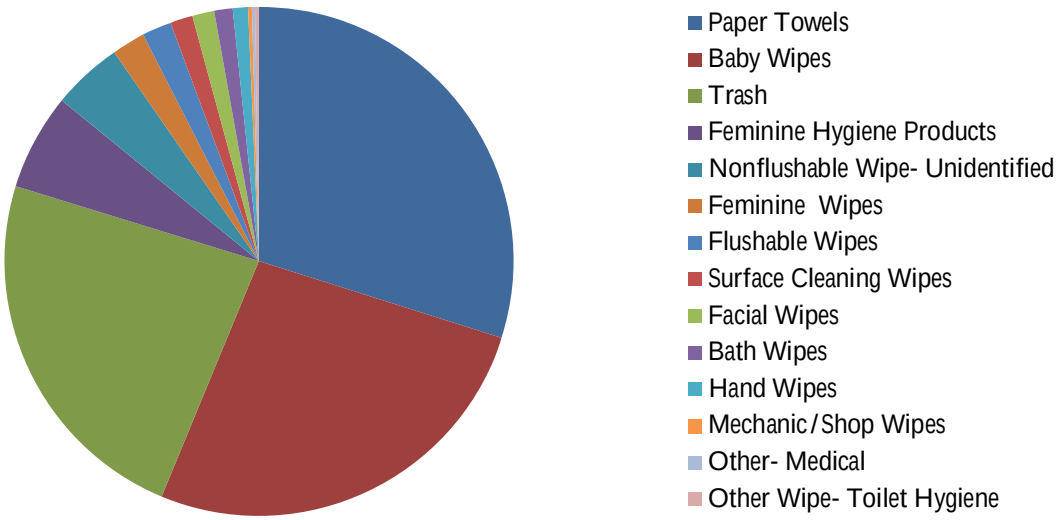


Table 4
All Materials Recovered – Manhattan Channel Sort

All Materials Recovered	Count	%
Paper Towels	127	29.88%
Baby Wipes	112	26.35%
Trash	100	23.53%
Feminine Hygiene Products	26	6.12%
Nonflushable Wipe	19	4.47%
Feminine Wipes	9	2.12%
Flushable Wipes	8	1.88%
Surface Cleaning Wipes	6	1.41%
Facial Wipes	6	1.41%
Bath Wipes	5	1.18%
Hand Wipes	4	0.94%
Mechanic/Shop Wipes	1	0.24%
Other- Medical	1	0.24%
Other Wipe- Toilet Hygiene	1	0.24%
Totals	425	100%

Figure 4 shows the breakdown of wipe materials recovered from the Manhattan Channel Sort on February 18, 2016. This breakdown does not include trash or paper towels. 65% of wipe materials recovered were various brands of Baby Wipes. *Table 5* shows the count and percentage breakdown of wipe materials recovered. *Appendix B* shows an overview of specific brands of each type of wipe found during the sort of items recovered from the Manhattan channel.

Figure 4
Breakdown of Wipes Recovered
Wards Island - Manhattan Sort - Feb 17, 2016

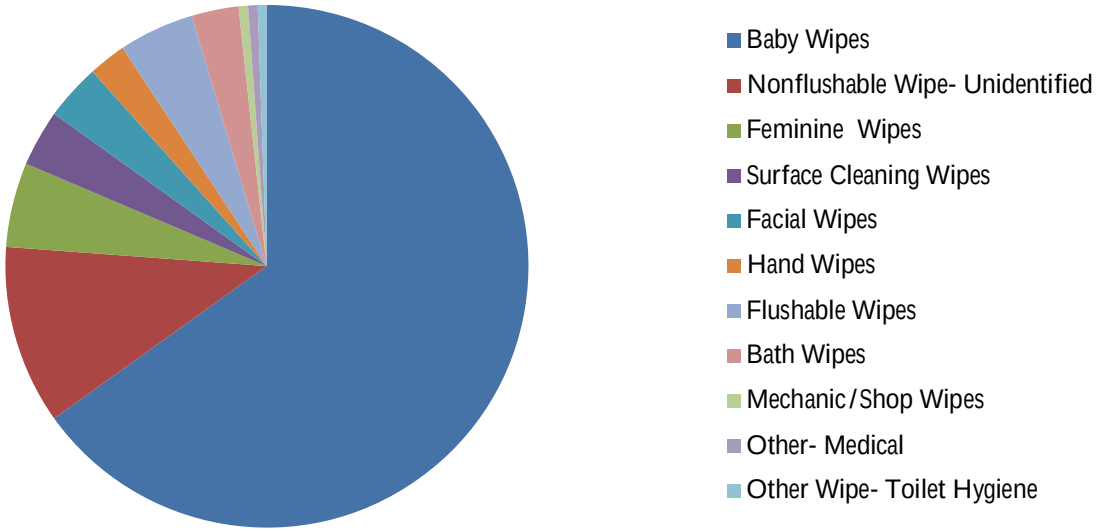


Table 5
Breakdown of Wipes Recovered – Manhattan Channel Sort

Wipe Materials Recovered	Count	%
Baby Wipes	112	65.12%
Nonflushable Wipe	19	11.05%
Feminine Wipes	9	5.23%
Surface Cleaning Wipes	6	3.49%
Facial Wipes	6	3.49%
Hand Wipes	4	2.33%
Flushable Wipes	8	4.65%
Bath Wipes	5	2.91%
Mechanic/Shop Wipes	1	0.58%
Other- Medical	1	0.58%
Other Wipe- Toilet Hygiene	1	0.58%
Totals	172	100%

For the Manhattan sample, a summary of recovered wipes is as follows:

Wipes Identified by Brand=	125
Total Wipes Recovered=	172
% Identified=	72.7%
# of Unique Category/Brands Identified=	38

8 Documenting and Archiving Recovered Items

8.1 Archiving

All items recovered were given a specific unique identification number to identify the origin of the sorted materials, using the format described in *Section 5*. Since the components are still biologically active, the items were archived in a way that minimizes decomposition.

The preferred method of archiving was lamination, using self-laminating (i.e., non-thermal) pouches distributed by ULINE. These laminating pouches are 8 mils thick, are 9 1/16" x 11 9/16" in size, and isolate the archived item from air, slowing down decomposition.

Some of the identified branded materials were found multiple times. There were over 150 wipes recovered in the Bronx sort and over 170 wipes recovered the Manhattan sort, exceeding the number of recovered wipes that were estimated during the planning process. As a result, not enough laminating pouches were present on site to archive all wipes this way, and more pouches could not be delivered to the Wards Island facility in time to be used.

After consultation with and consensus from New York City Law Department staff, the Fuss & O'Neill team prioritized laminating at least one example of each positively identified product, and laminating all items identified as flushable wipes. The Fuss & O'Neill team purchased zippered plastic bags at a retail store near the Wards Island facility, and used these to archive duplicates of the laminated products. At least one example of each positively identified product was archived by lamination. 90 items were archived using the lamination method; the remaining were placed in the zippered plastic bags.

The unique identification number, date, type of material, and brand was documented on every archived- both laminated and bagged- item using adhesive labels. The brand was archived as *Unknown* if the specific brand identity could not be determined.

Archived items were kept in a cold location to preserve the intact samples. Since the components are still biologically active, the material will continue to break down during and after the lamination process. Keeping the items at a lower temperature will limit this deterioration.

8.2 Video Recording

The entirety of the evaluation process was video-recorded to document the consistent methodology used by Fuss & O'Neill staff.

All critical activities performed by Fuss & O'Neill (including sorting, identification, archiving, and documentation of recovered items) were recorded using a SONY Handycam (model DCR-SX45). The forensics evaluation of Manhattan items performed by Ms. Strause in Maine was also recorded in this way.

The video data was saved to the portable WD "My Passport" Ultra hard drive attached as *Appendix C*.

8.3 Photographs

Photographs documenting both sides of each archived item were taken. The photos document the characteristics of each wipe recovered during the evaluation, in the event that ongoing biological decomposition of the recovered materials over time makes visual inspection less useful.

Approximately 570 photos were taken of the recovered items. These have been saved on the hard drive attached as *Appendix C*. The file name for each photo includes the unique identification number, as well as whether the photo shows the front or back of the item.

Examples of wipes archived from the Bronx and Manhattan sorts, respectively, are shown in *Figures 5 and 6*.

Figure 5:
Example of Archived Material from Bronx Sort
with Unique Identification Number

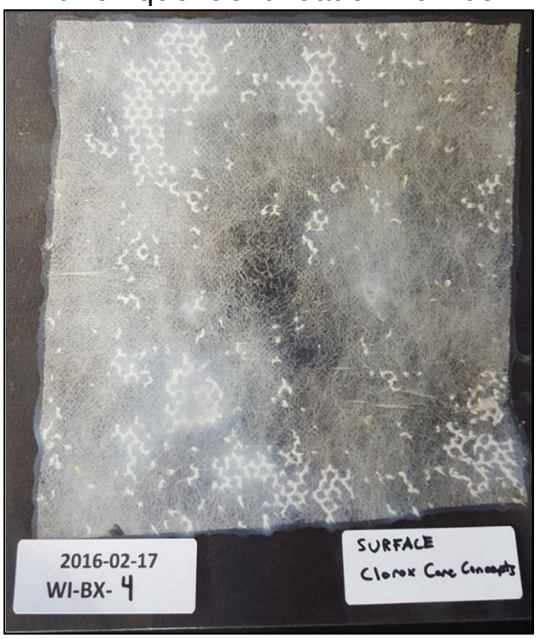
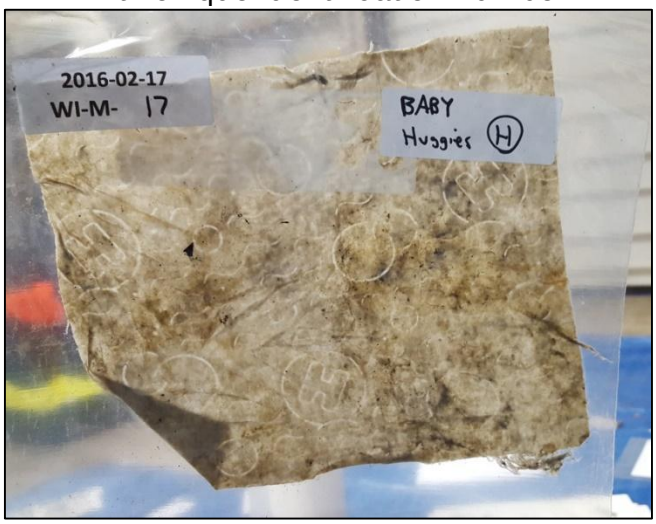


Figure 6:
Example of Archived Material from Manhattan Sort
with Unique Identification Number



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9 Conclusions

When comparing items recovered from the two sorting events, the following are observed:

- The Manhattan sample contained more individual items (425) than the Bronx sample (333).
- The Manhattan sample had a higher percentage of "flushable" wipes (4.6%) than the Bronx sample (2.5%).
- The Manhattan sample had a lower percentage of trash (23%) than the Bronx sample (30%).
- The Manhattan sample had a higher percentage of paper towels (29.8%) than the Bronx sample (18.6%).
- The Manhattan sample had a lower percentage of wipes (40.7%) than the Bronx sample (47%).
- The Manhattan sample had a higher number of unique brands identified (38) than the Bronx sample (33).
- Approximately 80% of wipes in the Bronx sample were positively identified.
- Approximately 73% of wipes in the Manhattan sample were positively identified.
- The majority of wipes that couldn't be identified in both Bronx and Manhattan samples were spunlace fabric, and were stretched or distorted to an extent that unique characteristics could not be observed.

The overall results from this evaluation differ from other forensics studies for several reasons. These include the following:

1. The study area was a combined system, resulting in a higher percentage of trash than recovered from forensics evaluations that were performed in separated sanitary sewer systems.
2. The prevalence of trash skews the results by percentage (*Figures 1 and 3*) when compared to other forensics evaluations.
3. The evaluation was performed shortly after a wet weather event. This could have created more turbulence in the system than seen in an equivalent separated sanitary sewer system, resulting in a lower percentage of "flushable" wipes than recovered from other forensics evaluations.

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Appendix A

Brands of Identified Wipes from the Bronx Channel Sort

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Table 6 - Brands of Identified Wipes

Wards Island - Bronx Sort - Feb 17, 2016

Category and Brand	Number Recovered
Baby: Huggies- Unknown version	33
Baby: Amazon Elements	13
Baby: Huggies Pure/ Soft Skin	12
Feminine Hygiene: Soft & Gentle	8
Baby: Pampers Baby Fresh	6
Baby: Well Beginnings, etc (Rockline)	6
Baby: Well Beginnings Scented (Nutex)	5
Surface Cleaning: Total Home (CVS)	4
Baby: Pampers Sensitive	4
Baby: Parents Choice (WalMart)	4
Baby: Huggies Natural Care	3
Facial: Cetaphil	3
Baby: Marvel Super Hero	2
Bath: Parents Choice (WalMart)	2
Feminine Hygiene: Playtex Personal	2
Baby: Seventh Generation	1
Baby: Babyganics Hand, Face, and Baby	1
Baby: Bumboosa	1
Baby: Honest Co	1
Baby: Huggies Cucumber	1
Baby: Little Ones	1
Baby: Members Mark (Sam's Club)	1
Baby: Water Wipes	1
Bath: equate (WalMart)	1
Facial: Murad	1
Facial: Up & Up Pink Grapefruit (Target)	1
Feminine Hygiene: Clarisse	1
Flushable: Kirkland (Costco)	1
Flushable: Wipe 'N Fresh	1
Hand: CVS Face & Hand	1
Hand: Purell Sanitizing	1
Medical: Clorox Care Concepts	2
Other: NUBY (Pacifier)	1
Wipes Identified by Brand=	126
Total Wipes Recovered=	157
% Identified=	80.3%
# of Unique Category/Brands Identified=	33

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Appendix B

Brands of Identified Wipes from the Manhattan Channel Sort

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Table 7

Brands of Identified Wipes

Wards Island - Manhattan Sort - Feb 17, 2016

Category and Brand	Number Recovered
Baby: Huggies- Unknown version	22
Baby: Pampers Baby Fresh	14
Baby: Pampers Sensitive	9
Baby: Huggies Pure/Soft Skin	8
Baby: My Fair Baby	6
Baby: Well Beginnings Scented (Nutex)	5
Baby: Amazon Elements	4
Baby: Parents Choice (WalMart)	4
Baby: Seventh Generation	4
Baby: Well Beginnings, etc (Rockline)	4
Baby: Huggies Natural Care	3
Baby: Smile & Save (Duane Reade)	3
Feminine Hygiene: Clarisse	3
Feminine Hygiene: Summer's Eve	3
Hand: CVS Face & Hand	3
Baby: 365 Everyday Value	3
Baby: Baby Touch	2
Baby: Bumboosa Bamboo	2
Baby: Johnson & Johnson	2
Facial: Equate Sensitive	2
Feminine Hygiene: Playtex Personal	2
Baby: Babyganics Face Hand & Baby	1
Baby: Honest Company	1
Baby: Little Ones	1
Baby: Tender Touch	1
Facial: Acne- Greenbrier	1
Facial: Burt's Bees Exfoliating	1
Facial: Just the Basics	1
Facial: LA Fresh	1
Feminine Hygiene: Soft N Gentle	1
Flushable: Pampers Kandoo	1
Flushable: Rockline	1
Flushable: Up & Up	1
Hand: Wet Nap	1
Medical: Clorox Care Concepts	1
Other- Toilet Hygiene: White Cloud Moist Soft Cloth	1
Surface Cleaning: Lysol	1
Surface Cleaning: Total Home	1
Wipes Identified by Brand=	125
Total Wipes Recovered=	172
% Identified=	72.7%
# of Unique Category/Brands Identified=	38

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Appendix C

Photographs & Videos attached on WD Passport hard drive

5.2 Water UK Study 2017

WATER UK

WIPES IN SEWER BLOCKAGE STUDY

FINAL REPORT

Report Ref. No. 21CDP.WS4.WS

Programme Area	**21st Century Drainage Programme**
Report Title	**Wipes in sewer blockage study – Final Report**
Supported by	**EDANA members, Defra**
Programme Manager	**John Spence**
Workstream Chair	**Rachel Dyson, Anglian Water**
Contractor	**WRc plc**
Sub-Contractor	**None**
Author of Report	**Andy Drinkwater and Frank Moy**
Report Type	**Final**
Period Covered	**May to October 2017**

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WATER UK

WIPES IN SEWER BLOCKAGE STUDY – FINAL REPORT

Executive Summary

Objectives

The project objectives were to:

i) Carry out investigations in wastewater utility areas/catchments, to obtain updated information regarding the composition of both sewer blockages and pump clogs.

ii) Use the information gained from the investigations to help determine interventions to reduce the incorrect disposal of non-flushable products.

iii) Use the information gained from the studies to help demonstrate the effect that non-flushable wipes and other non-flushable products have on the sewer network.

Conclusions

1) The majority of the sewer blockage material recovered comprised of non-flushable wipes that were not designed to be flushed and should not have been disposed of via the WC. Baby wipes accounted for over 75% by weight of identifiable products. Surface wipes, cosmetic removal wipes and feminine hygiene products accounted for approximately 20% by weight of identifiable products.

2) The products recovered that were designed to be flushed accounted for a small proportion of the products recovered – Approximately 0.88% by total weight and 1.9% by weight of products that could be identified. However, it is accepted that during the blockage recovery process some toilet tissue and other weaker material is lost in the blockage removal process.

3) The analysis of the samples collected at wastewater treatment works inlets shows a similarity with the items recovered from the sewer blockage samples. This suggests that the items causing/present in sewer blockages are the same types of items (by intended use) and that they remain intact as far as the wastewater treatment works.

4) The majority of material in pumping station clogs was an unidentifiable mass of wipes. However, a single pumping station clog where individual products could be recognised, showed that it contained a higher proportion of non-flushable wipes than sewer blockages – 95% as opposed to 75% in sewer blockages. There was limited flushable wipe material (0.09%) identified in the pump clogs in this single sample**.** Experience suggests that this is because sewage pumps are able to mechanically break the flushable wipes and pass them downstream.

5) The analysis of features associated with blockage locations, for which sufficient data was provided, showed a wide variability in the reason for the blockage having formed:

- 11 were the result of features which are integral to drain and sewer system design in the UK, such as interceptor traps, backdrops, 90° bends etc.
- 4 were the result of other unavoidable debris entering the pipe (gravel/deposits) and a sewer defect that was in need of repair.
- 6 were due to inappropriate disposal practice; the flushing of a dishcloth, a curtain and at 4 sites, excessive volumes of wipes.
- 3 were at locations where, despite adequate information being returned from site, there was no obvious cause.
- 3 of the 7 pump clogs recovered were caused by material (clothes etc.) being disposed of to the sewer system.
- For the remaining 20 sewer blockages insufficient data was available to assess the features at the blockage locations.

6) It is apparent from an analysis of the recovered sewer blockage samples that a significant number of people are unaware of the 'do not flush' advice on the non-flushable wipes packaging; do not appreciate the reason why wipes designed not to be flushed should not be flushed, or are unconcerned by the potential consequences of their actions.

Recommendations

Following the conclusion of this report it is recommended that:

1) Public/press communications should target the inappropriate disposal to sewer of non-flushable products.

2) Polypropylene or Polyethylene fibres should not be included in any product labelled as flushable.

3) Manufacturers and retailers adhere to the labelling requirements of EDANA's flushability guidelines and COP v2. This requires a clear 'do not flush' logo on the front of pack, on all non-flushable wipes.

4) Manufacturers and retailers of non-flushable wipes provide responsible disposal information in their advertising and awareness campaigns.

5) Manufacturers, retailers and the water industry working collaboratively on a customer campaign, to raise awareness of the correct disposal of non-flushable wipes.

6) Awareness and information campaigns need to reinforce the message that, as well as being illegal, in respect of Section 111 of the Water Industry Act 1991, the disposal of clothes/woven materials should be via the solid waste route.

7) Consideration should be given to issues around toddler wipes.

8) Consideration should be given to conducting a repeat of the study following educational campaigns to see if they have been effective in reducing the number of non-flushable wipes in the sewer.

Benefits

The benefits of the project have been:

i) An updated and far more detailed evaluation of the material found in blockages and pump clogs, than was previously available.

ii) To provide information to better target interventions. This may include:

- Better labelling, in particular for the types of items found in the material collected: and
- Better targeting of awareness/information campaigns by **all** stakeholders concerned.

iii) As a result of the above interventions, there is the potential for:

- Significant financial savings to customers;
- Improvements in water quality and the natural environment;
- Reduction in sewer flooding to homes and pollution to the environment; and
- Increased expenditure by the water industry on improving services to customers as result of not spending the money dealing with avoidable blockages and related incidents.

iv) Increased reputation of manufacturers and retailers, as responsible players in the area of 'do not flush' labelling and awareness of correct disposal methods for non-flushable products.

v) Provides basis from which collaborative opportunities can be identified with the water, manufacturing and retail industries.

Contents Page Number

1 Introduction

Wipes and other disposable products are the main cause of sewer blockages and emergency call outs to sewage pumping stations.

A relatively small study undertaken in the UK in 2011 showed that baby wipes and other items not suitable for WC disposal made up a substantial proportion of the blockage material.

This larger study has been undertaken by WRc as part of the Water UK 21st Century Drainage Programme. It has involved the collection of sewer blockages and pump clogs by six water and sewerage companies (WaSCs) and, by WRc staff, three samples from sewage treatment works inlet channels. The 54 different samples were subsequently assessed by a combination of WaSC staff, manufacturers' representatives, EDANA and WRc staff during the 'Recognition Days' held at WRc on the 7th and 8th August 2017.

This project final report gives details of the blockage sample collection methodology, product identification and the analysis of the findings. Previously, in mid-August 2017, an Interim Report was issued which gave the interim findings from the 'Recognition Days'.

The updated blockage content information will help the water industry and manufacturers, retailers, NGOs to better target their actions and investment to reduce the flushing of inappropriate items.

2 Sample collection

Sample collection was undertaken from blockage incidents allocated to sewer blockage crews and reactive pump maintenance crews who had been selected by the participating water companies to carry out the sample collections. Blockages were allocated to the sample collection crew from the blockage incidents reported to the water company call centre or the pump station control room on a daily basis.

A brief data sheet was provided by WRc for the crews to complete to be attached to the samples. Where possible, a copy of the Incident Reports/feedback from the water company database was requested to provide details of the site and mode of blockage. Some companies also provided photographs. This information was used to subsequently establish the cause of each blockage.

It should be noted that collection of blockage material is totally dependent on the occurrence of appropriate material and the configuration of the drainage system to facilitate collection of that material.

A total of 44 sewer blockages, 7 pump clogs and 3 WwTW inlet samples were collected during the period 11 May to 31 July 2017.

2.1 Sewer blockage collection method

The collection of sewer blockage material samples was carried out as a specific sample collection activity and did not rely on the capture of material cleared from standard blockage clearance with a jetting machine. Experience has shown that collection of material from jetted blockages is very unreliable and material recovered is not necessarily representative of the composition of the blockage.

Where possible the recovery of samples was achieved using drain rods fitted with a plunger. Where upstream and downstream chambers were accessible, a plunger was used from upstream to push the blockage to the downstream collection point in a controlled manner. The plunger helps control the discharge of the backed up effluent.

Some material was recovered using a worm screwed tightly into the blockage from the upstream chamber and the blockage drawn slowly and as intact as possible to the upstream manhole. Samples were also collected from interceptors using a grab. However, it was necessary to dislodge some blockages using a jetter operating under low pressure and samples were collected from the material snagged on the rear of the jetting nozzle.

The samples were recovered from the manhole using a grab or basket (where possible), with care taken not to collect material from the flow backed up by the blockage. However, evidence gained during the blockage recovery process shows that some of the material, such as toilet tissue and other weaker material are lost in the blockage removal process.

2.2 Pump blockage collection method

Pump blockage material was collected by the reactive pump maintenance crews from pump failures on an opportunistic basis.

Pump blockage material was only collected from blockages that required the pump to be lifted to clear the blockage. This ensured the material collected was that which could be specifically identified as being part of the blockage and not general debris from the wet well. Samples recovered were examples of blockages that were removed intact and others that were extracted piece by piece.

2.3 Wastewater Treatment Works inlet collection method

Three sets of samples of wipes and other non-sewage material were collected at two waste water treatment works, serving populations of 117,000 and 216,000, on 22 May and 3 July 2017. Both catchments comprised of residential, commercial and light industrial areas.

Samples were collected from the surface of the flow approaching the inlet screens and also from the screens themselves in order to sample the subsurface material. Samples were recovered at random over a period of up to two hours (morning peak flow) using a grab and/or basket. Samples were recovered largely as single items but samples of entangled materials were also recovered.

Intact wipes were targeted to allow identification of products that represent the bulk of material captured on the screens.

2.4 Sample processing

Samples were either delivered to WRc by courier or collected from designated storage at each water company by WRc.

On receipt of the samples at WRc's laboratories in Swindon, each sample was gently rinsed with tap water to remove organic material and the bulk of toilet paper captured with the blockage. It is recognised that dispersible wipe material may also have been washed out during this process as it is similar to toilet paper, although care was taken to retain any of this material if it was identified. All materials other than this, including sanitary products, cotton buds, stones, metals, textiles, plastics, roots etc., included in the blockage, was returned to the sample buckets along with the wipes for subsequent identification. A disinfectant was added at this stage to reduce decomposition and to make the examination of the materials less offensive.

3 Sample 'Recognition Days'

Samples 'Recognition Days' were held at WRc Swindon on the 7th and 8th August 2017. An interim report titled '*Initial findings from Wipes Recognition Days'* was issued on 16th August 2017.

The report gives details of the work that was undertaken and, in an appendix, details of the contents of each of the 54 samples analysed.

4 Analysis of Results

4.1 Contents of samples collected

The contents of each of the 54 samples analysed during the 'Recognition Days' were recorded in an excel database. This resulted in 70 different descriptors being used in the description of the contents. Many of these descriptors were similar and, in order to simplify and enable understandable comparisons, these 70 descriptors have been combined into 18 main categories, as detailed in the tables in Appendix 1.

Sample proportions are defined by weight. It should be noted that the weight represents wet, hand rung samples, not dried samples.

Wipe samples were classified as either '*unidentifiable*' or '*identifiable*', as follows:

- The unidentifiable wipes, 53% by weight, were unidentifiable due to being deformed and/or twisted and are grouped together as an '*unidentifiable mass of wipes'* category.
- The identifiable wipes, 47% by weight, were categorised by their intended use, for example, baby wipes, surface wipe, moist toilet tissue etc, as listed in Appendix 1.

Tables 1, 2, 3 and 4 give the results of the sample analysis, in terms of percentage by weight of the product categories, for the following groups of samples:

- Table1 - All 54 samples analysed;
- Table 2 - Sewer blockage samples;
- Table 3 - WwTW inlet samples; and
- Table 4 - Pumping Station – pump clog samples.

It is noted that the two categories '*Unidentified mass of wipes'* and '*Baby wipe*' are dominant and account for between 79% to 87% of all items from Sewer, WwTW and Pumping Station samples, depending upon the source.

Furthermore, referring to Table 1 below, in excess of 98.7% of items found in the samples analysed are in the first 7 categories, indicating that items in the other 11 categories are relatively uncommon and of less significance in terms of the materials found.

The categories '*Unidentified mass of wipes*' and '*Baby wipe'* are the top two categories, by weight, in each of the groups of samples. '*Surface Wipes*', '*Female Hygiene*' and '*Cosmetic Wipe'* categories are always present in the top 7 categories in both the Sewer and WwTW samples.

The Pumping Station samples likewise show '*Unidentified mass of wipes*' as the primary pump blockage causes (87.6%) but 'Materials/Clothing' account for 11% of blockage material by weight. All other items combined represent less than 1.3% of material removed from the pumps.

Gravel/deposits (including encrustation and concrete) are only significant in the sewer samples. Clothing/materials are only significant in the pump blockage samples.

Table 1 Percentage of samples in each product category for all samples (pipe blockage, pumps and inlet)

Product categories	Total weight kg.	% of sample
Unidentified mass of wipes	24.533	49.07
Baby wipe	18.055	36.11
Surface wipe	2.067	4.13
Material/clothing	1.438	2.88
Female hygiene	1.191	2.38
Cosmetic wipe	1.025	2.05
Gravel/deposits	0.863	1.73
Flushable wipe/Moist toilet tissue	0.44	0.88
Plastic wrapper	0.091	0.18
Personal care (non wipe items – See Appendix 1 for further details)	0.083	0.17
Toddler wipe	0.065	0.13
Paper products	0.049	0.10
Metal	0.03	0.06
Various debris	0.024	0.05

Product categories	Total weight kg.	% of sample
FOG	0.023	0.05
Cotton pad	0.012	0.02
Industrial	0.008	0.02
Toilet paper	0.004	0.01
Total	**50.001**	**100.00**

Table 2 Percentage of samples in each product category for Sewer pipe blockage samples

Product categories	Total weight kg.	% of sample
Unidentified mass of wipes	17.217	45.52
Baby wipe	15.665	41.41
Surface wipe	1.917	5.07
Gravel/deposits	0.863	2.28
Female hygiene	0.783	2.07
Material/clothing	0.433	1.14
Flushable wipe/Moist toilet tissue	0.418	1.11
Cosmetic wipe	0.35	0.93
Personal care (non wipe items – See Appendix 1 for further details)	0.064	0.17
Metal	0.03	0.08
FOG	0.023	0.06
Plastic wrapper	0.019	0.05
Paper products	0.013	0.03
Cotton pad	0.012	0.03
Various debris	0.011	0.03
Toilet Paper	0.004	0.01
Industrial	0.003	0.01
Total	**37.825**	**100**

Table 3 Percentage of samples in each product category for inlet of wastewater treatment works samples

Product categories	Total weight kg.	% of sample
Baby wipe	2.278	53.41
Unidentified mass of wipes	1.106	25.93
Female hygiene	0.331	7.76
Cosmetic wipe	0.18	4.22
Surface wipe	0.15	3.52
Plastic wrapper	0.066	1.55
Toddler wipe	0.065	1.52
Paper products	0.036	0.84
Flushable wipe/Moist toilet tissue	0.014	0.33

Product categories	Total weight kg.	% of sample
Various debris	0.013	0.30
Personal care (non wipe items – See Appendix 1 for further details)	0.012	0.28
Cotton pad	0.005	0.12
Industrial	0.005	0.12
Toilet paper	0.004	0.09
Total	**4.265**	**100.00**

Table 4 Percentage of samples by product category for Pumping Station samples

Product categories	Total weight kg.	% of sample
Unidentified mass of wipes	6.204	63.29
Baby wipe	2.389	24.37
Material/clothing	1.088	11.10
Female hygiene	0.087	0.89
Personal care (non wipe items – See Appendix 1 for further details)	0.019	0.19
Flushable wipe/Moist toilet tissue	0.009	0.09
Plastic wrapper	0.006	0.06
Paper products	0.001	0.01
Total	**9.803**	**100.00**

4.2 Contents of samples collected – Domestic flushed products only

A further analysis has been carried out after removing the following categories from the analysis:

- *Unidentified mass of wipes;*
- *Material/clothing;*
- *FOG;*
- *Metal;*
- *Gravel/deposit*'; and
- *Various debris.*

This enables a comparison of the different types of wipes and products used in a domestic scenario, which could be positively identified, to be made.

The results are given in the following tables:

- Table 5 - All 54 samples analysed;

- Table 6 - Sewer blockage samples;
- Table 7 - WwTW inlet samples; and
- Table 8 - Pumping Station – pump clog samples.

It should be noted that the '*unidentified mass of wipes*' could not be untangled, so whilst the majority appeared to be baby wipes and facial wipes, we cannot be 100% certain. We don't know the proportions of each and as such cannot report, with any accuracy, the make-up of the tangled masses.

The analyses indicate that the majority of domestic product items recovered were baby wipes. In the case of sewer blockage samples and WwTW samples this was 77% and 72% of all domestic items by weight respectively. The vast majority of the other products recovered from sewer blockage samples and WwTW samples, over 20% of all domestic items by weight, were either surface wipes, female hygiene products or cosmetic removal wipes. Moist toilet tissue accounted for 1.9% by weight of domestic products. Toddler wipes, which may or may not be designed to be flushable, accounted for 0.3% by weight.

It is noted that there is a similarity in the proportion of items, by intended use, recovered from the sewer blockage and WwTW inlet samples. This suggests that the items present in sewer blockages are the same types of items and that they remain intact as far as the wastewater treatment works.

The analysis of four pumping station clogs in which a significant proportion of wipes etc. were recovered, showed that, of the items that could be recognised, over 95% were baby wipes. The lower proportion of other categories of product is because sewage pumps are able to mechanically break up some of these items and pass them downstream – Baby wipes, on the other hand are seen to remain relatively intact in the tangled mass samples, despite the considerable forces applied to them.

It should be noted that the pump clog analysis is only on items that could be positively identified. It does not include the unidentified mass of wipes, typically found in pump clogs. Reference to Table 4 shows that the majority of materials found in four pump clogs were entangled masses.

Three pump clogs were the result of clothing/materials being ingested into the pumps. These clogs did contain some wipes but these have not been included in the above pump clog analysis.

Table 5 Percentage of samples by domestic product category for all samples collected (sewers, pumps and wastewater treatment works inlets)

Product categories	Total weight kg.	% of sample
Baby wipe	18.055	78.2
Surface wipe	2.067	9.0
Female hygiene	1.191	5.2
Cosmetic wipe	1.025	4.4
Flushable wipe/Moist toilet tissue	0.44	1.9

Product categories	Total weight kg.	% of sample
Plastic wrapper	0.091	0.4
Personal care	0.083	0.4
Toddler wipe	0.065	0.3
Paper products	0.049	0.2
Cotton pad	0.012	0.1
Industrial	0.008	0.0
Toilet paper	0.004	0.0
Total	**23.113**	**100.0**

Table 6 Percentage of samples by domestic product category for Sewer Samples

Product categories	Total weight kg.	% of sample
Baby wipe	13.387	76.8
Surface wipe	1.917	11.0
Cosmetic wipe	0.846	4.9
Female hygiene	0.773	4.4
Flushable wipe/Moist toilet tissue	0.419	2.4
Personal care	0.052	0.3
Plastic wrapper	0.019	0.1
Paper products	0.013	0.1
Cotton pad	0.012	0.1
Industrial	0.003	0.0
Total	**17.441**	**100.0**

Table 7 Percentage of samples by domestic product category for WwTW Samples

Product categories	Total weight kg.	% of sample
Baby wipe	2.278	72.4
Female hygiene	0.331	10.5
Cosmetic wipe	0.18	5.7
Surface wipe	0.15	4.8
Plastic wrapper	0.066	2.1
Toddler wipe	0.065	2.1
Paper products	0.036	1.1
Flushable wipe/Moist toilet tissue	0.014	0.4
Personal care	0.012	0.4
Cotton pad	0.005	0.2
Industrial	0.005	0.2
Toilet paper	0.004	0.1
Total	**3.146**	**100.0**

Table 8 Percentage of samples by domestic product category for Pumping Station Samples

Product categories	Total weight kg.	% of sample
Baby wipe	2.389	95.2
Female hygiene	0.087	3.5
Personal care	0.019	0.8
Flushable wipe/Moist toilet tissue	0.009	0.4
Plastic wrapper	0.006	0.2
Total	**2.51**	**100.0**

4.3 Analysis by features

Sample collection crews were asked, whenever possible, to identify and record the probable cause of each sewer blockage where samples were recovered. Nevertheless, it is recognised that there are occasions when it is not possible to identify the likely cause.

Of the 44 sewer blockage samples recovered, detailed information accompanied 24 of the blockages. This information was contained on either the blockage data sheet which the crews were asked to complete by WRc and or from the WaSCs corporate incident report system.

Unfortunately, 20 of the sewer blockages were accompanied by either insufficient or no information to enable the cause to be determined.

Of the 24 sewer blockages where sufficient data was provided, the features associated with sewer blockages have been determined, as indicated in Table 9.

Table 9 Features associated with sewer blockages

Feature	Number
Combination of inappropriate disposal and feature in the drain/sewer system	
Backdrop pipe	2
Bend	3
Interceptor trap	3
Low/intermittent flow	3
Item in pipe or defect	
Gravel/deposits	3
Sewer defect	1
Disposal of items	
Disposal of dishcloth (Sample 11)	1
Disposal of a curtain (Sample 49)	1
Volume of wipes	4
No obvious cause	
Sufficient information supplied and no obvious cause	3
TOTAL	24

Of those sewer blockages where a likely cause could be determined 11 were due to a combination of inappropriate disposal and features that are common in sewer system design. These features in all other respects would be regarded as a serviceable sewer.

Four of the blockages were caused by either deposits in the pipe or by a defect.

Six blockages were caused by disposal practices; two were due to the disposal of woven textiles and four due to large volume of wipes. Where volume of wipes was recorded, all were in pipes of 150 and 225 mm diameter with large numbers (200 to 1000+) of properties connected. A greater variety of types of products were also noted compared to blockages with fewer properties (12 or less) upstream. In all of these blockages there was no other obvious contributory factor, for example a pipe defect or gravel being present.

In three blockages there was no obvious cause. The pipe was in a fully serviceable condition and there were no obvious features or defects in the drainage system. Similarly, items such as gravel or woven cloth were not present. Therefore, the most likely cause of the blockage was volume of wipes.

4.4 Analysis by cause of pump blockage

Of the seven pump blockages recovered, the following items were present:

i) Mass of wipes (most likely baby wipes) - 3 pump clogs in pumps rated from 2.4 to 37 kW.

ii) Baby wipes (could be separated and identified as such) – 1 pump clog in a pump rated at 13.5 kW.

iii) Woven textiles (clothing etc.) – 3 pump clogs in pumps rated from 1.3 to 18.7 kW.

5 Conclusions

1) The detailed analysis of the contents of sewer blockages, together with 7 pump clogs and three treatment work inflow samples, has given significant new and detailed information, which will be very useful to both the water industry and wipe manufacturers.

   A similar, although far smaller study, was carried out in 2011 and this gave a valuable insight into the problem at that time. This new study gives a more detailed, representative and up to date review of blockage content - 54 blockages have been analysed and the results show a consistency between many of the samples analysed. The majority of material recovered comprised of wipes that were not designed to be flushed and should not have been disposed of via the WC. Of the items that could be identified, baby wipes accounted for over 75% by weight of identifiable products. Surface wipes, cosmetic removal wipes and feminine hygiene products accounted for approximately 20% by weight of identifiable products.

2) A significant finding that has come out of the study is that a large proportion of the material present in sewer blockages and pump clogs are non-flushable wipes, the

majority of which are spun lace. Such wipes are not suitable to be flushed and should not have been disposed of via the toilet. Whist many of these products are labelled as not flushable (or similar) there is clearly a significant number of people who are unaware of this labelling or do not appreciate the reason why these items should not be flushed or are unconcerned by the potential consequences of their actions.

3) Whilst the vast majority of products recovered were not designed to be flushed, a small proportion of the products recovered (approximately 0.88% by total weight and 1.9% by weight of products that could be identified) were designed to be flushed. However, it is accepted that during the blockage recovery process toilet tissue and other weaker material, is lost in the blockage removal process. Similarly, there will be some material loss with the blockages that are 'rodded through' to the next accessible manhole. The analysis of the samples collected at wastewater treatment works inlets shows a similarity with the items recovered from the sewer blockage samples. This suggests that the items causing/present in sewer blockages are the same types of items (by intended use) and that they remain intact as far as the wastewater treatment works.

4) The majority of material in pumping station clogs was an unidentifiable mass of wipes. However, a single pumping station clog where individual products could be recognised, showed that it contained a higher proportion of non-flushable wipes than sewer blockages – 95% as opposed to 75% in sewer blockages. There was limited flushable wipe material (0.09%) identified in the pump clogs in this single sample**.** Experience suggests that this is because sewage pumps are able to mechanically break the flushable wipes and pass them downstream.

5) The analysis of features associated with blockage locations, for which sufficient data was provided, showed a wide variability in the reason for the blockage having formed. Of the 24 blockages where sufficient information was returned, 11 were at features which are integral to drain and sewer system design in the UK. These features, in all other respects, do not present a problem and are regarded as being part of a serviceable sewer. Four of the blockages are thought to have been the result of other unavoidable debris in the pipe (gravel/deposits) and a sewer defect that was in need of repair. Six blockages were due to highly inappropriate disposal practice; the flushing of a dishcloth, a curtain and at 4 sites, excessive volumes of wipes.

   Three blockages were at locations where, despite adequate information being returned from site, there was no obvious cause. The pipe was in a fully serviceable condition and there were no obvious features or defects in the drainage system.

6) Three of the seven pump clogs recovered were caused by material (clothes etc.) being disposed of to the sewer system. This proportion is considerably higher than had been anticipated and may be a consequence of a relatively small number of pump clog samples being collected and analysed. Also, many pumps that become stalled because of foreign matter caught in the impellors are able to be cleared by reversing the pumps. Accordingly, the samples collected represent the most severe of the many problems that occur.

6 Recommendations

It is recommended that:

1) Public/press communications should target the inappropriate disposal to sewer of non-flushable products.

2) Manufacturers and retailers adhere to the labelling requirements of EDANA's flushability guidelines and COP v2. This requires a clear 'do not flush' logo on the front of pack, on all non-flushable wipes.

3) Manufacturers and retailers of non-flushable wipes provide responsible disposal information in their advertising and awareness campaigns.

4) Manufacturers, retailers and the water industry working collaboratively on a customer campaign, to raise awareness of the correct disposal of non-flushable wipes.

5) Polypropylene or Polyethylene fibres should not be included in any product labelled as flushable. This is because the majority of the items found in the sewer blockage and pump clog samples are composed of these materials.

6) Awareness and information campaigns need to reinforce the message that, as well as disposal to sewer being illegal, in respect of Section 111 of the Water Industry Act 1991, clothes/materials should be disposed of via the solid waste route.

> *Section 111, of the Water Industry Act, states:*
>
> *'Subject to the provisions of Chapter III of this Part, no person shall throw, empty or turn, or suffer or permit to be thrown or emptied or to pass, into any public sewer, or into any drain or sewer communicating with a public sewer—*
>
> *a) any matter likely to injure the sewer or drain, to interfere with the free flow of its contents or to affect prejudicially the treatment and disposal of its contents'*

7) A useful cross-reference to this study would be to ascertain from market data all types and numbers of wipes currently sold in the UK.

8) Consideration should be given to issues around toddler wipes.

9) Consideration should be given to a repeat of the study following educational campaigns to see if they have been effective in reducing the number of non-flushable wipes in the sewer.

7 References

1) UKWIR Phase 2 – Flushability Joint test Protocol. Briefing Note 4 – Analysis of blockage and pump clog samples, categorisation by inspection and weight, October 2011.

2) UKWIR – Contents of Sewer Blockages and Pump Clogs – Interim Report, August 2017.

3) Water Industry Act 1991

Appendix 1

Product categories, as used in Section 4 of the report, are as follows:

Final product type categories.	***70 different descriptions from Recognition Day categorised as 18 types of products***
Baby wipe	Baby wipe/hard surface wipe, baby/facial
Cosmetic wipe	Cosmetic wipe, facial wipe
Cotton pad	Cotton pad, cosmetic pad, cosmetic removal pads
Female hygiene	Tampon, panty liner, panty liner plastic, sanitary towel, fem care remainders, adult incontinence products
Flushable wipe/ Moist toilet tissue	Flushable toilet wipe, moist toilet tissue, MTT
FOG	FOG, fat lumps
Gravel/deposits	Gravel, encrustation, concrete
Industrial	Industrial wipe
Material/clothing	Shirt, material, knickers, restaurant serviette, curtain, high vis, net
Metal	Iron, grid
Paper products	Paper towel, kitchen roll, kit roll fragments, wallpaper pieces
Personal care products (other than wipes) Note – this is not personal wipes	Disposable glove, ear bud stem, condom, gloves, dental floss
Plastic wrapper	Biscuit wrapper, disposable carrier bag, packing tape, plastic, plastic film napkin wrap, pill packet, toilet block holder, wrap
Surface wipe	Cleaning wipe, , cleaning mop wipe, floor wipe, household cleaning wipe
Toddler wipe	Toddler training wipes
Toilet paper	Toilet paper
Unidentified mass of wipes	Mass of wipes that would not come to pieces
Various debris	Silicon, plastic sewer collar, various debris, chunks, hair, general, snake skin, chamois leather

The categorisation of wipes as being non-flushable or potentially flushable, are as follows:

<table>
<tr><td>Overall category</td><td colspan="3">Wet Wipes</td></tr>
<tr><td>Flushable/DNF</td><td>Non-flushable wipes [1]</td><td colspan="2">Flushable wipes [2]</td></tr>
<tr><td>Application</td><td>Baby, cosmetic, hard surface cleaning wipes</td><td colspan="2">Moist toilet tissue and toilet cleaning wipes</td></tr>
<tr><td>Technologies</td><td>Spunlace = long fibres, carded and hydroentangled, or alternatives</td><td>Wetlaid pulp and short fibres, hydroentangled (GD3 compliant)</td><td>Airlaid pulp with binder or synthetic fibres for bonding. (mostly not GD3 compliant)</td></tr>
<tr><td colspan="4">Notes
[1] Baby wipes, cosmetic removal wipes and other cleaning wipes, made of long staple fibres
[2] Flushable wipes, such as moist toilet tissue and toddler training wipes are made of pulp and short fibres, designed to be (potentially) flushable</td></tr>
</table>

5.3 Maine Education Pilot – final report

INDA-MEWEA "Don't Flush Baby Wipes" Pilot Public Education Campaign

Final Report

May 2015

INDA, the Association of the Nonwoven Fabrics Industry, and the Maine Water Environment Association (MEWEA; formerly known as the Maine Waste Water Control Association [MWWCA]), jointly committed to conduct a pilot consumer education campaign in Maine. This commitment represented an alternative to legislation proposed by the then-MWWCA in January 2011 that would have created a state-specific approach to the sale and distribution of products labeled as flushable. This campaign was part of a continuing industry/wastewater collaborative effort to resolve impacts on private plumbing and municipal sewer systems caused by products that should not be flushed, such as baby wipes.

The development of the Maine pilot public education campaign occurred from January 2012 through late 2013, and the campaign was executed and analyzed during the first half of 2014. The multimedia campaign was intended to produce positive impacts on consumer awareness and measurable changes in behavior within a limited portion of the sanitary sewer served by the Portland Water District in Greater Portland. The consumer understanding was validated by market research focused on this limited service area, and the consumer behavior change was validated by an observed reduction in the number of baby wipes being disposed by flushing in the limited service area during a time period closely following the campaign.

The campaign materials developed were able to show effective improvement in addressing the issue of improper flushing of a non-flushable product. Moreover, the messaging vehicles were identified which were effective at providing community-level public education as well as at creating consumer behavioral change. The messaging was found to be most effective at modifying consumer behavior in the first four weeks immediately after the public education campaign, with the number of baby wipes observed climbing to pre-campaign levels after those four weeks.

Objectives:

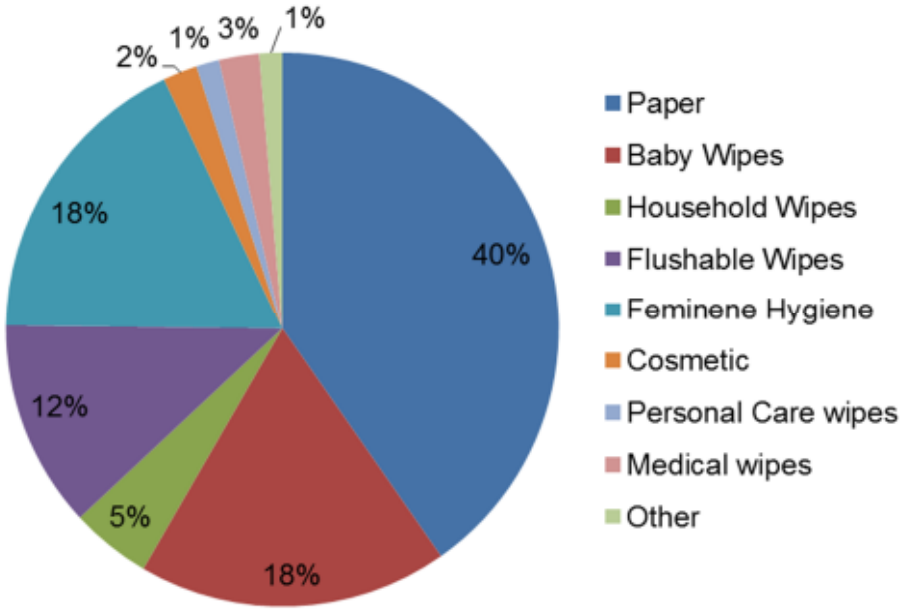
The pilot public education campaign objectives were the following:

1. To raise consumer awareness of the issue (e.g. flushing baby wipes and the impact it can have on their pocketbook, wastewater system and environment and other) and change their attitudes regarding flushing baby wipes.
2. To change consumer flushing behavior to reduce the amount of baby wipes being flushed as a result of the messages delivered by the pilot education program.

3. To validate the flushing behavior change by measuring the quantity of baby wipes captured on screens at the Cottage Place pump station both pre and post campaign.
4. To learn which messaging and vehicles aided in awareness, claimed behavior, and behavior change.
5. To increase awareness of disposal instructions on package ('When in doubt of any instructions or other – throw it out') and measure consumer behavior of looking for and adhering to instructions.

Background:

Prior to the Maine pilot public education campaign, collection data gathered jointly by INDA and MEWEA (with assistance from Water Environment Federation [WEF] representatives) at the Portland Water District Cottage Place Pump Station's influent screen had identified significant quantities of paper towels, feminine care products, baby wipes, hard surface wipes and other improperly flushed personal care wipes. Additionally, data gathered at this facility in Westbrook, Maine had indicated that baby wipes could have been a significant driver of historic pump clogs at the facility (prior to installation of the influent screen) since collection study showed that they were approximately 20% of the total by count.



The Greater Portland media market (fully overlapping with the service area to the Cottage Place Pump Station) was chosen as the target area for an advertising campaign designed to improve the level of awareness of this issue and change behavior regarding the flushing of baby wipes. The advertising test was conducted in Q1 2014. Quantitative research was

conducted Q4 2013 and Q2 2014 to measure the effectiveness of this advertising campaign.

- A pre-wave analysis was conducted to measure awareness of the issue prior to the campaign's launch.
- A post-wave analysis was conducted at the end of scheduled primary media blitz.
- Data from the pre-wave was compared to data collected post-wave to measure the effectiveness of the campaign.
- A count of actual baby wipes flushed on a pre/post basis was conducted at the Cottage Place Pump Station to determine if observations mirrored reported behavior changes. The total number of baby wipes entering the station was normalized per 100,000 gallons of flow during the collection period (as measured by flow meters at the pump station), to provide a consistent metric.

Campaign Details: 'Save Your Pipes, Don't Flush Baby Wipes'

Target Audience	Baby wipes users within the Greater Portland Time Warner Cable (TWC) Zone were targeted through TV and other media. • Consumers on public sewer systems who use baby wipes for personal care to change their behavior by educating them about the clogging issue and its consequences. • Baby wipe users include households with and without children, (both resident and businesses) in the Cottage Place Pump Station service area, which includes parts of Westbrook, Gorham and Windham (considered part of the Greater Portland media market).
Schedule/Timing	**Oct–Dec 2013** Public awareness research of issue (to be used for campaign data analysis) • Pre-wave report issued (12/4) **Oct–Nov 2013** Forensic data collection at Cottage Place Pump Station in Westbrook, ME **Dec 2013** Campaign Concept Approval **Dec–Jan 2014** Development of production materials **1/21/2014** Kick-off Press Conference (Westbrook, ME) **Jan-Mar 2014** Time Warner Cable TV spots (8 weeks) Additional media • Local print ads/inserts, • Website (Saveyourpipes.org), • Social media (Facebook), • Signs/information at Hannaford stores, • Flyers in public restrooms, • Sticky note on the front page of Portland Press Herald, • Local news stories, • Bill stuffers

	Mar-Apr 2014 Measure of campaign effectiveness: • Issue awareness • Issue understanding and attitude • Campaign awareness • Claimed behavior • Measured observations compared to reported behavior changes. **Apr-May 2014** Forensic data collection at Cottage Place Pump Station
Budget	$113,000 Total Campaign Budget Cap: • $30,400 Research Budget • $40,500 Media Budget • $22,000 Production Budget • $20,000 Services Budget Financial commitment from both INDA and MEWEA. • Materials produced to be used by manufacturers and utilities in other municipalities around the US • MEWEA contributed $15,000 (much of it donations from its members and partners around the country) and the time of its volunteers. • $98,000 funded by INDA through its member company contributions.
Brand Character/Tone	Campaign concepts ranged from Informational/public service announcement style to Edgy/Humorous. The style was refined based on pre-wave research results.
Creative/Tactical Considerations	Campaign needed to be scalable to other markets as well as to other disposable products which are not intended to be flushed. Additional tactics/ materials were developed, but not implemented in the Portland market. They are part of a creative template "toolbox" to be utilized by manufacturers and utilities in other markets and municipalities.

Awareness Results

To raise consumer awareness of the issue and to change consumer flushing behavior, a single message was used throughout the communication campaign of 'Save Your Pipes: Don't Flush Baby Wipes'. This singular message clearly shared with the consumer that baby wipes were not flushable and that they cause expensive problems by clogging both residential plumbing and public sewer systems when flushed. This message was shared with the public by a variety of methods shown in Appendix B.

Television ads, produced and aired at a cost of $24,000, were shown on Time Warner Cable (TWC) and were the dominant source of awareness for the campaign; 81% recall. This was followed by local news stories (17% recall) and local print ads/inserts (12%

recall). The campaign's website and placed posters were not as noticed among these campaign tactics. Few (3%) noticed the bill stuffers, which has been a popular method used previously by wastewater utilities.

Based on Portland area consumer polling before and after the campaign, consumer awareness of "Don't Flush Baby Wipes" message had increased.

- Awareness of the message was 4 times greater after the campaign
- Consumer belief that baby wipes aren't safe to flush reached the 2/3 mark after the campaign
- Awareness of among Time Warner Cable customers was 10 times greater after the campaign

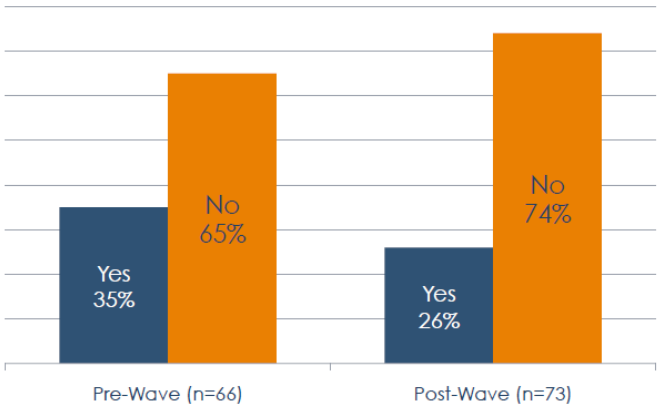
Behavior Change Results

Nearly four out of ten respondents who recalled the ad slogans noted they would be less likely to flush or will no longer flush baby wipes. After the campaign, baby wipes users in Portland area increased their reported frequency of disposing baby wipes in the trash instead of the toilet. Additionally, a significant reduction was reported by consumers who previously said they flushed baby wipes "occasionally"; a drop from 29% to 21% after the campaign.

	Recall Specific Ad Slogan (n=52)
NET: I am less likely to flush baby wipes/I no longer flush baby wipes	**37%**
I am less likely to flush baby wipes	23%
I no longer flush any baby wipes	21%
I am more likely to tell others not to flush baby wipes	**31%**
This advertisement has had no effect on me	**29%**
I am now more likely to read baby wipes packaging	8%
I am now less likely to purchase baby wipes	6%
I have switched from baby wipes to flushable wipes	4%

Even though many of the baby wipes users referenced that they 'looked at the baby wipes package' to determine if it is safe to flush/not safe to flush, most have actually never looked at the package for flushing instructions – and this lack of tendency has not changed even with the campaign messaging to read packaging for "do not flush" instructions. However, at the time of the campaign, with the exception of the leading brands, many baby wipes sold in the target area did not contain disposal instructions; the inclusion of the "do not flush" message on packages has improved since that time.

9%

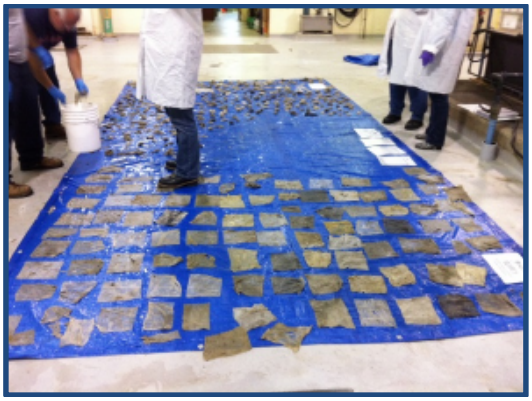


Have you ever looked on a baby wipes package for disposal instructions?

Validation of the flushing behavior change

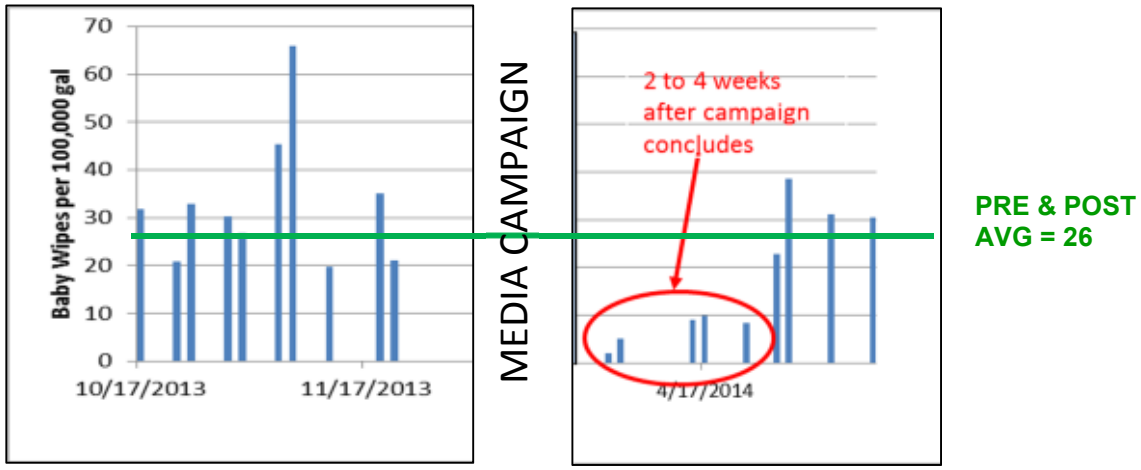
To measure the effectiveness of the campaign, and specifically to determine if observed results mirror reported behavior changes, on-site analysis of materials found in the Cottage Place Pump Station (a subset of the Greater Portland market reached by the campaign) was conducted. Pre- and post- pilot data collection occurred 6 weeks before and after the pilot campaign at the Cottage Place Pump Station in Westbrook, Maine. Sorting was conducted by MEWEA/Portland Water District members and INDA industry members.

Aubrey Strause (MEWEA), Kim Babusik (Industry member), Gayle Rece (Industry member), and Scott Firmin (MEWEA) compare a wipe to the reference binder.



Materials removed during two hours of flow into the pump station, sorted to separate baby wipes (foreground) from other materials (background). Pre-campaign

The following graph and data in Appendix A shows a quantitative measure of baby wipes before and after the 'Save Your Pipes: Don't Flush Baby Wipes' campaign. It is clearly evident that the campaign had a measurable effect on decreasing the number of non-flushable baby wipes flushed into the municipal system. This decrease is most visible in the first four weeks after the campaign concluded.



PRE-CAMPAIGN POST-CAMPAIGN

It was noted that the number of flushed baby wipes started to increase beyond four weeks after the end of the campaign; this points to the need of continuous consumer education for proper product disposal.

Additionally, as the percentage of other articles such as tampons and feminine products remained at a high level, the percentage of baby wipes as compared to total number of articles was shown to be reduced.

Development of a "Toolkit"

To satisfy the pilot education campaign objective of transitioning the creative elements of the Pilot Program into a "toolkit" to be used in other municipalities around the US, MEWEA sought volunteers to create customizable Word documents from the graphic design files provided by the marketing firm. To date, four customizable campaign materials (a bill stuffer, a flyer, and a print ad in two sizes) have been produced by MEWEA and its volunteers

MEWEA hosts these materials and low-resolution versions of the two television ads on its website, www.mewea.org/pump-clog-resources/outreach-materials-dont-flush-baby-wipes-campaign/. This website lists contact information for persons wishing to gain access to the high-resolution television ads, which are too large to put on the MEWEA website. To date, MEWEA has provided files to several municipalities and utilities around the country, although very few have been able to utilize the television ads.

Management of the SaveYourPipes.org website has been transferred from INDA to the National Association of Clean Water Agencies (NACWA), an organization representing wastewater utilities around the country. MEWEA intends to work with NACWA to upload

the customizable materials MEWEA has produced on this website for downloading by other municipalities and utilities who may have the ability to use them.

NACWA and WEF have been enthusiastic partners with MEWEA in spreading the word about the availability of the “toolkit” materials.

Discussions about incorporating the results of this pilot education program into future packaging, labeling, and marketing decisions by manufacturers, and to include disposal instructions more prominently (or at all), did not occur as part of the Maine pilot public education campaign. These conversations will be part of a Product Stewardship Initiative (PSI) Technical Workgroup kicking off in March 2015. Members of MEWEA, INDA, NACWA, and WEF who participated in the Maine pilot education program will be participating in the PSI Technical Workgroup. We look forward to providing a future update on the results of these discussions and the conclusions of the PSI Technical Workgroup.

Concluding remarks

The INDA/MEWEA ‘Save Your Pipes: Don’t Flush Baby Wipes’ campaign was able to produce measurable, if temporary, positive impacts on consumer awareness and behavior within the limited service area of the Portland Water District sewer system targeted by the campaign. A quantifiable reduction in the number of baby wipes being disposed in the waste water system was documented in the first four weeks after the end of the campaign.

This campaign was distinguished by Maine to be noteworthy. In 2014, the Maine Department of Environmental Protection presented MEWEA, INDA, and the Portland Water District with an ‘Environmental Excellence’ award for this “Save Your Pipes: Don’t Flush Baby Wipes” campaign. It was noted that this campaign raised awareness of an important environmental and economic problem facing the country’s wastewater treatment facilities – the flushing of baby wipes. The United States Environmental Protection Agency (USEPA) Region 1 office similarly acknowledged these three organizations in 2014 with the presentation of an Environmental Merit Award for this project.

The collaboration was also noted as creatively seeking a solution with a public/private partnership for a widespread concern in order to protect our environment. Efforts to share the materials developed as part of this collaboration, and to inform decisions about future packaging, labeling, and marketing decisions by manufacturers, are ongoing as of the date of this report.

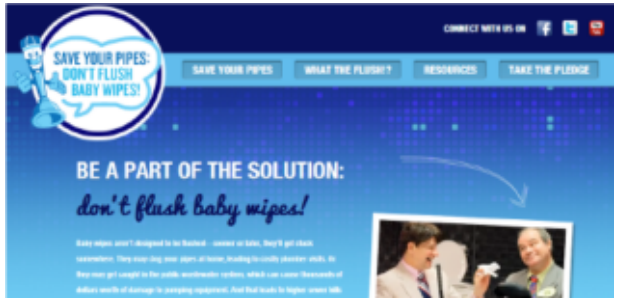
Appendix A: Quantitative measure of baby wipes before and after campaign

SUMMARY	Pre week 1	Pre week 2		Pre week 3		Pre week 4		Pre week 5	Pre week 6	
Date	10/17/2013	10/22/2013	10/24/2013	10/29/2013	10/31/2013	11/5/2013	11/7/2013	11/12/2013	11/19/2013	11/21/2013
Start time	7:00 AM	8:00 AM	8:00 AM	8:00 AM	8:00 AM	8:00 AM	8:00 AM	8:00 AM	7:30 AM	7:30 AM
End time	9:00 AM	10:00 AM	10:00 AM	10:00 AM	10:00 AM	10:00 AM	10:00 AM	10:00 AM	9:30 AM	9:30 AM
Total Flow	189,233	182,431	188,475	215,139	186,923	214,161	207,857	178,317	213,628	208,309
Number of Baby wipes	60	38	62	65	50	97	137	35	75	44
Tampons,Fem	73	67	79	65	69	59	64	49	62	70
Others (paper, tampon, other wipes, etc)	253	349	368	385	324	472	504	179	332	334
Other less Tampons and Baby Wipes	120	244	227	255	205	316	303	95	195	220
Total articles	313	387	430	385	374	569	641	214	407	378
% Baby Wipes	19%	10%	14%	17%	13%	17%	21%	16%	18%	12%
Baby wipes per 100K gallons	32	21	33	30	27	45	66	20	35	21
% Tampons, Fem	23%	17%	18%	17%	18%	10%	10%	23%	15%	19%

SUMMARY	Post week 1		Post week 2		Post week 3	Post week 4		Post week 5	Post week 6
Date	4/1/2014	4/3/2014	4/15/2014	4/17/2014	4/24/2014	4/29/2014	5/1/2014	5/8/2014	5/15/2014
Start time	8:00 AM	8:00 AM	8:00 AM	7:00 AM	6:00 AM	8:00 AM	12:00 AM	8:00 AM	8:00 AM
End time	10:00 AM	10:00 AM	10:00 AM	9:00 AM	8:00 AM	10:00 AM	12:00 AM	10:00 AM	10:00 AM
Total Flow	581,220	446,760	324,780	373,560	204,540	244,920	435,240	102,532	95,163
Number of Baby wipes	12	23	29	37	17	56	168	32	29
Tampons, Fem	56	-	-	-	-	71	140	84	67
Others (paper, tampon, other wipes, etc.)	238	196	216	291	86	263	539	343	337
Other less Tampons and Baby Wipes	170					136	231	227	241
Total articles	250	219	245	291	103	319	707	375	366
% Baby Wipes	4.8%	10.5%	12%	13%	17%	18%	24%	9%	8%
Baby wipes per 100K gallons	2	5	9	10	8	23	39	31	30
% Tampons, Fem	22%					22%	20%	22%	18%

Appendix B: Key elements of the campaign

- Cable TV ads,
- Local print ads/inserts,
- Website (Saveyourpipes.org),
- Social media (Facebook),
- Signs/information at Hannaford stores,
- Flyers in public restrooms,
- Sticky note on the front page of Portland Press Herald,
- Local news stories,
- Bill stuffers



Appendix C: Press Release

For immediate release

Michelle Clements, Maine WasteWater Control Association
(207) 774-5961 | mclements@pwd.org

Dave Rousse, INDA®, the Association of the Nonwoven Fabrics Industry
(919) 233-1210 | drousse@inda.org

"Save Your Pipes: Don't Flush Baby Wipes"
Improper disposal of baby wipes leads to expensive clogging issues

PORTLAND, MAINE (January 21, 2014)—For many communities across the country, the flushing of baby wipes has been a significant contributor to a serious and costly problem. Since baby wipes are not designed to breakdown in water, they can clog home drain pipes, causing messy toilet overflows and requiring expensive plumber visits to repair.

Even more serious, baby wipes can be a significant contributor to the clogging of public wastewater system equipment, which can cause sewer backups into homes and damage to equipment, costing hundreds of thousands of dollars. In addition, clogs can cause overflows which have negative impacts on the environment. The effects on sewer systems can result in dramatic increases in monthly sewer costs for homeowners.

INDA®, the Association of the Nonwoven Fabrics Industry and the Maine WasteWater Control Association (MWWCA) have partnered to address the issue with a campaign to raise consumer awareness with the theme, "*Save Your Pipes: Don't Flush Baby Wipes*". "Some products are designed to be flushed, while others are not. It is the products that are not designed to be flushed, but get flushed anyway, such as baby wipes, that are creating the problem for wastewater systems. We are working collaboratively with Maine's wastewater entities to change this," said INDA President Dave Rousse. The campaign kicked off with a press conference at the Westbrook Treatment Facility with representatives from both groups. Television commercials featuring a game show titled, "*What the Flush?!?*" will begin tomorrow to educate consumers as to what is flushable.

The Cottage Place and East Bridge Pump Stations in Westbrook serve over 6,000 businesses and homes in Westbrook, Gorham and Windham, and have seen costly repairs as a result of clogs created by baby wipes and other non-flushable products. A $4.5 million screen system was installed in 2009 to prevent clogging of pumps by baby wipes and other items that should not be flushed. "We hope the campaign will make people stop and think about what they flush, and we will see a reduction of baby wipes at these locations," said Scott Firmin, Director of WasteWater Services at the Portland Water District. **Consumers can find more information on this issue at SaveYourPipes.org, or on Facebook at facebook.com/SaveYourPipes.**

For more information, please visit SaveYourPipes.org.

SaveYourPipes.org is a project of INDA, the Association of the Nonwoven Fabrics Industry and Maine WasteWater Control Association (MWWCA) to address the growing problem of consumers flushing baby wipes. This pilot campaign is intended to educate consumers about the issue and change behavior to avoid costly repairs both in homes and public sewer systems, and serve as a model for other wastewater entities across the country.

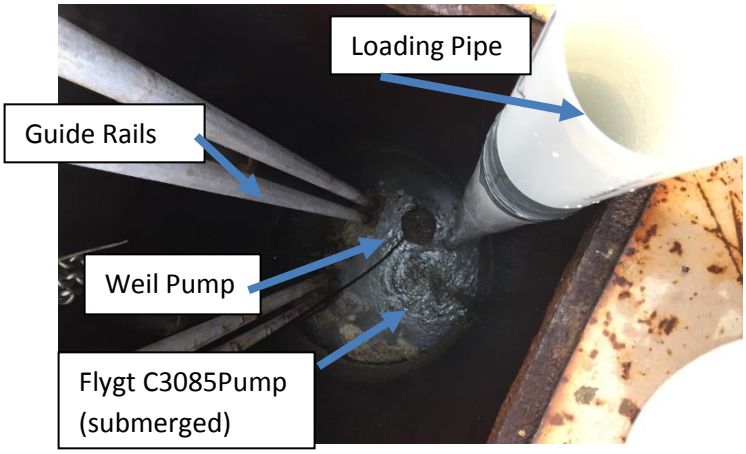
5.4 KC Pump Wet Well dosing study - 2016

Direct dosing study of operational wet well pump

Work carried out by David Powling and Peter Lortscher, Kimberly Clark Corporation at West Office Campus, County Road II, Neenah, Wisconsin 54956.

1. **Wet well details**
    a. Pump Tested: Weil W-2515-11 1.5Hp Submersible Sewage Pump, 3”Outlet. Displacing 130 gallons against a 10’ head for 45second runs.
    b. Wet well – Serve 2 building on KC Neenah campus which with a population 300-500 people daily, 17 restrooms and a cafeteria. Since 2009 the 2 buildings have had Flushable Wipes in all the restrooms and power monitoring devices installed at the control unit allowing studies of pump performance and wipes usage to be carried out. Over the 7 years of testing there have been no clogs of either of the pumps.

Aerial view of site – Google Maps



Product Dosing into the pump was managed using a 3" PVC pipe with elbow at end, the elbow being placed under the suction of the pump, a weighted plunger used when water level was towards end of pump cycle to help push wipes out of the pipe into pump

The Wet well had been cleaned prior to the study. All flushable wipes in the 2 buildings which feed to the wet well were removed for a 6 week period during which testing was carried out. Supplementary flow of 6-8GPM from outside faucet was delivered through inspection cover 1, to help build flow and speed up testing.

2. Method

- Loading pipe was positioned with elbow under suction of pump
- All samples were placed in bucket of water (50-60F) for 10minutes before dropping[A] down into the loading pipe.
- A weighted plunger was then lowered down inside pipe to move samples towards the elbow
- The pump was manually turned on for a 45 seconds cycle (normal cycle when running on float switches)
- Mid way through the 45 second pump cycle, the weighted plunger was lowered again down into pipe to ensure all samples exited the pipe and entered the pump whilst running
- After 45 seconds the pump turned off allowing well to refill
- A ½" mesh sieve in an 8" frame used to intercept flow in the 8 " line at inspection point 2
- For each product, 5 consecutive runs were made with product loaded and then 2 additional runs recorded subsequently with no product[B]
- Data logger was set to 1 second measurement interval (same as FG507), measuring Voltage and Current for all 3 phases with date /time stamps
- % power calculated using long term average power draw for Pee, Poo and Paper

Note: A. All samples were fully intact when dropped into tube.

B. Difficult to ensure all wipes go into pump every run. 2 additional runs made following the 5 product loadings to gather any stray materials which failed to enter the pump first time, these 2 extra runs included in the statistical analysis of power consumption to ensure all loaded product was accounted for.

3. Codes Tested

	Loading	Number of runs	Average % Power Calculations	FG507 – average % power result
Flushable Wipe A	10 wipes / run. [1]	5 consecutive runs	5 consecutive runs + 2 empty runs following vs ambient	0.1 +/-0.3
Flushable Wipe B	10 wipes / run.	5 consecutive runs	Calculated for 5 runs + 2 empty runs following	9.8 +/- 0.7
Flushable Wipe C	10 wipes / run.	5 consecutive runs	Calculated for 5 runs + 2 empty runs following	3.9 +/- 0.9
3ply Toilet Paper	6 x 6 sheet implement /run.	5 consecutive runs	Calculated for 5 runs + 2 empty runs following	Not tested
Spunlace Baby Wipe	1 wipe got stuck and could not be dislodged 1 more wipe added which also got stuck	Multiple runs without product following introduction of each baby wipe	Calculated for each single product runs + multiple empty runs following	>15%

4. Results

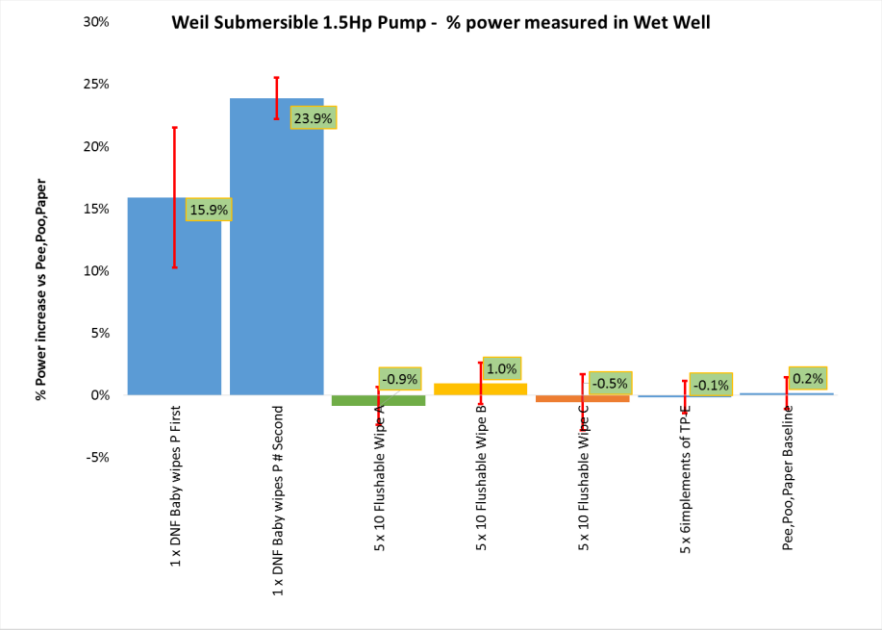
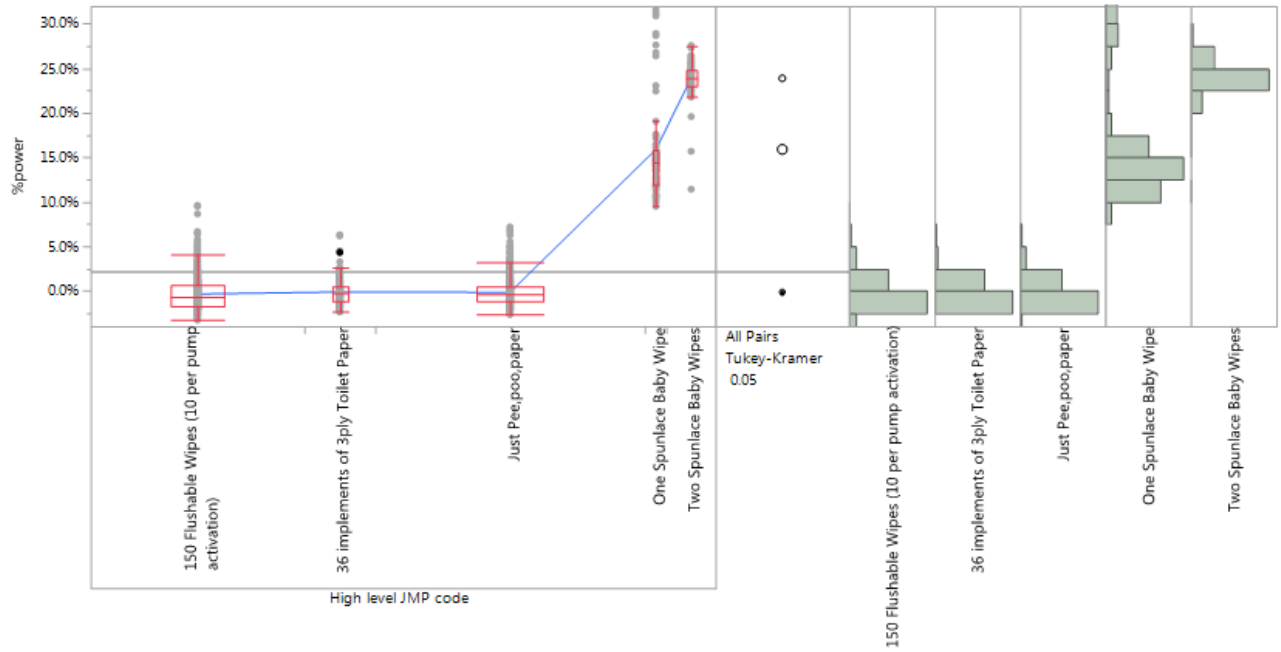


Figure 1- Average % power increase by individual code

[1] The loading level of 10 wipes for Flushable wipes was set deliberately high at 10X typical loading for a small submersible pump. For a small wet well serving 200 homes, loading of Flushable wipes would be around 1 wipe/ pump operation on average. Loading level for Toilet Paper was pro-rated vs wipes using the loading levels from FG501 as reference.

Oneway Analysis of %power By High level JMP code



Means Comparisons
Comparisons for all pairs using Tukey-Kramer HSD
Confidence Quantile

q*	Alpha
2.72983	0.05

Connecting Letters Report

Level					% Power Mean
Two Spunlace Baby Wipes	A				23.9%
One Spunlace Baby Wipe		B			15.9%
36 implements of 3ply Toilet Paper			C		-0.1%
Just Pee,poo,paper			C		-0.2%
150 Flushable Wipes (10 per pump activation)			C		-0.4%

Levels not connected by same letter are significantly different.

Figure 2- High Level Summary by Code

Material recovered on outlet ½" mesh sieve – see appendix for photos

- Baby Wipes – none recovered. All baby wipes were retained permanently in the pump
- Flushable Wipes – Typically less than 20% of wipes loaded was captured on each run, pieces were variable in size Whole wipes were not seen. Pump cleared within 2 operations of completion of loading product.
- Toilet Paper – Typically less 5% material captured than Flushable Wipes

5. **Conclusions**
    a. **Spunlace Baby Wipes**
        - Each of the 2 Spunlace Baby Wipes loaded into Weil pump, got wrapped inside the pump and did not leave the pump for a further of 3 days of normal pump operation handling Pee, Poo and Paper
        - As few as 10 baby wipes could potentially shut down this 1.5Hp Weil Pump
            - Small 3" and 4" outlet submersible pumps are >85 % of all US submersible pump sales[2]
        - The average power burden of one single Baby Wipe as seen by the Weil 1.5Hp pump is 2 orders of magnitude greater than 150 flushable wipes which pass FG507 Ed3 criteria (0-10% power increase)
    b. **Flushable Wipes –** with FG507 % power increase in the range 0-10%
    - Wet well operation
        - Fully intact Flushable wipes at 10X normal loading rate can pass through a small 1.5Hp submersible sewage pump without causing operational issue to the pump
        - 150 flushable wipes (FG507 % power increase in the range 0-10%) loaded 10 per operation generated statistically the same average % power increase as 3 ply Toilet Paper and Normal operation with Pee, Poo and Paper, when compared using TUKEY analysis of means
    - FG507 Lab test read across
        - The average %power increase measured for flushable wipes in an operational wet well under load is typically an 1-2 of magnitude less that measured in the lab (FG507)
        - A pass criteria of 1% average power in lab test FG507 provides no incremental protection for the pump in the field compared to a criteria of 10% average power increase.

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Report prepared by

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November 18, 2016

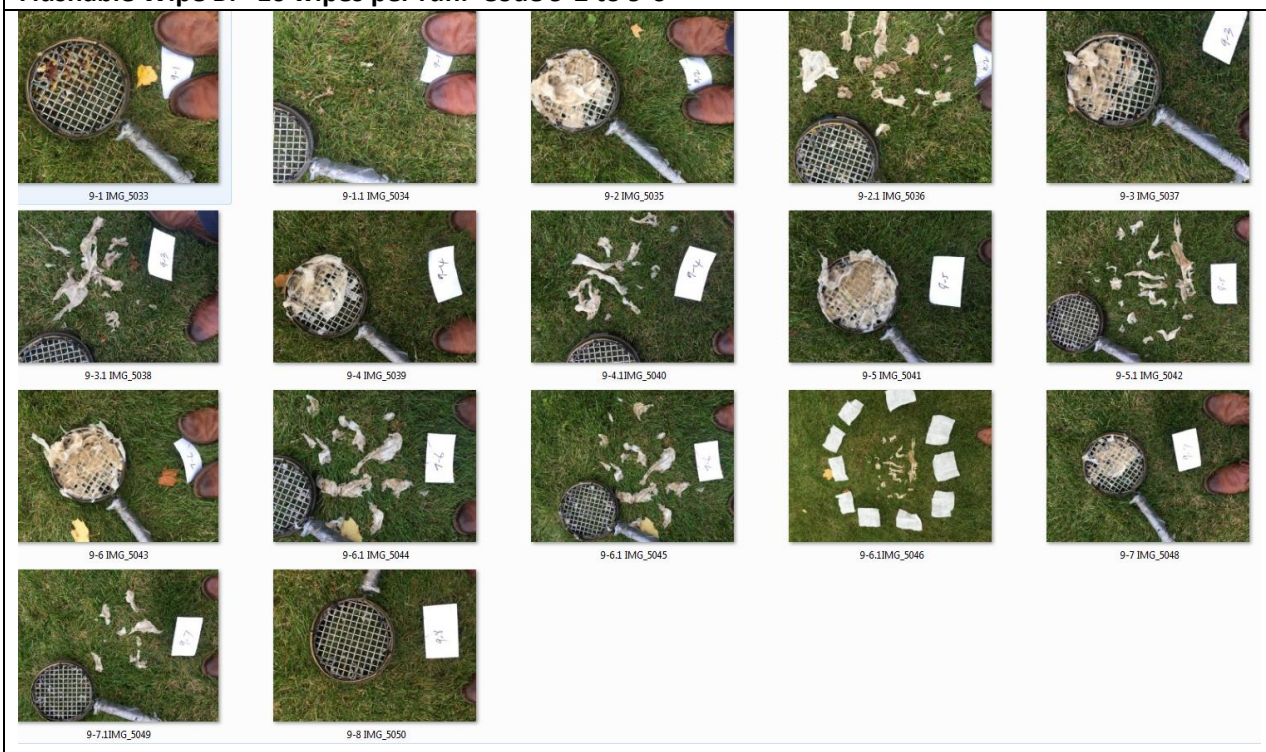
[2] Xylem. US Sales of Submersible Sewage Pumps. Letter to K-C January 2015. GD4 document

Appendix - Photos of material captured on 0.5” mesh at pump outlet at inspection point 2

Toilet Paper E 6 x 6 sheet implements. Run 7-2 to 7-6

Flushable Wipe A. 10 wipes per run. Run 8-2 to 8-6

Flushable Wipe B. 10 wipes per run. Code 9-2 to 9-6



Flushable Wipe C 10 wipes per run. Code 10-2 to 10-6