City of Winnipeg
Water and Waste Department

Combined Sewer Overflow Management Study

PHASE 3 Technical Memoranda

Appendix No. 6

FLOATABLES

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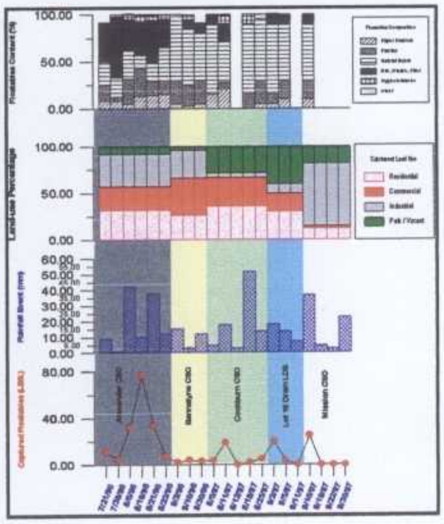
Internal Document by:

WARDROP Engineering Inc. and TetrES CONSULTANTS INC.

In Association With:

Gore & Storrie Limited and EMA Services Inc.



1996/1997 Floatables Capture Program

TetrES CONSULTANTS INC.

Solutions for a Sustainable Environment

and

WARDROP Engineering Inc.

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1.0 INTRODUCTION

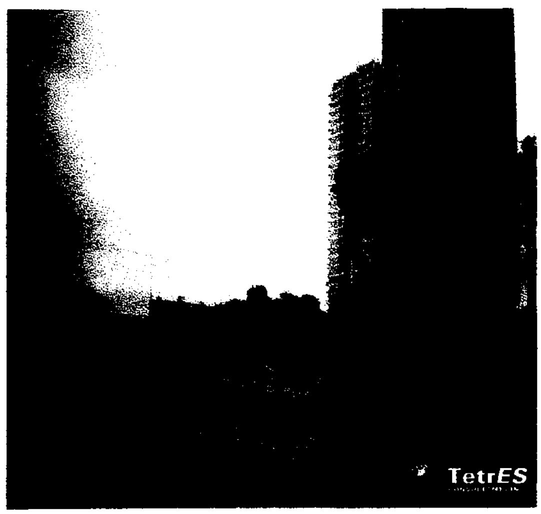
The City of Winnipeg is conducting a combined sewer overflow (CSO) study to determine appropriate long-term management strategies for overflows caused by wet weather events. One aspect of overflow management involves addressing aesthetic issues such as the presence of floating debris (referred to as "Floatables" throughout this report), in CSO and LDS discharges. The Floatables Capture Monitoring Program involved the installation of a floating boom at selected river outfalls. These outfalls were monitored and captured floatable material was extracted from the boom, measured, and categorized following rainfall events.

The monitoring program was conducted for portions of the 1996 and 1997 open-water recreational seasons. The 1996 Floatables Capture Program marked the start of a data-gathering initiative through the monitoring of floatables discharged at two combined sewer outfalls on the Red River. The 1997 program was intended to monitor 4 outfall locations (2 CSO and 2 LDS), however, prolonged high river water levels after 1997 spring flooding caused delays in implementing the program.

This report documents the approach in executing the 1996 and 1997 Monitoring Program campaigns and presents results and observations from the monitoring effort.

2.0 PURPOSE OF THE MONITORING PROGRAM

The Floatables Monitoring Program was conducted to increase the understanding of floatable debris discharge into the Red River in response to rainfall events. Over the years, some residents have voiced concern with the aesthetic quality of the rivers within the City of Winnipeg. The majority of aesthetic concerns have focussed upon the presence of "objectionable material" seen floating in the river. Material identified in this classification includes paper and plastic debris, discarded hygiene products, condoms and cigarette butts. These materials are small, lightweight and neutrally buoyant, consequently they tend to float at or just below the river surface. Collectively, these materials are referred to as "floatables". Floatables are known to be discharged via combined sewer overflow to the river after rain events.



The monitoring program was conducted to gather site-specific data regarding the volume and content of discharged floatables in response to a range of rainfall events. In addition to the influence of rain, it was important to look at the effect of sewer district land use patterns on both the volume and characteristics of discharged floatables.

3.0 SITE SELECTION

Over two summer programs, 5 outfalls were monitored for floatables. Outfall locations are shown in Figure 1 and were selected as follows:

Alexander Outfall: A CSO situated in the core area with a representative distribution of residential/commercial/industrial land uses. Outfall has easy access and anchorage points.

Bannatyne Outfall: A CSO upstream of the Harbourmaster's office and reported by the Harbourmaster to be a major source of debris.

Mission Outfall: A large CSO serving mostly industrial land uses. Anchorage and access are easily serviceable by boat.

Cockburn Outfall: A CSO serving an area mostly comprised of residential land use. This outfall offered excellent access and anchorage.

Lot 16 Drain: A LDS serving high density residential and shopping centres. A large catchment area with easy boat access and anchorage.

Figure 1: *Relative locations of monitored outfalls. Collected floatable volumes were greatest in red areas, and least in green coloured areas.*

4.0 METHOD OF FLOATABLE CAPTURE

4.1 BOOM ASSEMBLY

The assembly of the boom is a simple process requiring two workers and a minimum of handtools. The first step in the assembly process was to lay the boom out it's full length along a convenient working surface. Boom assembly for the 1996 field program was conducted on the deck of the Alexander Docks. As seen in Figure 2, the boom was laid out its full length in order to simplify attaching the mesh and mesh weights. The mesh was fastened to the floating boom using plastic fastening ties.

Once the mesh is attached, metal weights are fastened to the bottom of the mesh curtain at regular intervals (Figure 3). The weights serve to keep the mesh curtain in a downward position as it hangs suspended below the water surface below the floating boom. The boom measures out to approximately 100 feet in length, with 10 feet of mesh suspended below the floating boom.

Figure 2: *The boom is unrolled it's full length prior to beginning the attachment of the boom mesh curtain and the mesh weights.*

***Figure 3:** Metal weights are secured to the bottom of the mesh net to keep the curtain in the desired position as it hangs suspended from the floating boom.*

4.2 BOOM INSTALLATION

Capture of floatable debris was accomplished at selected outfall locations using floating boom technology acquired from Fresh Creek Technologies in New Jersey. The boom configuration has been used successfully by Fresh Creek Technologies in a number of installations in the U.S.

The boom system consists of a fluorescent orange (highly visible) impermeable floating boom with aluminium anchoring plates at each end. The anchoring plates are connected by steel cabling to anchor points on or adjacent to the outfall pipe. The boom is anchored in such a manner that flow from the outfall is directed into the perimeter of the boom. The boom is of sufficient length that flow does not pour over the boundary of the boom or lift the weighted mesh curtain.

As seen in Figure 4, the boom floats at the water surface level with a mesh netting curtain suspended below the boom. The mesh curtain hangs down along the length of the boom and is weighted down with small weights to keep the curtain in a downward position.

The curtain retains floatable material that might otherwise wash out just below the surface of the boom.

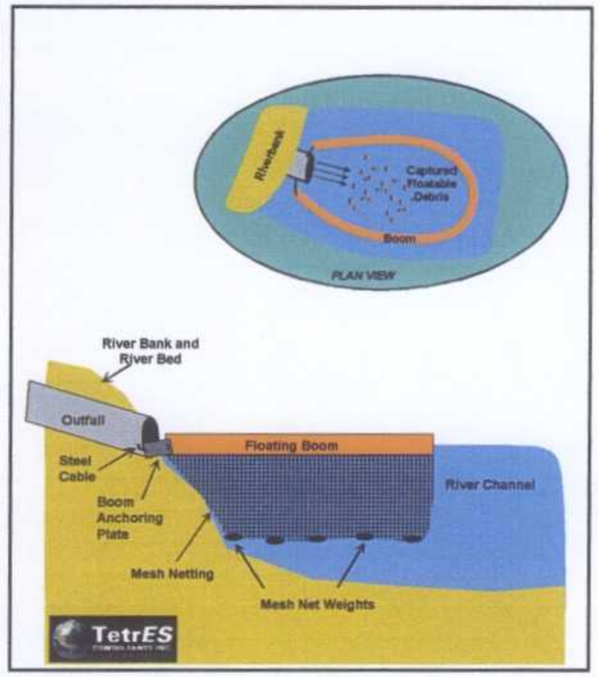


***Figure 4:** Boom installation configuration.*

4.3 POST RAIN-EVENT INSPECTION

After rainfall events, the boom was visually checked for captured floatable debris. The boom was photographed, and general notes were taken describing the presence of captured floatables and the condition of the boom. If the rainfall was significant enough to cause discharge containing floatables from the outfall, then arrangements were made with city of Winnipeg personnel at the NEWPCC for use of the City's industrial waste boat in order to get on the water for floatable collection and servicing of the boom.

4.4 FLOATABLE COLLECTION

When floatables were captured in the boom after a rain event, a crew of two personnel serviced the boom location via the City's industrial waste boat. One person piloted the boat and positioned the boat next to the boom extending into the river. The second person, dressed in protective clothing, glasses and gloves, collected the captured floatables (Figure 5). The protective gloves are puncture-resistant to reduce the likelihood of puncture wounds from fish hooks and other sharp objects which may accumulate in the boom netting. Safety is a primary concern with handling floatables debris and precautions were always followed to minimize possibility of puncture from hooks, hypodermic needles and other sharp objects.

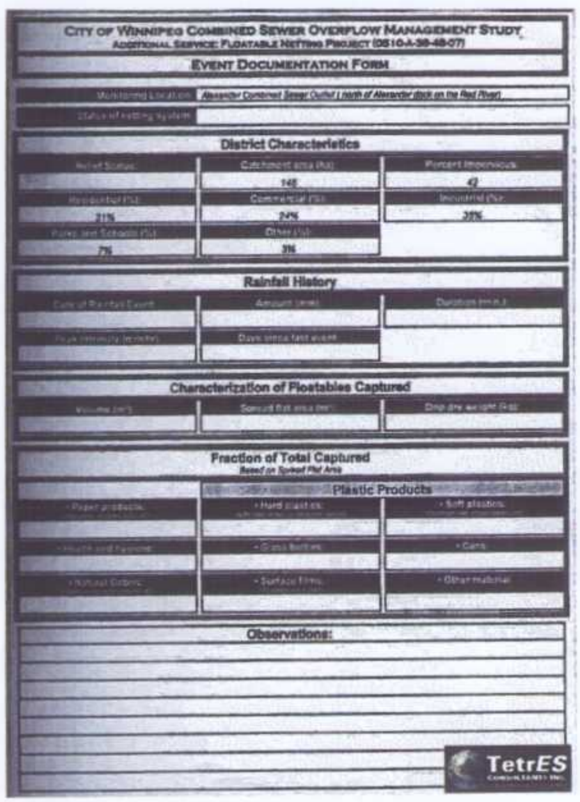
The floatables were collected from the boom using rakes and pool skimmers, placed in garbage bags, and placed in the boat. The crew returned to the Alexander Docks for characterization and measurement of the floatable material.

Figure 5: Personnel dressed in protective clothing and gloves skim floatables collected within the boom after rainfall events.

4.5 CHARACTERIZATION AND MEASUREMENT OF CAPTURED FLOATABLES

After collecting the captured floatables and returning to the Alexander Docks, the bagged floatables were emptied onto tarps for characterization and measurement. The collected floatables were weighed in the bags and then spread flat on the tarp. The weight and spread-flat area of the floatables was recorded. Photographs were taken of the captured floatables. The floatables were then manually sorted into similar components in order to estimate the fraction of different debris types within the captured floatables.

Figure 6 shows the documentation form which was filled out to describe the nature of the collected debris. Debris was classed into categories such as paper products, plastics, natural debris, health and hygiene products, among others.



CITY OF WINNIPEG COMBINED SEWER OVERFLOW MANAGEMENT STUDY
ADDITIONAL SERVICE: FLOATABLE NETTING PROJECT (0510-A-38-48-07)

EVENT DOCUMENTATION FORM

Monitoring Location: Alexander Combined Sewer Outfall (north of Alexander dock on the Red River)

Status of netting system:

District Characteristics

	Catchment area (ha)	Percent Impervious
	145	42
Residential (%)	Commercial (%)	Industrial (%)
21%	24%	30%
Parks and Schools (%)	Other (%)	
7%	3%	

Rainfall History

Date of Rainfall Event	Amount (mm)	Duration (min.)
Peak intensity (mm/hr)	Days since last event	

Characterization of Floatables Captured

Volume (m³)	Spread flat area (m²)	Drip dry weight (kg)

Fraction of Total Captured
Based on Spread Flat Area

	Plastic Products	
• Paper products	• Hard plastics	• Soft plastics
• Health and hygiene	• Glass bottles	• Cans
• Natural debris	• Styrofoam	• Other material

Observations:

TetrES

Figure 6: Documentation form used by field personnel to categorize floatable material captured from the boom.

5.0 1996 SUMMER FLOATABLES PROGRAM

5.1 BOOM LOCATION #1: ALEXANDER OUTFALL

The first boom installation was located at the Alexander outfall. This outfall is situated within the core area, and was considered to have a representative distribution of residential/commercial/industrial land use. The boom as installed is shown in Figure 7.

The area contains significant (approx. 45%) impervious area. In addition to the land use characteristics for this sewer district, the outfall offered advantages in accessibility and allowed easy anchorage of the boom. The outfall is located immediately downstream of the Alexander Docks on the Red River.

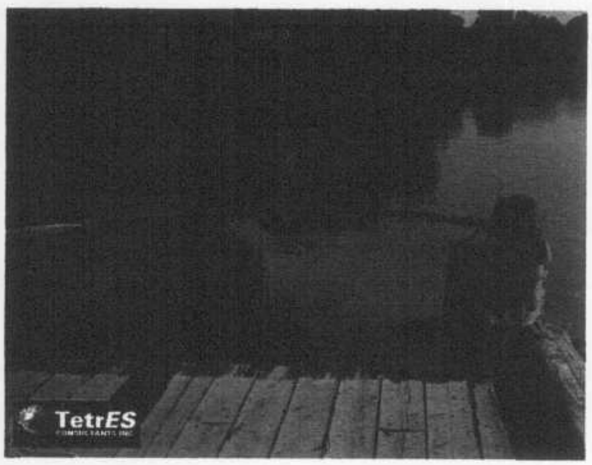


Figure 7: *The Alexander CSO Boom installation involved anchoring one end of the boom to the shore and the other end of the boom to the Alexander Docks.*

The boom was attached to the Alexander outfall from July 20 to August 23, 1996. A review of local rainfall characteristics indicated that rain events could be classified into three groups: small (less than 8mm total rainfall), medium (8 to 16mm) and large (over 16mm total rainfall).

Once rain events from each rainfall range had occurred and floatable data corresponding to these rain events was collected, the boom was detached from the Alexander outfall and moved to the next outfall location.

5.2 BOOM DISASSEMBLY AND RELOCATION

Boom removal began with the disconnection of steel cable and bolt fasteners which moor the boom to anchor points which were mounted on the riverbank and the dock. Once the boom was freed at both ends from the anchors, the boom was allowed to let the current move it into one long line. The upstream end of the boom was attached to the front of a City of Winnipeg power-boat, and the boat would tow the boom to the next outfall location.

For boom relocation over larger distances, either truck transfer or towing the boom after it is placed on a second boat would be more practical.

Total installation time (including boom removal at Alexander outfall, boom transport to Bannatyne outfall, and boom installation) was under 1.5 hours.

5.3 BOOM LOCATION #2: JUBA PARK OUTFALL

The boom was moved to its second location, the Bannatyne CSO located at Juba Park,on August 23, 1996. This location was suspected to be a major source of floatables (Petracci *pers. comm.* 1996). A floating dock exists several metres off shore from the outfall, with significant floatable debris accumulating at the dock. The Bannatyne outfall has surrounding structures (concrete

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wall with steel railing) which allow for easy anchoring of the boom during installation. Figure 8 shows the boom as installed at the Bannatyne outfall.

The boom was monitored at this second location until September 30, 1996.

Figure 8: *The Combined Sewer Outfall at Juba Park serves the Bannatyne Sewer District. The configuration of this outfall makes it an ideal location for boom installation.*

5.4 BOOM DISASSEMBLY AND END-OF-SEASON INSPECTION

On September 30, 1996, the boom was disconnected from its anchor points at the Bannatyne outfall and towed by power boat back to the Alexander Docks. The boom was pulled up onto the dock for inspection and dismantling and storage for the winter season.

The condition of the boom was good. A few minor holes in the boom fabric were detected, however, these were not large enough to hinder the boom's function. The mesh netting curtain was detached from the boom. Visual inspection revealed the netting to be heavily soiled by exposure to what appeared to be oil. New netting would be used in the next boom installation in the summer of 1997.

5.5 BOOM TRANSPORT AND WINTER STORAGE

The boom fits easily within the bed of a regular City of Winnipeg pickup truck (Figure 9). A City of Winnipeg crew picked up the boom and drove it to a works yard where it was spray-cleaned prior to winter storage. The total time required to remove the boom and load it into the truck was approximately three-quarters of an hour.

Figure 9: *The boom and mesh netting fit easily in the back of a pickup truck. The boom is spray washed prior to storing over winter.*

6.0 1997 FLOATABLES PROGRAM

The 1997 Summer Floatables Program was launched with the objective of building upon the 1996 Program's floatables characterization and quantification for CSO outfalls, and to begin the characterization of LDS discharges. The 1997 summer program was to begin in early July and involve boom installation at two CSO outfalls and two LDS locations. However, due to excessively high water levels from the 1997 Red River flood, the 1997 Summer Program could not begin until early August when river levels lowered to workable values.

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6.1 BOOM LOCATION #3: COCKBURN OUTFALL

The first boom installation of the 1997 Summer Floatables Program was the Cockburn CSO outfall located behind the Cockburn Lift Station. A survey of outfalls was conducted and Cockburn was selected due to its excellent accessibility and its configuration was well suited for anchoring the boom connections. The Cockburn outfall is located just downstream of the Elm Park Bridge on the north shore of the Red River. This outfall services the Cockburn sewer district, which is comprised of a large residential component and is considered to be representative of non-industrial area sewer districts with respect to land use. The boom was installed at this location on July 31 and remained at the outfall until August 26,

6.2 BOOM DISASSEMBLY AND RELOCATION

On August 26, after the Cockburn boom installation had been exposed to an appropriate range of rainfall events, the boom was disconnected from the Cockburn outfall in preparation for installation at the next outfall location. During the 1996 Floatables program, the boom was moved between outfall locations which were relatively close to each other, which allowed for the boom to simply be towed to the next outfall by the boat as it floated in the water.

For the 1997 Floatables Program, the distance between boom installation locations was too large to consider towing the boom in its floating position. As the drag of the floating boom was too great for towing over long distances, the boom was loaded into a Tetr*ES* Zodiac inflatable boat, and the loaded Zodiac was then towed by powerboat to the next boom installation site (Figure 10). This method provided effective, as it prevented the extra expense of a City truck and crew to assist in extracting the boom from the river, loading it onto a truck, and transporting the boom by road .

Figure 10: *Moving the boom over longer distances was done by loading the boom in to a zodiac boat and towing it behind a speedboat.*

6.3 BOOM LOCATION #4 : LOT 16 DRAIN (LDS)

One of the objectives of the 1997 Program was to monitor the extent of floatables discharged from an LDS outfall. During field program planning meetings in early 1997, the Crane LDS outfall and the Lot 16 Drain were considered as candidate sites for boom installation. At the end of August, levels on the Red River, while no longer dangerous, were still higher than normal. The elevated levels did not permit proper anchoring of the boom to the outfall, as much of the outfall pipe remained below the water surface.

The other candidate LDS site, the Lot 16 Drain, was observed to be positioned appropriately with respect to river levels for boom anchoring. The boom was moved to the Lot 16 Drain and installed on August 26. The boom was monitored at this location until

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September 15. The Lot 16 Drain services a large catchment area comprised of high density residential and commercial shopping centres. The outfall is located on the west shore of the Red River downstream of the Bishop Grandin Bridges.

6.4 BOOM DISASSEMBLY AND RELOCATION

The boom was separated from its anchoring points on the outfall and loaded into a Zodiac boat brought to the Lot 16 Drain LDS by powerboat. Once the Zodiac was loaded with the boom and netting it was towed behind the powerboat to the next boom installation site: Mission CSO.

6.5 BOOM LOCATION #5: MISSION CSO OUTFALL

The final boom installation site of the 1997 field program was the Mission CSO outfall (Figure 11). This large outfall is located upstream of the Seine River and Red River confluence.

The Mission CSO serves a catchment area of approximately 1,260 acres, 67% of this area is industrial. The boom was installed at the Mission outfall on September 15 and monitored for floatables through five rainfall events until its removal on October 1.

6.6 BOOM DISASSEMBLY AND END OF SEASON INSPECTION

On October 1, the boom was detached from its anchoring points at the Mission outfall and loaded onto the Zodiac inflatable boat for towing back to the Alexander

Figure 11: *The Mission outfall is located on the Seine River upstream of the Seine River / Red River confluence. In the photo above, debris and oils are trapped in the boom after a rainfall.*

Docks. Upon arrival at the Alexander Docks, a City of Winnipeg truck with a 2-man crew was present to assist in extracting the boom from the river. One end of the boom is attached to the hitch of the pickup truck and the truck slowly drives away from shore, towing the boom slowly out of the water. Due to the weight of the water-soaked netting mesh, the boom is too heavy to extract from the river without using the truck.

Once the boom is loaded completely onto the Alexander Docks, it is stretched out to its full length for inspection. The inspection is for assessing any damage to the boom and to evaluate the condition and suitability of the mesh netting. The inspection determined that the boom was in good condition, while the mesh netting was in satisfactory condition for re-use in the future. The mesh netting will be spray-rinsed clean prior to winter storage. After inspection, the boom and mesh netting curtain are disassembled and loaded in the City's pickup truck for winter storage .

6.7 BOOM WINTER STORAGE

The boom was sent to the Cockburn Lift Station building for winter storage.

7.0 PROGRAM FINDINGS

During the two summer seasons that the field program was conducted (1996 and 1997), a total of five outfall locations were fitted with a boom system which was left in place at each location until each location experienced a number of rainfall events. Results thus far suggest that for the City of Winnipeg system of outfalls, the loading of floatable debris is highly variable from outfall to outfall.

While some outfalls were found to episodically introduce significant floatable debris loadings to the river subsequent to rainfall events (Figure 12), others were found to discharge very low quantities of debris. In some cases, debris was specific to individual industry sectors in the sewer district (such as animal processing plants).

Based upon the observations obtained from the five boom installation locations thus far, it appears likely that floatable debris management and control on Winnipeg's rivers could be achieved through selective targeting of only the outfalls which have demonstrated problematic floatable debris loadings. The Alexander outfall was discovered to routinely discharge hypodermic needles subsequent to rainfall events (Figure 13).

***Figure 12:** The first boom installation at the Alexander outfall yielded significant volumes of captured floatables. After one rainfall, the boom at this location captured almost 80 pounds of floatable debris.*

Areas exist within the Alexander sewer district which have been associated with street activity such as prostitution and intravenous drug use. One possible source of the hypodermic needles found in captured floatables is the practice of drug-users discarding syringes from cars at curbside. The syringes would then be flushed into the combined sewer system with the street runoff following significant

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***Figure 13:** Used hypodermic needles were routinely found in the captured floatable debris of one city outfall, the Alexander outfall.*

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rainfall events.

It is important to note that the Alexander outfall was the only boom location which yielded used syringes in captured floatable material.

The Mission outfall was discovered to discharge significant amounts of animal tissue after one rainfall event (Figure 14). The Mission outfall serves an area of the city which contains several animal processing industries. It is quite possible that one of these industries is not practising proper filtration of biological tissues prior to discharging their effluent into the city sewer system.

Figure 14: *At the Mission outfall, one rainfall event resulted in the discharge of significant amounts of raw animal tissue. The animal tissue is seen as red material in the skimming rake pictured above.*

Land Drainage sewers were found to discharge floatables, however the composition of the floatables was almost entirely natural debris (Figure 15).

Observations taken at the Lot 16 Drain LDS outfall suggest that floatable discharges from this source would not be aesthetically noticeable by users of the rivers. The largest component of floatables captured from the monitored LDS outfall was grasses and small twigs.

Figure 15: *The Lot 16 Drain outfall was the only LDS outfall monitored in the floatables study so far. The largest component of captured floatables from this LDS was grasses and twigs.*

7.1 MONITORED RESULTS

Results obtained from monitoring selected outfalls are summarized in Table 1. The maximum observed floatable loading was 35 kg at the Alexander Combined Sewer outfall in response to a 42.0 mm rainfall event. Five rainfall events (ranging from 1.6 to 42.0 mm accumulations) resulted in no measurable floatable debris discharge. The average floatable debris loading was 5.6 kg (12.2 lbs.) for average rainfall accumulation of 12.9 mm.

If observations from monitored outfalls are representative of outfalls on a system-wide basis, the on average, each outfall may discharge one pound of floatable debris per millimetre of rain in a catchment area.

Of the five monitored outfalls, four were found to discharge floatables mostly comprised of natural debris. One Combined Sewer outfall (Alexander) discharged floatables with colloidal surface films (oil, scum, grease) as the largest fraction of its floatable loading. Two of the five monitored outfalls were found to discharge materials which could be considered both potentially unhealthy and aesthetically objectionable. Monitoring revealed that used hypodermic needles are routinely discharged from the

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TABLE 1: MONITORING RESULTS

					Fraction of Total Captured Floatable Debris (Percent of Spread-Flat Area)						
						Plastics					
Outfall Location	Rain Event Date(s)	Accumulated Rainfall (mm)	Captured Floatable Mass kg (lbs)	Spread-flat Area (m^2)	Paper Products	Hard	Soft	Natural Debris (twigs, leaves, grass)	Colloidal Surface films (oil, grease, scum)	Health & Hygiene	Other Material
Alexander CSO	Jul 20/96	8.0	5.0 (11)	0.8	8	2	15	25	40	1	Syringes recovered
Alexander CSO	Jul 24/96	0.8	2.0 (4.5)	0.4	8	-	5	20	65	2	
Alexander CSO	Aug 4/96	45.4	14.5 (32)	6.0	5	7	20	30	33	5	Syringes recovered
Alexander CSO	Aug 19/96	42.0	34.7 (76.5)	19.5	13	10	20	14	35	7	Syringes recovered
Alexander CSO	Aug 21/96	16.4	15.2 (33.5)	6.7	14	-	15	20	45	5	Syringes recovered
Bannatyne CSO	Sept 1/96	10.4	0.9 (2)	0.4	5	5	20	70	-	-	
Bannatyne CSO	Sept 9/96	4.4	1.8 (4)	0.6	2.5	2.5	20	60	10	5	
Bannatyne CSO	Sept 30/96	1.6	1.4 (3)	0.4	5	5	20	50	10	1	
Cockburn CSO	Aug 3/97	1.8	1.7 (3.7)	0.4	15	-	-	75	10	-	
Cockburn CSO	Aug 8,9/97	10.2	8.6 (19)	1.9	19	-	9	43	19	9	Sports equipment, fishing gear
Cockburn CSO	Aug 11/97	2.8	No debris	-	-	-	-	-	-	-	-
Cockburn CSO	Aug 15,16/97	46.2	0.9 (2)	0.2	-	10	5	75	-	10	
Cockburn CSO	Aug 23/97	4.8	2.3 (5)	0.5	5	10	15	65		5	
Lot 16 Drain LDS	Aug29-Sept 1/97	9.6	9.1 (20)	0.6	5	-	10	75	10		Dead muskrat
Lot 16 Drain LDS	Sept 4/97	4.2	1.6 (3.5)	0.4	10	-	20	60	10		
Lot 16 Drain LDS	Sept 7/97	6.0	Negligible	-	-	-	100	-	-	-	2 plastic pop bottles
Mission CSO	Sept 16	30.4	11.3 (25)	1.5	10	10	10	60	10		Oil slick, animal tissue, diesel odour, wood chunks
Mission CSO	Sept 19	2.4	No debris								
Mission CSO	Sept 22	1.6	No debris								
Mission CSO	Sept 30	9.6	No debris								

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Alexander combined sewer outfall into the river. There is known prostitution and associated drug activity in portions of the Alexander sewer district. It is possible that used hypodermic needles are discarded at curbside and rinsed into the system with overland flow. A letter of concern has been sent to City of Winnipeg officials regarding this issue.

At the Mission outfall, monitoring revealed significant discharge of raw animal tissue in the outfall's discharge.

The results as seen in Table 1 indicate that the loading of floatable debris is highly variable from outfall to outfall. While some outfalls were found to episodically introduce significant floatable debris loadings to the river subsequent to rainfall events, others were found to discharge very low quantities of debris. In some cases, debris was specific to individual industrial sectors in the district (such as animal processing plants).

Based on the observations obtained from the five boom installation locations thus far, it appears likely that floatable debris management and control on Winnipeg's rivers could be achieved through selective targeting of only outfalls which have demonstrated problematic floatable loadings.

Figure 16 shows the breakdown of average composition of captured floatables from outfalls discharging into the Red River.On average, natural debris is the main component of discharged floatables (49%) followed by surface films (22%), plastics (16%), paper products (8%), health & hygiene products (4%) and other material (~1%).

Surface films originate from dumping of greases, oils and detergents into the sewer system. Health & hygiene products (feminine hygiene, contraception, etc) typically find their way into the sewer system by being

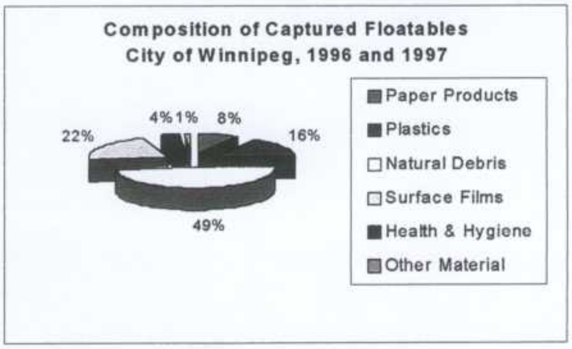

Figure 16: *Composition of captured floatables at observed City of Winnipeg outfalls was mostly natural debris. Approximately 74% of captured floatables can be attributed to street litter.*

flushed down the toilet. The remaining component of floatable debris (approximately 74%) is attributed to street litter washing into the sewer system after rain events.

CONTEXT: COMPARING WINNIPEG WITH NEW JERSEY

At the time of this document's writing, there was no data available to compare floatable loadings with other Canadian cities. The City of Edmonton conducted it's first monitoring program for floatable loadings into the Saskatchewan River in 1998. Edmonton's 1998 program began in August and monitored a single outfall. Data is available from a floatables study conducted for New Jersey in 1994(Parsons Engineering Science). In this report, floatables from three CSO's were quantified by mass and also expressed as Average Floatables Content (kg floatables per 1,000 cubic metres of CSO volume).

Winnipeg's floatable mass loadings and average floatables content values are very modest compared to those observed in New Jersey in the 1994 report . Winnipeg's highest average floatable content value was 0.4 kg per 1000 cubic metres of CSO volume. This value is 13.5 times less than the lowest

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average from New Jersey's three observed CSO's as reported in 1994 by Parsons Engineering Science. A summary of monitored sewer outfalls and their observed average floatables content is provided in table 2.

Outfall	Area (ha)	Average Floatables Content (kg/1000 m^3 runoff)
Alexander	160	0.40
Bannatyne	263	0.10
Cockburn	233	0.09
Lot 16	1256	0.04
Mission	753	0.03

***Table 2:** Monitored outfalls and observed Average Floatables Content expressed as mass (kg) of floatables discharged per 1000 cubic metres of available runoff.*

7.2 RECOMMENDATIONS

The reduction of floatable debris in Winnipeg's river system is a key component in increasing the aesthetic value for river users engaged in shoreline or secondary recreation activities.

Historically, judgements regarding the extent of objectionable floatable debris in Winnipeg's rivers has been based upon anecdotal evidence. Observations of five outfalls tend to suggest that large floatable debris loadings to the river are not widespread within the City's inventory of outfalls discharging into the Red and Assiniboine Rivers. While CSO outfalls have been thought to chronically discharge significant loadings of floatables during rainfall events, field results so far indicate the strong possibility that improved floatable control could be achieved through selective targeting of combined sewer outfalls. Additional measures could include selective targeting of industries for improved source control to reduce waste products found in their discharges. Examples to consider include targeting animal processing facilities near an outfall found to be discharging animal tissue, and information brochures in sewer bills for commercial customers (such as restaurants) for control of discharge of surface films (i.e greases and oils).

Source control appears to be an effective method of floatables control in Winnipeg. However, individual district characteristics and outfalls will need to be reviewed to assess the practicability of source control or outfall control methods such as in-system controls or end-of-pipe netting. Source control should be pursued as the first course of action before implementing more permanent and expensive capture systems at outfalls. Many jurisdictions have implemented public awareness campaigns to make the public mindful of the fact that articles left on streets or discarded into toilets can end up in the river system. This type of program may be worth tying into other public communication programs the City provides to the public and city schools.

Floatables Study personnel and the City of Winnipeg Harbourmaster have observed significant floatable debris present in the Red River following rainfall events. The monitoring of five outfalls is considered a good start to demonstrating the high variability in floatable debris loadings between outfalls. The results so far suggest that floatable debris discharges are not a system-wide problem.

It is recommended that ongoing monitoring be conducted to identify which of the remaining combined sewer districts cause the largest floatable debris loadings. Once outfalls representing the largest floatable discharges are identified, a selective floatables control strategy can be implemented.