# River Torrens / Karrawirra Pari Debris Program

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**Key points**

- Many native aquatic species face significant threats such as entanglement or ingestion from debris in waterways which can lead to behaviour changes, neurotoxicity, and death.
- A program was designed to categorise the debris in the River Torrens / Karrawirra Pari, Adelaide, and its tributary catchments.
- Gross pollutant traps, stormwater outfalls and riparian transects were surveyed across metropolitan Adelaide.
- Plastic material was found to be most common across all survey types comprising up to 65% of the debris collected. On average, 36% of the material collected from the different surveys contained loops.

## Abstract

Many native species face significant threats such as entanglement or ingestion from debris in waterways. This can lead to behaviour changes, neurotoxicity, and death.

A program was designed to categorise the debris in the River Torrens / Karrawirra Pari, Adelaide, and its tributary catchments. The river is an iconic component of the South Australian landscape with high ecological importance and significant cultural value for Kaurna people. Overarching aims of the project are to identify potential debris sources, risks to wildlife associated with the debris, and to identify and deliver mitigative actions to reduce these risks.

Adelaide University has undertaken a trial monitoring program at the confluence of Third Creek and the River Torrens / Karrawirra Pari to evaluate the most effective and deliverable methods for the wider catchment monitoring program. Phase 2 has expanded the monitoring across the broader metropolitan area and has surveyed gross pollutant traps (GPTs), stormwater outfalls and riparian transects. Plastic material was found to be most common across all survey types comprising up to 65% of the debris collected from stormwater outfalls. On average, 36% of the material collected from the different surveys contained loops, which are considered high risk items for species such as rakali and platypus. Foam and metal items were also prevalent.

Phase 3 of the program will work towards source identification and management. The results from prior phases will then be used to develop mitigative actions. These actions may range from local behaviour change programs, to collaborating with stakeholders towards influencing policy change.

## Keywords

River Torrens, Karrawirra Pari, debris, litter, plastic, gross pollutant trap, stormwater, entanglement, Platypus

## Background

Despite covering approximately 0.1% of the earth's surface, freshwater ecosystems support 10% of all species and 40% of all fish species, highlighting their ecological importance (Lundberg et al., 2000; Tickner et al., 2020). Overextraction, flow modification, habitat degradation, invasive species, and water pollution are all placing immeasurable pressure on these systems and their inhabitants. The River Torrens / Karrawirra Pari (River Torrens) is adversely affected by all these drivers, but particularly flow modification and water pollution. Increased urbanisation of the catchment, particularly the establishment of stormwater outfalls entering the system, has led to the increase of heavy peak flows transporting water, nutrients, organic, and inorganic matter into the river and its tributaries, leading to eutrophication, erosion, and build-up of debris and litter within the system (Gal et al., 2019). Litter is a global problem and is being addressed at every level, from the United Nations Plastic Pollution Treaty (Stofen-O'Brien, 2023), to the local level through changes in behaviour and policy (Nava et al., 2023).

The River Torrens is an iconic component of the South Australian landscape with high ecological importance and significant cultural value for Kaurna aboriginal communities. The river has a catchment that ranges from rural in the Adelaide Hills in the east, to peri-urban, and urban as it flows west towards the Gulf St Vincent. The urban catchment is characterised by impermeable surfaces which facilitate the rapid transport of water and contaminants to the river. The surrounding catchment has major influences on the quality of stormwater entering the waterway, with street paving, seasonal influences, and traffic intensity all reducing the quality of the stormwater (Barałkiewicz et al., 2014). Pollution compromises restoration efforts and contributes to increased accumulation of natural and anthropogenic debris in the River Torrens, representing a significant threat to local wildlife and the proposed rewilding of the Platypus and other species. Microplastics have been found in organs of birds and fish, causing growth retardation, neurotoxicity, and behavioural abnormalities (Bhuyan, 2022). Items of debris that have loops, such as fishing line, rope, and plastic bags can ensnare organisms. Entanglement may also lead to drowning, an inability to hunt or avoid predators, or injury via lacerations on the skin. To better address the issue of debris, it is important to identify the types of gross pollutants (plastics, metals, ceramics, rubber, etc.) entering the river, so that targeted management actions can be put in place.

Green Adelaide has funded the River Torrens Debris Program which is part of a range of projects working concurrently to investigate the condition and improve the health of the River Torrens. This has recently included investment to increase riparian habitat quality, understanding fish biodiversity and the regeneration of the lower section of the river at Breakout Creek. There is also a long-running program involving the collaboration between state and local governments, focusing on the removal and control of weeds and exotic trees, planting of native vegetation, improvement of water quality and bank stability.

## Aims

The River Torrens Debris Program aims to categorise the gross pollutants, including the organic and inorganic debris entering the River Torrens catchment. The aims of the overarching project being:

- Identification of potential sources and types of debris.
- Identification of the potential risks that these items and their locations pose to wildlife.
- Identification and delivery of mitigative actions to remediate the key issues identified.

The program specifically focused on determining the following:

- Quantity of debris to be sorted to ensure a representative sample of the total pollutant load capturing the diversity of organic and inorganic debris in stormwater runoff.
- Length of time taken to sample, sort, count and categorise the debris from each survey.
- Similarity of the debris that is captured in each survey.
- Quantity of stormwater outfalls required to be statistically representative of the collected debris types.

## Methodology

The River Torrens Debris Program has been designed in four phases:

**Phase 1: Trial Debris Monitoring Program** - The trial monitoring program was used to evaluate the most effective and deliverable methods for monitoring debris for the overarching, longer term project.

The study site for the trial was the confluence of Third Creek and the River Torrens (Figure 1 and Figure 2).

**Phase 2: Full Debris Monitoring Program** - The full debris monitoring program is currently being delivered over 3 years at a wider catchment scale (Figure 2).

**Phase 3: Source Management and Identification** - A future crucial step in monitoring and effectively addressing the debris impacting the River Torrens is the identification of the origin and the pathways that lead to litter and debris entering the system.

**Phase 4: Debris Campaign** - The results from prior Phases will be used to develop the mitigative actions of the Litter and Debris Campaign. It is expected these actions could range from local behaviour change programs, to collaborating with other stakeholders towards influencing policy change.

Adelaide University is undertaking the debris program funded by Green Adelaide, and is using a range of survey techniques to comprehensively categorise the pollutant load both in the trial program (Phase 1) and the full program (Phase 2):

- **Gross pollutant traps (GPTs) –** for monitoring macro pollutants or debris from larger sub-catchments.
- **Stormwater outfalls –** for monitoring micro pollutants or debris, smaller areas, and varying land uses.
- **Riparian transects –** for monitoring types of pollutants or debris entering from alternative pathways such as those flowing in the main channel or illegal dumping.

The debris from each survey type was categorised using an adapted version of the Green Adelaide marine debris program (Green Adelaide 2026) to include items with loops (Table 1). The main categories are as follows (Table 1).

**Table 1 Debris categorisation**

| Categories | Examples |
|---|---|
| Cloth | Clothing, rope, carpet |
| Foam | Sponge, polystyrene |
| Glass and Ceramic | Construction material, globes, jars and bottles |
| Metal | Cans, foil, wire |
| Paper and Cardboard | Boxes, food trays, newspapers |
| Plastic | Bottles, containers, sheeting, fishing items |
| Rubber | Balloons, tyres, shoes |
| Wood | Cork, timber |
| Other | Batteries, car parts, paint, furniture |

Looped items include hair ties, bottle rings, plastic bags, nets and ropes, rubber bands, fishing line, fencing material and shopping trollies and can be made of a variety of materials.

### *GPT surveys*

In Phase 1 and 2, each GPT is sampled three times with 9 x 90 litre containers collected from 2 nets spread across the width of the GPT (3 from each net). The nets are emptied every 21 days, or if 7 ml of rain is recorded in 24 hours or 10 ml in 7 days. As the project proceeds, not all GPTs in Figure 3 have been fully sampled. The selected nets were emptied and sifted through for macro and micro pollutants. The material was weighed, sorted, and categorised using Table 1.

### *Stormwater outfall surveys*

A variety of nets were installed on stormwater outfalls in the vicinity of Third Creek during the trial to evaluate the most effective method for debris capture. The flow from some of the outfalls was immensely powerful at times, so the nets installed had to withstand these conditions. Semi-permanent structures and fixtures were found to be the most suitable (Figure 4) and collaboration with local councils was necessary to enable placement of these nets. The traps were installed and removed at the outfalls before and after rain events and checked every 24 hours for potential clogging. All stormwater outfalls were assessed for accessibility and installation and maintenance risks. The material captured was sorted and categorised (Table 1).


**Figure 1 Phase 1 (Trial catchment) study area: Third Creek**

**Figure 2 GPT at Third Creek and River Torrens confluence**

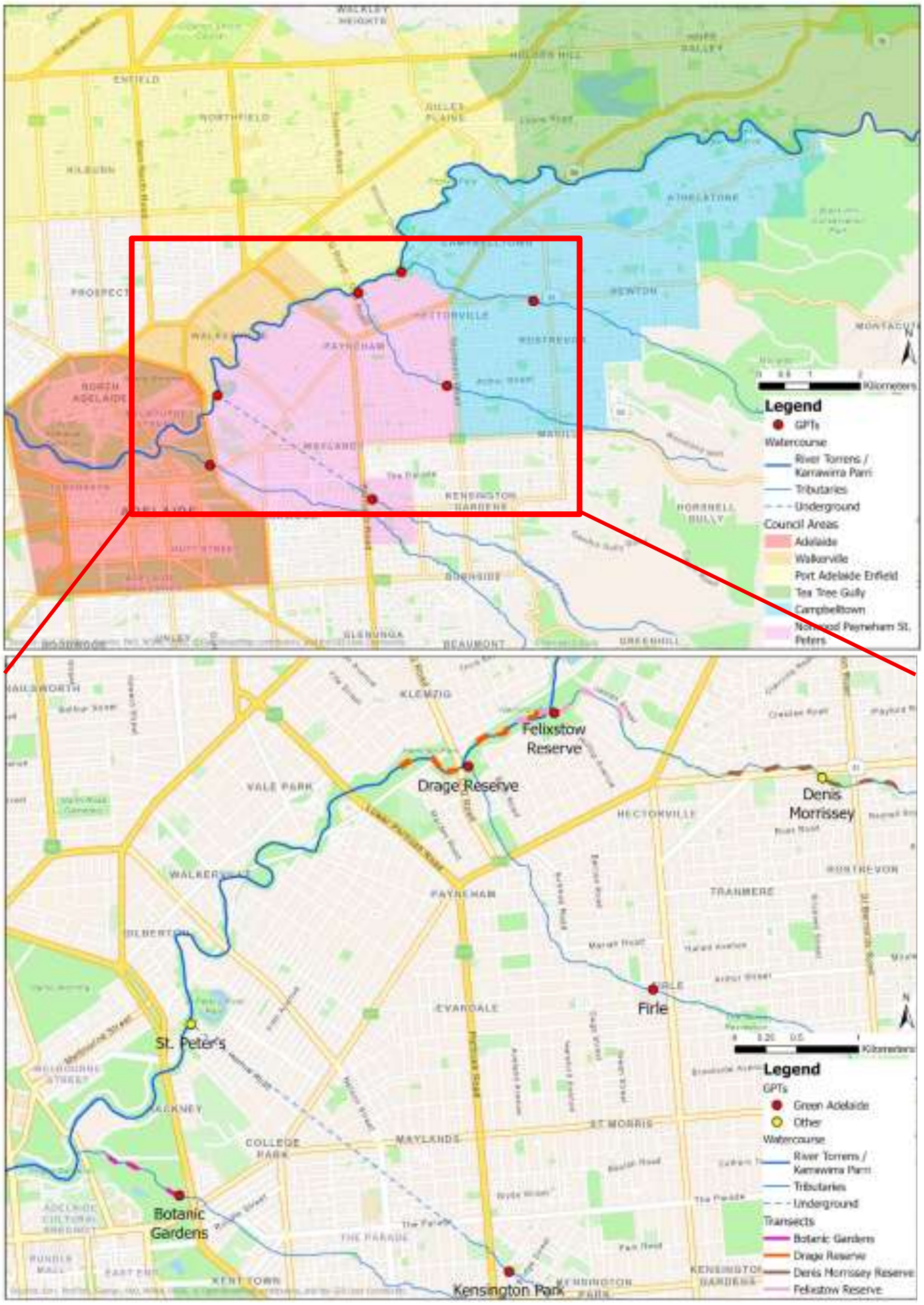


**Figure 3 Phase 2 study area**

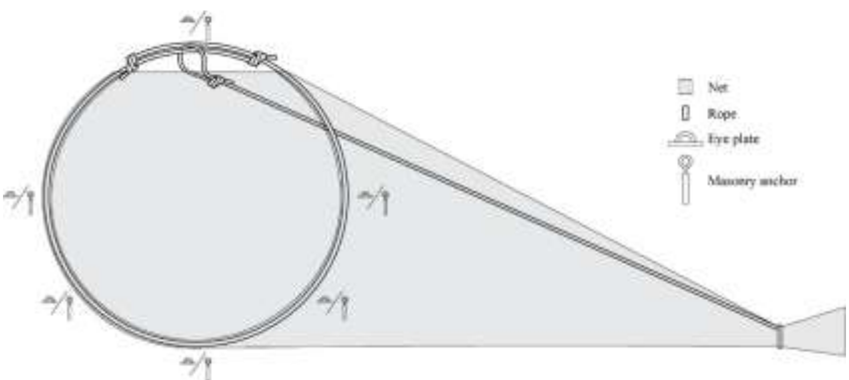


**Figure 4 Final design of monitoring for the stormwater outfalls**

### *Riparian transect surveys*

The trial phase initial adopted transects perpendicular to the river, but these were found to be less effective for categorising the debris that accumulates in the riparian zone. In Phase 2, parallel transects 2 metres in width were therefore adopted to maximise the material collected. Surveyors walked along the transect collecting all non-organic debris for later categorisation (Table 1) and quantification. Material that was unable to be retrieved was also documented. Transects were completed upstream and downstream of each GPT in the study area where access allowed and on both sides of the river.

## Results

### *GPT surveys*

Three GPT sites were sampled during Phase 2 of the program: Adelaide Botanic Gardens on First Creek, Drage Reserve on Third Creek and Felixstowe Reserve on Fourth Creek. Accumulation curves were constructed to ensure that adequate sampling was undertaken to fully categorise the types of debris collected. The analysis to date has shown that little additional sampling will be required to achieve this. These graphics are not shown in this paper.

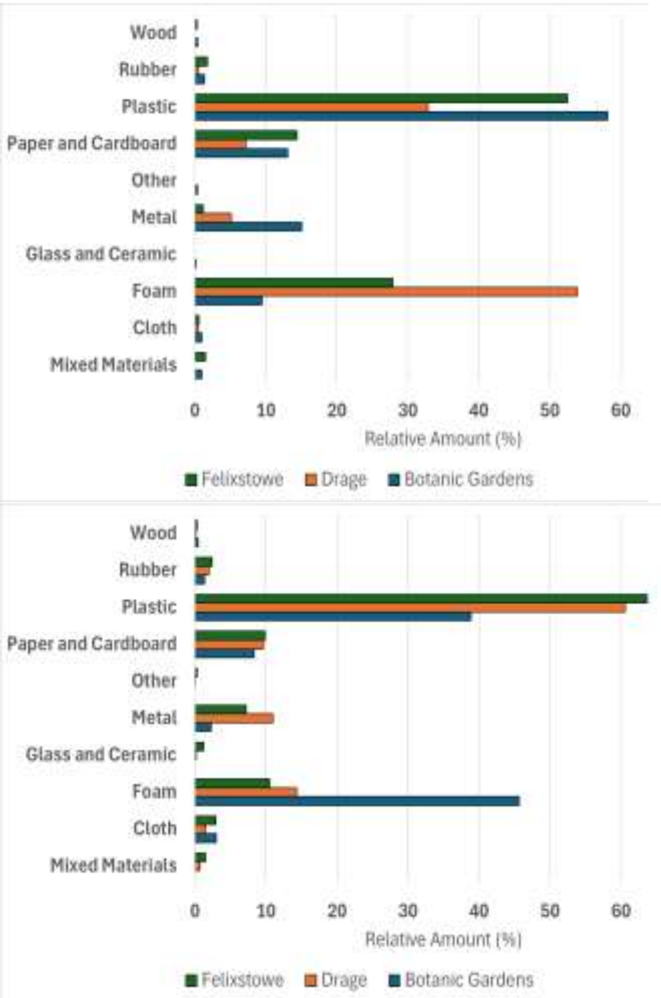


**Figure 5 (a) Proportion of items collected for the major debris categories from the GPT surveys (left) and (b) riparian transect survey (right)**

Figure 5a shows that plastic and foam items were found to be the most prevalent types of debris (54-62%), followed by metal, paper, and cardboard across the sampled GPTs. When the GPTs are routinely cleaned, the total mass removed and deposited to landfill, is recorded. The ratio of debris and rubbish to organic matter was calculated using this data and was found to be consistently around 1% for all sites.

### *Riparian transect surveys*

Similar accumulation and sample completeness curves were undertaken for the riparian transects and substantial additional sampling would be required to fully categorise the debris types present in the transect samples. Figure 5b shows that the most common types of debris collected from the riparian transects aligns with the GPT surveys with plastic (up to 65%) and foam items (up to 45%) being the most common.

### *Stormwater outfall surveys*

Limited data was collected from the stormwater outfalls due to the length of time that the nets were installed. Further sampling is required to indicate which variables have a significant impact on stormwater debris counts, such as differing council areas, drain size and rainfall in the previous 24-48 hours. The distribution of debris types from stormwater outfalls was consistent among councils, with plastic representing much of the debris (up to 65%) (Figure 6).

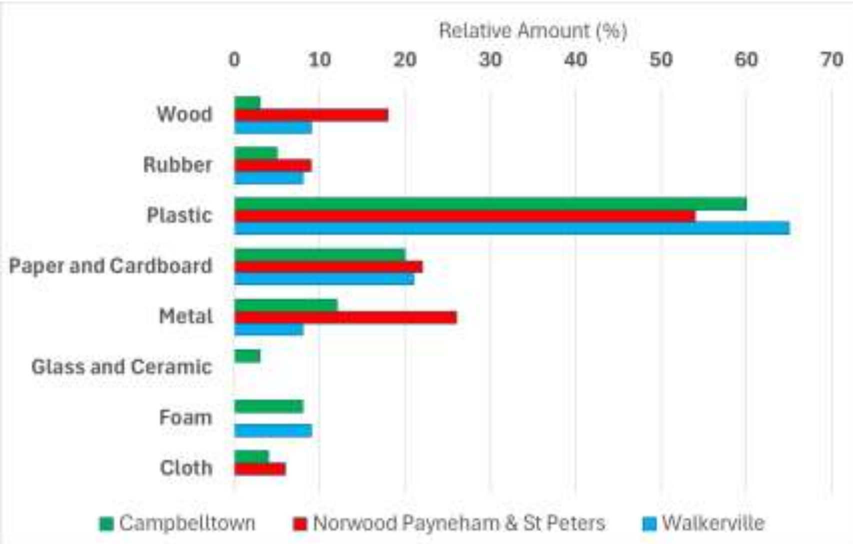


**Figure 6 Proportion of items collected for the major debris categories from the stormwater outfall surveys**

## Discussion

The results show that the methodology applied to each survey type is producing usable results and, with additional data collection (repeat sampling in time and at additional sampling sites), will be able to fully categorise the debris types present at each site. On average, 28kg of debris was collected from the GPTs. With stormwater outfalls and transects, the results were inconsistent and at some sites only a few items were collected whereas at other times over 50 items were collected with huge weight discrepancies. The most debris were collected from the riparian transects and plastic was the most frequent debris type found in all three data sources, alongside foam, metal, and paper and cardboard. Data collected shows that on average, 36% of debris contained a loop. Cloth, metal, plastic and rubber were the categories that showed the highest frequency of loops across all sources. Plastic items were not only the most common in each of the surveys, but presented higher than average occurrences of loops, presenting a clear endangerment issue to native fauna (Figure 7).

Foam and plastic fragments were widespread in riparian areas which causes concerns for species living in the River Torrens and its immediate surrounds. These fragments can be consumed by fauna leading to physical and chemical impacts, organ damage, oxidative stress, malnutrition, and false satiation (Bhuyan, 2022). Plastic fragments appeared as a wide range of items from small hard plastics to fragmented soft plastics, creating hazards in waterways for local fauna such as entanglement, neurotoxicity and choking (Bhuyan, 2022). Plastic fragments found along the riparian transects and stormwater outfalls had a high rate of looped items (47%) (Figure 7). Like the transect results, GPTs contained elevated levels of polystyrene packaging, plastic fragments and tobacco products such as cigarette packaging and butts. When comparing GPT results with transect results, polystyrene foam packaging was prevalent in both, however items found in transects surveys such as metal wire and "others" (vapes, spray paint cannisters and metal construction ties and materials) were not found in GPT surveys. This indicates that these products have made their way into the system through alternative routes such as illegal dumping, as opposed to transported downstream via the river and its tributaries. Phase 3 of the project will look at identifying potential sources of material such as fast-food outlets and the construction industry.

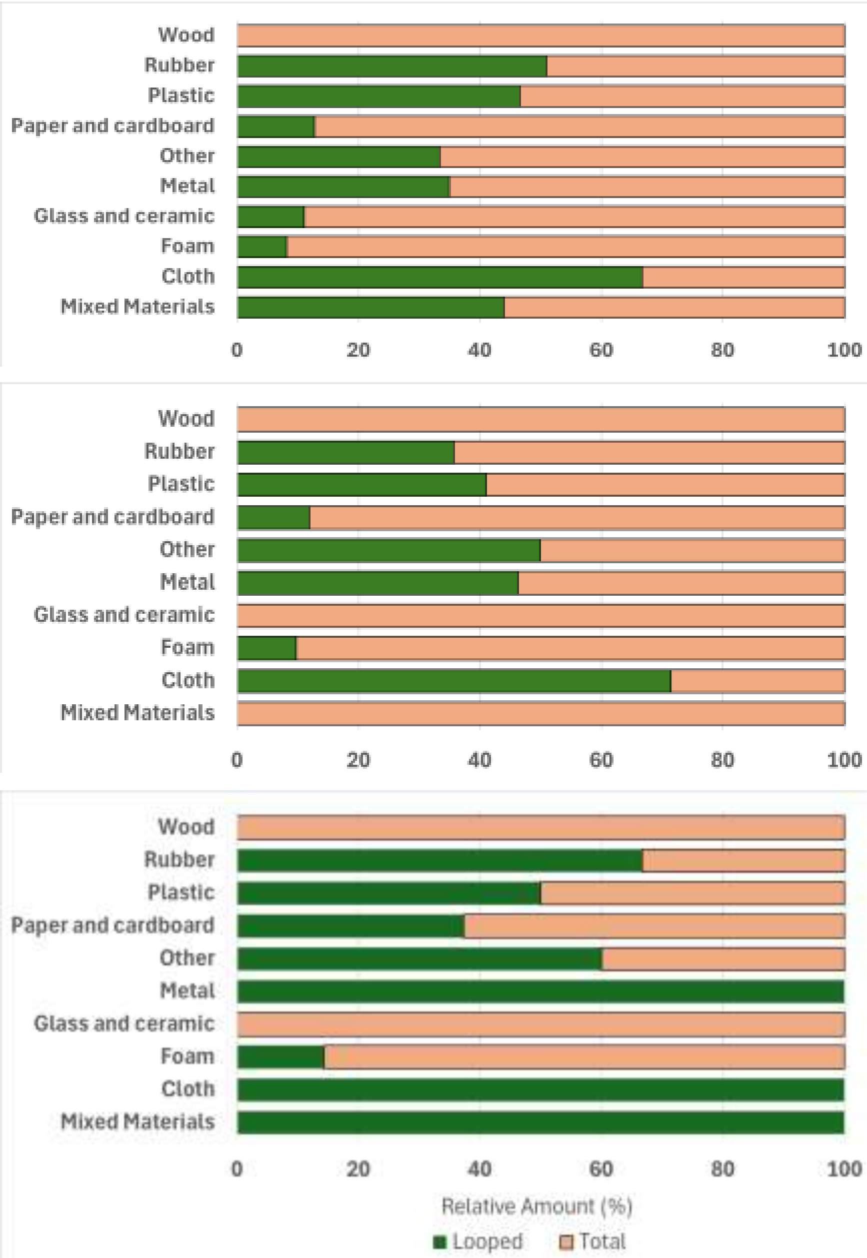


**Figure 7 The proportion of looped debris in each major category for the various surveys (top – GPTs, middle – transect and bottom – stormwater outfalls), as a percentage of the total number of items found belonging to that category**

When exploring the relationship between debris count and rainfall, the currently limited data is unable to provide a clear indication of any sort of correlative relationship, therefore continued data collection is required to determine the presence of a clear relationship. This result did, however, provoke the idea that the number of dry days between rain events should also be considered as this may influence the debris load more so than amount of rainfall as a greater volume of debris may accumulate in stormwater systems and along riverbanks before eventually making its way into the river. It was observed that drain sizes did not differ between councils, whereas debris counts did, which could be due to population density, the total area of pipes leading to the outfalls or land use type. This will be considered further in the upcoming phases.

The larger mesh size (up to 70 mm) of GPTs allows smaller items of debris and sediment to pass through, whereas the finer mesh of stormwater outfall nets (40 mm) retains a greater proportion of debris. This will be investigated further by recording debris size to assess whether smaller items are more prevalent downstream of GPTs and occur at higher proportions in stormwater outfall surveys compared to GPT surveys. One major limitation of the stormwater outfall monitoring was the unexpected power of the flows entering the River Torrens through the stormwater drainage system. These high flows led to the destruction of nets resulting in data that could be misrepresentative. Upgrading the nets to be more durable material increased the likelihood of nets remaining intact, however, due to the larger mesh size, may have led to smaller pieces of debris being unrepresented.

## Conclusions

This study has established a methodology for monitoring debris in GPTs, stormwater outfalls and riparian zones along the River Torrens and its tributaries. Preliminary findings from Phases 1 and 2 of the debris monitoring program suggests that plastic material was found to be the most common debris type across all survey types comprising up to 65% of the material collected. On average, 36% of the material collected from the different surveys contained loops. These findings will be used to inform the next phases of the program.

The main goal is to establish full monitoring of Adelaide's eastern suburban area by expanding all types of monitoring, as well as commencing monitoring in the suburbs to the west of Adelaide CBD where the River Torrens flows through. As the project moves into Phase 3, it is apparent that there must be a focus on plastic material, followed by paper and cardboard, and metal products. In Phase 3, it is suggested that the amount of data collected during debris categorisation is increased to achieve that phase's goal of source management and identification. It is recommended that information on the item's origin (residential/commercial/industrial) be recorded, along with the recording of any identifiers such as barcodes or nearby potential sources (e.g. construction plastics could be traced to nearby construction works or sporting equipment such as tennis balls traced back to sporting clubs or schools). As stated previously, each object's size and weight should also be recorded to provide a clearer indication of the volume of debris within the system.

## Acknowledgements

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