Port Phillip Bay Stakeholder Groups for The Next Generation Baykeeper

Charlie Dursin

John Laukaitis

Hailey McCasland

Julia Pope

Advisors:
Lorraine Higgins
Uma Kumar

Project Liaisons from the Port Phillip EcoCentre:

Neil Blake

Fam Charko

An Interactive Qualifying Project submitted to the Faculty of Worcester Polytechnic Institute in partial fulfillment of the requirements for the Degree of Bachelor of Science

WPI

Acknowledgment

We acknowledge the Kulin Nations, the traditional inhabitants of the Australian land. We respect the Aboriginal culture and the Elder members of the Australian community.

Table of Contents

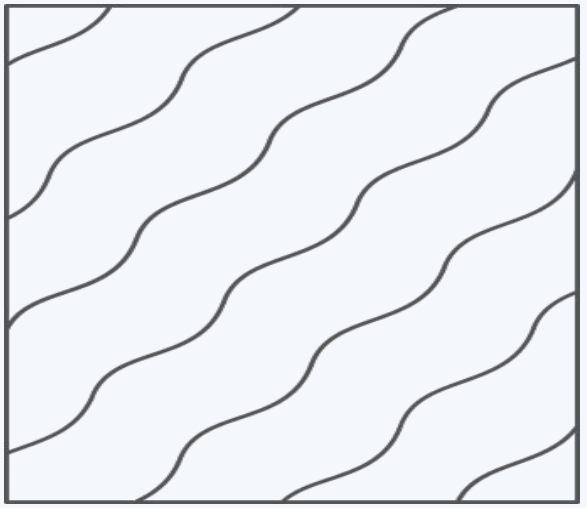
Abstract

The Port Phillip EcoCentre is an organization that focuses on environmental solutions and seeks to build community. Its current Baykeeper oversees efforts to keep Port Phillip Bay clean, and he leads many of its initiatives but is soon retiring. To continue this work, the EcoCentre and its new Baykeeper will need to build strong alliances with other groups working to protect the environment and marine ecosystem. Our WPI team was tasked with forming three stakeholder groups vested in three primary issues: spider crab fishing, waste management, and microplastic pollution. These groups will form a network and pool of expertise that will be helpful to the next Port Phillip Baykeeper.

To accomplish this task, we completed website and newspaper research to learn about these issues and identify relevant stakeholders in Victoria. We then interviewed key stakeholders to ask solution-oriented questions and understand each organisation's initiatives and priorities. Finally, we hosted three focus groups where stakeholders brainstormed solutions, identified barriers, and created a unified voice. From this information, we further developed EcoCentre's interactive stakeholder map and created three issue papers that contain background research, workshop findings, and actionable steps for each issue. The EcoCentre will use these papers to display our team's findings and to further educate the community on the issues of waste management, microplastics, and spider crab fishing.

"Each small organization needs to come together under one banner to say that this is a huge problem and to bring information to support that."

-*Carmen Torraca, Tangaroa Blue Foundation*
Quote from WPI's Microplastics Focus Group



Introduction

Human activity has created a negative impact on oceans. From fishing litter to toxic chemicals and microplastics, it is not uncommon to find beaches that have been closed due to high amounts of pollutants or shorelines filled with plastics. Keeping water swimmable, drinkable, clean, and safe is a crucial task. As a result, many environmental organizations are taking action to create policy and change to keep our oceans clean , like the Port Phillip Bay Eco Centre in Victoria, Australia.

Port Phillip Bay is located on the Southern Coast of Victoria, Australia. It stretches about 50 kilometres long and 40 kilometres wide. It has a shoreline of about 264 kilometres and in total the bay's surface waters cover approximately 1,930 square kilometres. It is a major recreational destination and now accommodates Australia's busiest port for shipping, so it attracts many people and travellers by boat. Port Phillip Bay allows for swimming, beaching, surfing, kayaking, diving, scuba diving, and many other water-based activities. Two rivers, the Yarra and Maribyrnong, have a significant impact on the cleanliness of the Bay since they are the two largest rivers with the greatest areas of catchments flowing to the Bay (Encyclopaedia Britannica, 2017). Port Phillip Bay is also home to many marine species like dolphins, penguins, fish, sea stars, anemones, jellyfish, sponges, crustaceans, molluscs, and much more (Port Phillip Bay Marine Life, n.d.).

The range of human activity in Port Phillip Bay poses threats to its health. A large population of people live in catchments, also known as watersheds, shown in Figure 1. This has contributed to several kinds of pollution that end up in the Bay.

Figure 1. Port Phillip Bay and drainage catchments (Melbourne Water, 2020)

One form of pollution the Bay struggles with is Microplastics. Millions of tiny plastic particles barely visible to the eye float in the water, most of which carry a myriad of chemical residue on them (Barbozaa, 2018). This poses a major threat to not only the marine wildlife that lives in the Bay, but also to people who eat local seafood or swim in the Bay for recreation. These particles are very difficult to remove from the water and beaches because of their tiny, sometimes microscopic size.

The problem of microplastic and other Bay pollution is a symptom of an issue with the methods of waste management used in the city of Melbourne and surrounding area. Overflowing bins, careless disposal, littering, and dumping can lead to debris littered streets. These materials wash into nearby rivers through stormwater, and are carried into the Bay. Plastic materials can break apart into microplastics along the way.

The mass fishing of spider crabs and improper disposal of bait used for this purpose, including chicken carcasses, also is problematic for the Bay. Tourists come to observe the phenomenon of spider crab moulting and the lack of policy around fishing has placed the species at risk and increased pollution in the process.

The Port Phillip EcoCentre is a non-profit established 1998 by the City of Port Phillip as an environmental hub with-

25 affiliate groups, many of which are spread across the wider Melbourne region, one with national reach, and one with an international reach.

Figure 2. Port Phillip Bay and immediate surround (PPSP, 2009)

The overall mission of the EcoCentre is to build relationships, demonstrate sustainable environmental practices, and strengthen people's connection to the natural world. EcoCentre uses the physical world as a classroom and citizen science as a key component of EcoCentre’s community engagement. It gathers evidence to advocate for change.

The EcoCentre has many relationships with organizations that also work on environmental issues such as Scouts Victoria, Yarra Riverkeeper Association, Werribee River Association, Bellarine Catchment Network, Beach Patrol, Love Our Streets, and Tangaroa Blue. The EcoCentre also connects with government agencies such as Melbourne Water, the Environmental Protection Agency Sustainability Victoria, Department of Land Water & Planning, Parks Victoria, City of Bayside, City of Greater Geelong, and the City of Port Phillip (Charko, 2018). These relationships are key in maintaining the health of the Bay.

The founding director of the Port Phillip EcoCentre is the current Baykeeper of Port Phillip, Neil Blake. During the time that Neil Blake has been involved, he and the program have had many positive impacts, not just for the Bay but for many other environmental missions as well. Because of EcoCentre's work, for example, microplastic tracking and analysis is now included as part of the Victorian EPA's litter monitoring. Microplastics were a previously unrecognized but prevalent issue. In the Victorian State Environment Protection Policy, plastic in general is now included as a threat to the health of waterways, due to advocacy of the EcoCentre.

Neil Blake has also co-written and co-produced numerous informational pieces on pollution, litter, and other issues prevalent to the Bay in the Melbourne region. He has conducted research in removal of invasive species in the Bay, as well as research on protecting aboriginal cultural heritage sites (EcoCentre, 2019). Since 2013 the EcoCentre has focused on studying microplastics, currently building on six years of research on microplastics and the best methods of preventing their influx into waterways and removal.

The focus of our project is to work with the EcoCentre to facilitate communication with stakeholders about waste management issues pertaining to microplastics and to spider crab fishing. For the EcoCentre and future Bay Keeper to continue addressing Port Phillip Bay's environmental threats, they will need to build alliances and trust with partnering organizations.

Our goal was to create connections between the stakeholders so that they might come up with a collective plan and share resources to more effectively address these issues moving forward. Based on the information we collected, we created three issue papers with the purpose of educating readers on the history of these problems and what steps can be taken to address them moving forward. We also developed several infographics to educate the community about these issues.

Methodology

The overall goal of this project was to promote collaboration and communication between the EcoCentre and other stakeholders around Port Phillip Bay, as well as provide a smooth transition between the current Baykeeper, who is retiring, and the new Baykeeper. To achieve this goal, we were seeking to meet the following objectives, shown in Figure 3:

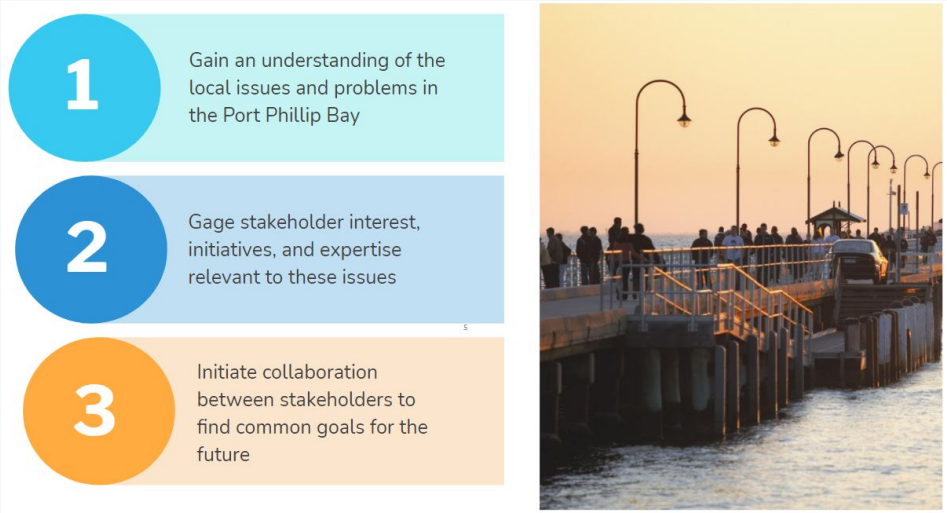


Figure 3: Objectives and Methods

To meet our first objective we conducted extensive research using studies, online news sources, and books, as well as conversations with the EcoCentre tailored around spider crab aggregation, microplastics, and waste management in Port Phillip Bay. Because we would later be speaking with stakeholders about these topics, we needed to be able to have intelligent conversations and ask relevant questions, and to acquire background information for the issue papers we would later write

To accomplish our second objective, we located relevant stakeholders mentioned in our background research and by the EcoCentre. Additional stakeholders were identified as the project progressed through the use of snowball sampling. We interviewed these stakeholders to gage interests and learn about their organization's initiatives. Afterwards, we compared our interview notes to find areas of common interests and initiatives the stakeholders might be able to work on together. We raised these issues at a subsequent focus group.

Our third objective was to initiate collaboration across these groups and find commonalities. We wanted to initiate conversations for change through focus groups, to gather their expertise for our infographics and issues papers, and identify solutions, barriers and next steps the group might take.

Because of the coronavirus pandemic, we conducted much of our research online and over Zoom. Below, we explain our methods for conducting interviews and focus groups and our methods for creating the final issues papers and infographics, which resulted from that research

Identifying Stakeholders and Their Expertise

Before conducting any interviews, we first developed a list of 30 initial stakeholders and reviewed their websites and articles written about them. Table 1 contains the complete list of stakeholders identified, along with which issue they were most pertinent to.

Table 1: Stakeholders Researched

Spider Crabs	Waste Management	Microplastics
Victorian Fisheries Authority	Aquatic Environmental Stress Research Group (RMIT University)	EPA Victoria
Victorian National Parks Association	Sustainability Victoria	Yarra Riverkeeper Alliance
Spider Crabs Alliance	Boomerang Alliance	Melbourne Water
Josie Jones	Nationwide Waste Solutions	Tangaroa Blue
Chinese Angling Association	Cleanaway	BioGone
Polperro Dolphin Swims	Wormlovers	Scouts Victoria
	Ewaste Solutions	RMIT Plastics Lab
	Newtechpoly Ltd.	Love our Street
	Fieldtech Solutions / Beach Patrol	Bellarine Catchment Network & Caring for our Bays
	Bayside	Department of Environment, Land, Water & Planning - LitterWatch

This helped us create a profile for each individual stakeholder. We created a template to record this information, and noted specific questions we would want to ask them in a subsequent interview. An example is shown in Table 2, and profiles for every organization can be found in Supplemental Materials Section A (SM - A)[1].

Stakeholder Name, Sector	**Victorian National Parks Association,** Government
Organization's Goal and priorities	Broad organization. Has partnered with the VFA, Spider Crab Alliance on a petition that received 35,000 signatures. Supporting the "no take" time of March-July.
How do the priorities align with the EcoCentre? Why are we reaching out?	Overlapping interests with Eco Centre: sustainable fishing practices of spider crabs, social and cultural value of spider crab aggregation. Reaching out because their insight into the spider crab issue can be valuable in a round table discussion. May be able to largely contribute to spider crab celebration.
Additional Interview Questions	Who do you believe are the key stakeholders to be considering in managing the spider crab aggregation? How do you believe the annual spider crab aggregation should be managed, how is the Spider Crab catch limit tailored towards that? What other activities do you believe could complement the annual aggregation for the benefit of the wider community? How do you think the issue of spider crab fishing could gain more attention? Is there evidence of the spider crab population being harmed due to fishing (direct visible impacts?) Is there a specific contact in the VFA that you've worked closely with?

[1] Supplemental materials for this project may be found at http://www.wpi.edu/melbourne/projects/, using the search bar to locate project materials.

Our goal was to identify a mix of government organizations, non-profits, and private stakeholders to gain multiple perspectives. After The EcoCentre called the organizations to preface our contact, our group reached out by phone or email.

We introduced our team and project, asked for an interview, and informed them of our intent to create issue papers and host a follow up focus group. Each email was personalized for the stakeholder, addressing specifically what we wanted to discuss with them. One example is given in Figure 5 below.

Dear Victorian Fisheries Authority,

My name is Julia Pope, I am writing on behalf of a project team at Worcester Polytechnic Institute. We are working with the Port Phillip EcoCentre on an extended research project on spider crab fishing in Port Phillip Bay. Neil Blake and Fam Charko have referred us to the Victorian Fisheries Authority

We noticed that the VFA has overlapping interests with the EcoCentre: sustainable fishing practices of spider crabs, and upholding the social value of spider crab aggregation while respecting anglers.

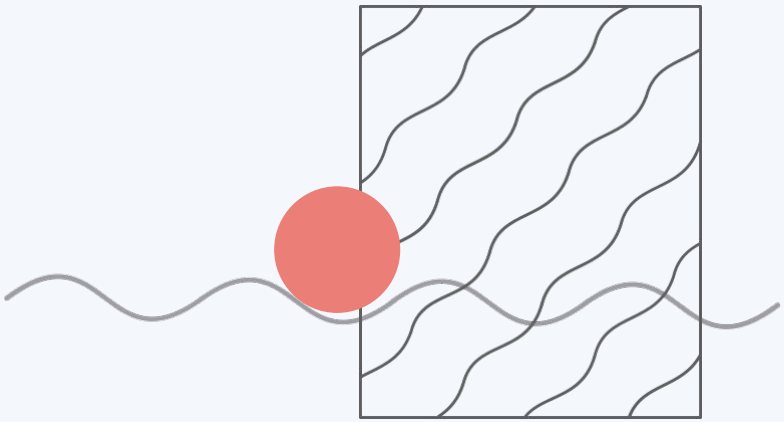
The goal of our team's project is to initiate communication among stakeholders and create a round table workshop to discuss the creation of a celebration around spider crab aggregation. Additionally, our team will create infographics and short issues papers to educate the community about spider crabs and advocate for a spider crab celebration period in Port Phillip Bay.

If you are open and willing, we would like to conduct a brief 30 minute interview about the VFA's initiatives and if the VFA would be interested in a larger workshop with other stakeholders. If you are interested, we are available to meet from 9-11am AEST on all business days. Let us know what time works best for you, and we can set up a meeting.

Figure 5. Email sent to the Victorian Fisheries Authority

Fourteen stakeholders agreed to participate in these semi-structured interviews, conducted over Zoom and other online video calling programs. The questions varied for every stakeholder, but in general we were interested in hearing about previous projects each stakeholder was involved in and how effective they were, goals for how they would like to further address the issue in the future, and the types of barriers preventing them from doing so, as well as any specific topics relevant to the stakeholder (SM - B).

An interview spreadsheet was created to record information from each interview. We then color coded any information pertaining to specific initiatives or suggested solutions. Next, we looked for solutions most commonly mentioned so that we could raise them in our focus groups.



Facilitating Cooperation Between Stakeholders

Our final objective was to promote collaboration between the stakeholders and EcoCentre. To accomplish this, we organized three, one-hour focus groups, bringing stakeholders who work on similar issues into the discussion. Our goal was to have around six stakeholders per issues group to create new working relationships and incentivize collaboration. Because of this, we wanted each group to have a mix of people who have worked together and people who have not. Additionally, we wanted each group to have a variety of different types of organizations in them: government, non-profit and private. This ensured that each issue group had a wide range of influence and expertise.

We created an agenda for each group, seen in Figure 6, based on common initiatives discussed in the interviews.

Spider Crabs Agenda:

1. Introductions and acknowledgment of Traditional Owners (5 min)
2. Each given 3 minutes to summarise their organisation's position on Spider Crab fishing; and (in point form) list (in point form) the issues that need to be addressed if fishing is permitted during the aggregation? (25 min)
3. Recap on likely scenario for 2021 Spider Crab aggregation/s.
4. Mornington Peninsula Nature Showcase: celebrating the contribution of nature to local community wellbeing and culture.
4.1. List existing events / activities and promotional platforms
4.2. Any wild ideas?
5. Next steps for the round-table

Waste Management Agenda:

1. Introductions and acknowledgment of Traditional Owners (5 min)
2. Each given 3 minutes to summarise their organisation's experience with Waste Management
3. Discuss Youth Education regarding recycling and proper waste disposal
4. Discuss the pros and cons of bin standardization, and what steps would need to be taken to implement it
5. Discuss the level of manufacturer accountability needed for change
5. Discuss the potential of further separating different waste streams, specifically glass and plastic
6. Next steps for the round-table

Microplastics Agenda:

1. Introductions and acknowledgment of Traditional Owners
2. Each given 3 minutes to summarize their organization and your experience with microplastic pollution
3. A discussion about oxo-degradable plastics
4. Single-use plastics - what percentage of trash collected do they represent?
5. Discuss benefits and opportunities for strategic collaborations
6. Next steps for the round-table

Figure 6. Agenda for the three Focus Groups

Across all three issues, interviewees placed a large emphasis on the importance of education and raising awareness of the issue, specifically getting the youth engaged. For this reason, we made an effort to talk about this in every focus group.

In regards to the spider crab group specifically, one commonly proposed solution across the interviews was a stricter no-take period, however there was some disagreement in the specifics of how it would work. While we did bring this up during the focus group, we chose to focus on topics where there was a greater consensus from the interviews. One of these was creating a series of nature based events around the time of the spider crabs at the Mornington Peninsula, similar to a festival in Whyalla surrounding giant cuttlefish. We asked the stakeholders to brainstorm any pre-existing events that could be folded into this festival, as well as any new events that could be added.

For waste management, every stakeholder that was interviewed spoke about the need to standardize waste bins across different municipalities, so this was a large focus during the roundtable discussion. Another recurring proposition from the interviews was separating different waste streams, specifically separating glass, so we asked the stakeholders to discuss the logistics of something like this.

The biggest commonality among the Microplastics stakeholders was the need for some form of legislation to reduce the usage of single-use plastics, so during the focus group we discussed ways in which the stakeholders could collaborate in order to more effectively lobby for this type of change.

Oxo-degradable plastics was a topic that we did not have much time to discuss during the initial interviews, but we felt it would still be valuable to discuss during the focus groups.

For each new discussion point, we would begin by sharing a slide that presented the topic, then returned to the gallery view so that everyone could see each other. We then allowed anyone to give their thoughts on the topic in a conversational style. Because we emphasized the commonalities among the stakeholders when developing our agenda, we found that the conversation flowed from one topic to the next very naturally, often without us even prompting them. These meetings were focused less on us learning about the key issues from the stakeholders, (though we hoped we might learn more), but rather about how the stakeholders could help one another to take action against these issues and address any barriers to change. The main objective was to create working relationships that will continue even after the project.

Visuals and Infographics

We used all of this research to develop infographics. An effective infographic will be engaging to the viewer, grasp their attention, and properly educate the viewer on the issue.

Our group created several infographics for standalone use or use within our issues papers. To do so, we created the guide shown in Table 3 to assist us.

Table 3. Tool for Developing Effective Infographics

Pre-development	Softwares (with free student licenses): Canva, Adobe Photoshop, In Design, PowerPoint Research Organization: -Determine what data will be visualized, sort research into bullet points or numerical data. -Select quotes to highlight, if applicable. -Think about what research and facts show the magnitude of the issue. -Convey a brief background of the issue for those that have not heard of the issue.
Delivery	1. Determine what the goal of the infographic and the most impactful approach. Example: Conveying the magnitude of an issue→ analogies, before and after graphics, assertions and visual evidence, telling a story. Display numerical data → chart, graph, numerical display, simple table/ Prompting action → making the step to take action simple (petition, organization to contact, vote for change), outline clear steps, show gravity of the issue An infographic is best when it includes a combination of multiple design methods in a simple way. 2. Determine audience for infographic, which will drive design. 3. Determine the path of travel for the viewer's eyes. Where will the visual guide them? 4. Select graphic style: color scheme, aesthetic, fonts, shapes and smaller graphics.
Post-edit	- Determine where text can be cut and simplified. - Reach out to a fresh pair of eyes for review-- ask them what they learned from the infographic and ask questions? Feedback is valuable in order to make edits to the delivery method. - Make sure that the infographic is saved both as a png and pdf as well as the original file format for easy editing - Create a brief guide for future editors (if needed)

Stakeholder Map

This project is part of an ongoing series with the EcoCentre. Prior to our involvement, Peter Dentch, Salvatore Lombardo III, Shelby Morrison, and Nicole Shedd conducted a similar project, focusing on climate change and invasive species. They created an interactive map that displayed information on all of the stakeholders they identified through the course of their project. Our team created a separate map following the same guidelines. The map includes the location of each stakeholder, the type of stakeholder, a brief description of what each stakeholder does, and a link to a website if applicable. Stakeholders are divided by the three topics, with different colored pin points representing each. This map can be found in SM-W

Issues Papers

An issues paper is a short overview written about a specific topic or problem, typically including background/history, existing framework surrounding it, knowledge gaps, recommendations on how to better address the issue moving forward, and a conclusion. They are made to be brief, easy to understand, and appealing to the eye. They are made to educate and to persuade readers to get involved in addressing the issues on hand. Our issues papers were developed from our internet and library research, information gathered from stakeholders during interviews and focus groups, and in discussion with the EcoCentre. Previous groups who have worked with the EcoCentre in the past to write issue papers created the template in Figure 7. Since this is an ongoing project for the EcoCentre, we want to ensure that our deliverables were consistent with previous work in terms of both style and form, so we followed the same outline.

1) Background
History and potential/probable causes of the issue. What has been done in the past about this and where are we now?

2) Probable threat to waterways and/or Bay health
How is this issue threatening waterway and Bay health? Is this a local issue, or is it waterway and/or Bay-wide?

3) Responsible management agencies
List of agencies and their particular responsibility (e.g. policy making, management, on-ground works)

4) Other stakeholders
Who else is involved in/affected by this issue? Including community, recreation groups, businesses, education sector, etc.

5) Existing policy framework
Existing laws and policies that manage and frame this issue and how they relate to each other. Includes potential/existing management practices.

6) Existing knowledge
What existing studies are there that help understand and research the issue? Science and research based, including local, national and international examples.

7) Existing management practices
What is already being done about this issue now?

8) Knowledge gaps
Why has this issue not been resolved yet? What are the gaps in knowledge and management that are perpetuating the issue?

9) Recommendations
This info will be a result of the outcomes of the issues round tables.

10) Other links and information

Figure 7. Outline for Developing Issue Papers (Dentch et al., 2020)

In what follows, we discuss the results of the research described above, summarizing what we learned about microplastic pollution, Melbourne's struggles with waste management and the excess litter produced as a result of spider crab fishing and the shared agendas these groups might pursue. We follow that with samples of the infographics and issue papers we created (SM - T-W).

Spider Crabs

Spider crabs are a large crustacean species found in the bays of Victoria. They are a native, non-invasive species that can reach up to 70 centimeters in diameter across both their legs (Victorian Fisheries Authority, 2020). Each winter, the crabs travel inwards from deep waters and gather by the thousands to molt in the waters of Port Phillip Bay (Staufenberg, 2016). They gather in large numbers for the purpose of safety. The molting process involves sticking algae and seaweed to their shells in order to camouflage. Then, the spider crabs molt by transferring shells. During this molting process, spider crabs are particularly vulnerable to predators (Staufenberg, 2016). During the spider grab gathering, scuba divers and snorkelers flood to Port Phillip Bay to observe the molting process.

Figure 8: Scuba Diver in Port Phillip Bay (Marris, 2019)

Figure 9: A mound of spider crabs forms in the shallow waters of Port Phillip Bay (ABC, 2019)

The rising tension between fisheries and scuba divers has led to a proposal created via a joint effort between the Spider Crab Alliance and Spider Crabs Melbourne.[iv] They circulated a petition for a NO-TAKE fishing period for the crabs during the molting season, a petition which, as of present, garnered 35,000 signatures. This restriction would be implemented through April-July. The petition also calls for increased funding for government research into the Giant Spider Crab population in order to benefit the natural ecosystems. To achieve these objectives, vested stakeholders will need to unite and initiate communication in order to come to a resolution for the NO-TAKE period and spider crab waste management before it becomes a crisis.

Figure 10: Trash left among the spider crabs (Victorian Fisheries Authority, 2019)

Stakeholder Identification & Outreach

In order to hold an effective conversation regarding spider crab fishing, we developed a list of stakeholders from multiple sectors including special interest groups and nonprofit, state government, and local government organisations, as displayed in Table 4.

Table 4: Stakeholders Interviewed

Stakeholder	Background	Initiatives
Josie Jones, *Graphic Designer, Illustrator & Environmental Change Agent,* **Share the World Design Studio**	Values the nature in Port Phillip Bay and the aggregation of Spider Crabs in addition to education about spider crabs. Could have ideas on a series of nature-based events in the bay.	Successfully led the Only Butt Campaign in Port Phillip Bay to cigarette butt litter. Used infographics and implemented disposal bins, reducing this littering 6/10 to 2/10 butts.
Mechelle Cheers, *President,* **Rye Community Group**	Residential organization with valuable insights into spider crab aggregation and observations regarding fishing litter and fishing habits.	No spider crab initiatives found
Shannon Hurley, *Nature Conservation Campaigner,* **Victorian National Parks Association**	VNPA has a wide scope [HLD6] into many issues and species in the bay. The organisation takes a clear stance on advocating for a NO-TAKE policy during aggregation.	No spider crab initiatives found
Judy Muir, **Polperro Dolphin Swims**	This organisation has insight into tourism in the bay and can provide valuable insights into a round-table discussion regarding a series of nature based events and the impact spider crab aggregation has on tourism.	No spider crab initiatives found
Zoe McKenzie, **Spider Crabs Melbourne** PT Hirschfield , *Founder,* **Spider Crabs Melbourne**	Spider Crabs Melbourne has a vested interest in implementing a NO-TAKE period and runs advocacy groups on social media platforms.	Along with the Spider Crab Alliance, Spider Crabs Melbourne has developed a petition for a NO-TAKE period with over 35,000 signatures.

The team conducted a thorough background analysis of these stakeholders, collecting information online such as previous initiatives, viewing organisation's websites, and reading articles published by the stakeholder (SM - A).

We then identified and interviewed stakeholders with varied perspectives, knowledge, and initiatives regarding spider crab fishing. We narrowed the group to those had aligned priorities with the EcoCentre: those who advocated for a NO-TAKE period, who wanted to work on solutions to mitigate fishing litter, and who would be interested in helping to develop a series of nature-based events to educate the public about the natural wonders of Port Phillip Bay and the Mornington Peninsula, including spider crabs.

We were particularly interested in speaking with stakeholders that had prior experience in event planning and developing infographics and educational tools. We interviewed six individuals across five organizations, ranging in sector and size.

At the interviews we discussed spider crab aggregation management, ideas or barriers to a series of nature-based events in Port Phillip Bay, and what to do about? spider crab fishing litter. Questions were tailored specifically for each stakeholder based on their organisation's initiatives and opinions (SM - B)

Interview Results

Common Solutions

Identifying similar ideas across stakeholders was critical for facilitating an effective workshop where they could further develop those ideas. After interviewing the stakeholders, we identified the full range of solutions they advocated and noted which were similar and which might produce some disagreement (SM - C).

Among the stakeholders, opinions overlapped greatly in terms of spider crab fishing- related litter. All stakeholders agreed that litter increased during aggregation and that the disposal of chicken carcasses and fishing gear into the ocean was abundant and affecting greater marine life. All stakeholders also expressed interest in a NO-TAKE period, although there was a variation in opinion regarding the specifics of and implementation of such a policy of . All stakeholders liked the idea for creating nature-based events but brought up that further collaboration and planning would be necessary.

Workshop Results

The attendees of the workshop were the Rye Community Group, Spider Crabs Melbourne, Polperro Dolphin Swims, The Port Phillip EcoCentre, and Share The World. Table 5 below displays the solutions, barriers identifies, ways to overcome the barriers, and next steps for collaboration

Table 5: Spider Crab Aggregation and NO-TAKE

Solutions	A NO-Take period at some point during the spider crab aggregation to Port Phillip Bay. Ensuring that all stakeholders have access to viewing and enjoying the spider crabs. Holding anglers accountable for overfishing or for disregarding current policies.
Barriers Identified	A more vigorous way of collecting data on the spider crabs and the effects of fishing is needed to prove to the fisheries that a NO-TAKE period is needed. The fisheries main focus is on clients, who are anglers?, which is what makes it hard to negotiate with them. They currently have what they want by having an unprohibited spider crab fishing period. The environmental minister is new, so she may be taking her queues from the fisheries.
Ways to overcome barriers	Writing letters to environmental ministers and decision-makers, in addition to identifying more individuals that can implement a NO-TAKE period at the government level. Creating a united voice amongst many stakeholders will demonstrate to officials and fisheries that many organisations believe that a NO-TAKE period is significant. Have dedicated resources in terms of education and also enforcing rules and making them clear. Recognising all stakeholders, including those not involved with the conversation, and their respective priorities will be necessary for negotiation. It's not about outlawing spider crab fishing, it's about protecting the Rye Pier. This argument could make it easier to negotiate with the VFA. Finding common ground ways to negotiate with fisheries will allow for change to occur.
Potential Steps for For Future Collaboration	Letters have already been written to environmental ministers and fisheries from stakeholders, letter-writing and ongoing advocacy of the NO-TAKE period must continue. Continuing group meetings and creating a collective voice is the most effective strategy for creating a NO-TAKE period.

Table 6, displayed below, shows workshop results related to discussion around creating a series of nature based events in the Mornington Peninsula.

Table 6: Creating a Series of Nature-based Events

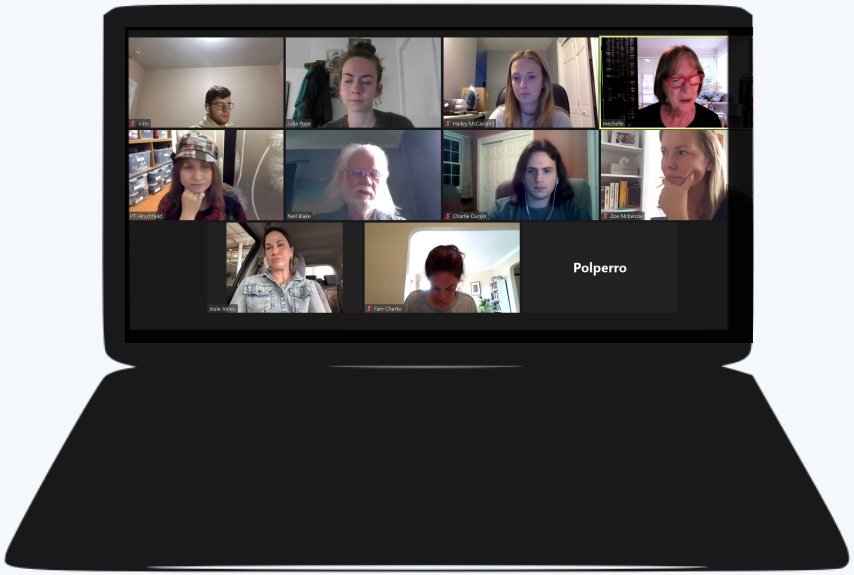
Solution	A nature based celebration or event to educate people about the Bay and crabs.
Barriers	A single celebration for spider crab aggregation isn't a good approach because sometimes the crabs naturally aggregate to other areas and it focuses on only one part of Port Phillip Bay's ecosystem. Lack of unison and clarity as to what events will be part of the series. Organisation will be necessary. These crabs are aggregated around very small areas of the bay. If everyone's crowded around there, there could be a safety concern (especially sting rays). In terms of crowding, viewing from a boat might be ok, but the number of vesicles could be constrained by the area in which the spider crabs show up. Budgeting and obtaining funding. Gaining permits and local approval.
Ways to overcome barriers	There's a large budget for eco-tourism That could be used. Creating a unified group (like this workshop ground) and determining what other stakeholders can be involved will be important for making the nature based event series happen. Boat tours of spider crabs on a schedule to prevent crowding. Speaking with fisheries and determining how they could be involved.
Potential Steps for For Future Collaboration	Developing a unified planning group and interested organisations. Creating a series of activities and a schedule for the events. Drafting the framework and logistics of the events.

Table 7, displayed below, shows workshop results related to discussion around spider crab fishing related litter.

Table 7: Spider Crab Fishing Litter Results

Solutions Identified	Education -- showing pictures that display the magnitude of the effect that fishing litter has on the bay. Increased number of trash bins along the pier and around areas where fishing is common. Higher accountability for crabbers during the aggregation period.
Barriers	Having pier staff maintain trash receptacles and making sure that those bins aren't overflowing at all times.. Holding anglers accountable for properly disposing litter.
Potential Steps for For Future Collaboration	Identifying and starting conversations with individuals that can implement more trash bins by the pier. Bringing individuals together as a group. Obtaining funding to place more trash receptacles on the pier. Developing a strategy to communicate the effects of litter. Create a creative platform is impactful, similar to the Only Butts Campaign.

The issues paper (SM - T) was the primary deliverable of the project and can be used to educate others on the issue of spider crab fishing. Potential collaborators can also be found in the issues paper and through the stakeholder map.



Waste Management

According to the World Bank Group (2020), the rate of trash produced globally is accelerating and "expected to grow to 3.4 billion tonnes [annually] by 2050", a 70% increase from today. The councils in Victoria, Australia are constantly working to reduce the amount of litter on their streets (Staff, 2020). A recent higher demand for take-away food has led to a jump in single-use plastics, and in turn higher litter rates (Staff, 2020). Litter in Melbourne streets ends up in Port Phillip Bay carried there by surrounding rivers, reservoirs, and stormwater systems.

Currently, Melbourne has a well-established trash and recycling program, but with recent increases in waste production the city is challenged to keep up. Private contractors collect trash and recycling weekly from designated street bins. Still, problems arise. Confusing labeling and lack of awareness on proper recycling methods has led to a large amount of plastic ending up in landfills and dumps. The city is well aware of the ongoing littering issues it faces and is actively working to address the problem. The City of Melbourne has installed "almost 450 solar smart bins, 230 public bins, 2000 public litter bins, and 500 cigarette butt bins" around Metropolitan Victoria (City of Melbourne, 2020). Examples of the bins used are shown in Figures 11 through 13.

Figure 11: Solar Smart Bins (Hayes, 2017)

Figure 12: Public Bins (Vovchok, 2018)

Figure 13: Cigarette bins (McNicol, 2017)

Though this may seem adequate, it is not. The 3180 different bins, when divided by the Greater Melbourne area (9993 km^2), come out to fewer than one bin per square kilometer. M. Ross's new report from Sustainable Victoria (2020) estimated that 95% of plastic that ends up on the beaches of Port Phillip Bay comes through the city's stormwater system off the streets. This is likely caused by the collection bins constantly overflowing (Figure 14). A quick google search for Melbourne Street Bin will result in many images of Melbourne's trash cans. In many photos, garbage is scattered around the bin, some of which will wash into the storm drains. From which, this debris and uncollected trash can end up in Port Phillip Bay. D. Sulaeman (2018) states that trash disposed of in bodies of water leads to increased microplastic and chemical pollution. As the quality of water decreases, so does the health of those relying on it.

Figure 14: Overflowing bin (Binstrap, 2018)

Potential water pollution is just one of the consequences of poor waste disposal. Items meant for recycling ending up in landfills poses another (Taylor, 2019 & Murray-Atfield, 2019). Public recycling bins are often contaminated by non-recyclable waste. This results in batches of almost recyclable material being sent to landfills instead of processing centres.

In 2017, China updated its regulations concerning imported waste and allowable contamination levels. As Victoria previously exported most of its waste to China, this change caused massive backlogs resulting in warehouses packed with contaminated recycling and other garbage . As it turned out, Victorian waste contractors were secretly storing "tens of thousands of tonnes of waste in five warehouses in Melbourne's west … [and] large stockpiles stored in Adelaide and Hobart", depicted in Figure 15 (Oaten, 2019). As the problem grew, one contractor stopped picking up curbside waste and recycling in over 30 Victorian Councils. This results in the waste either being stored in a warehouse indefinitely or sent permanently to a landfill (Oaten, 2019).

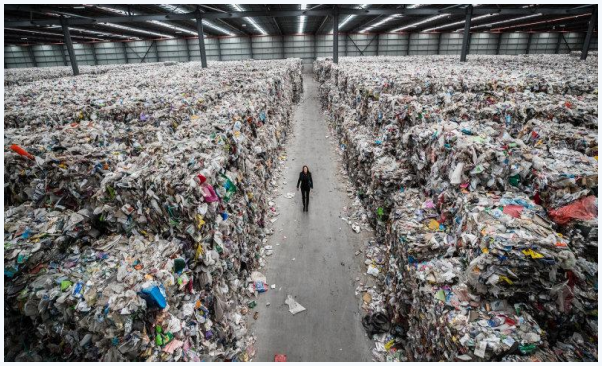


Figure 15. A warehouse in Victoria filled with compacted waste. (South, 2009)

The negative impact of landfills is not always visible to the public but it exists nonetheless. According to WorldBank (2020), 33% of all global waste ends in an open dump. Notorious for emitting greenhouse gasses, open dumps and treatment plants contributed to 5% of global greenhouse gas emissions in 2016. When left exposed to the environment, plastic breaks down into methane and ethylene, common greenhouse gasses, due to the high energy rays emitted by solar radiation (Swaters, 2018). Metropolitan Melbourne in 2017 reported that it recovered 103,844 pieces of plastic using the city's recycling program but landfilled 328,452 more, a 24% recovery rate (Sustainability Victoria, 2018). Sustainability Victoria defines recovered as being processed by a recycling plant instead of being sent to a landfill. The pie chart contained in Figure 16 shows that recyclable materials - including paper/cardboard, plastics, glass, and metals - made up 27.5% of all material in landfills.

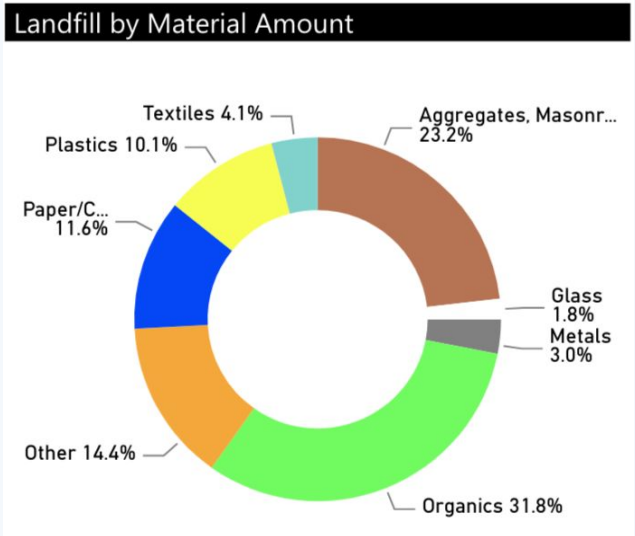


Figure 16. 2017 Metropolitan Melbourne landfill composition (Sustainability Victoria, 2018)

The same report projects 110,796 plastics recovered with 333,549 landfilled in 2021, improving slightly to a 25% recovery rate. Though Figure 17 may seem exactly the same as Figure 16, there are small differences. Figure 17 exists to show there is no predicted change of recyclable material composition in landfills between 2017 and 2021.

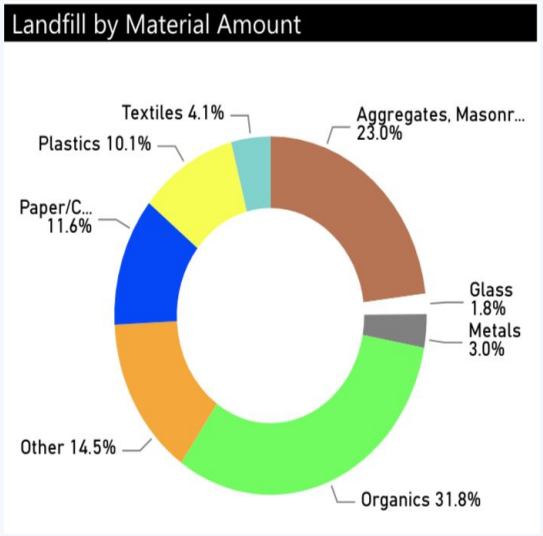
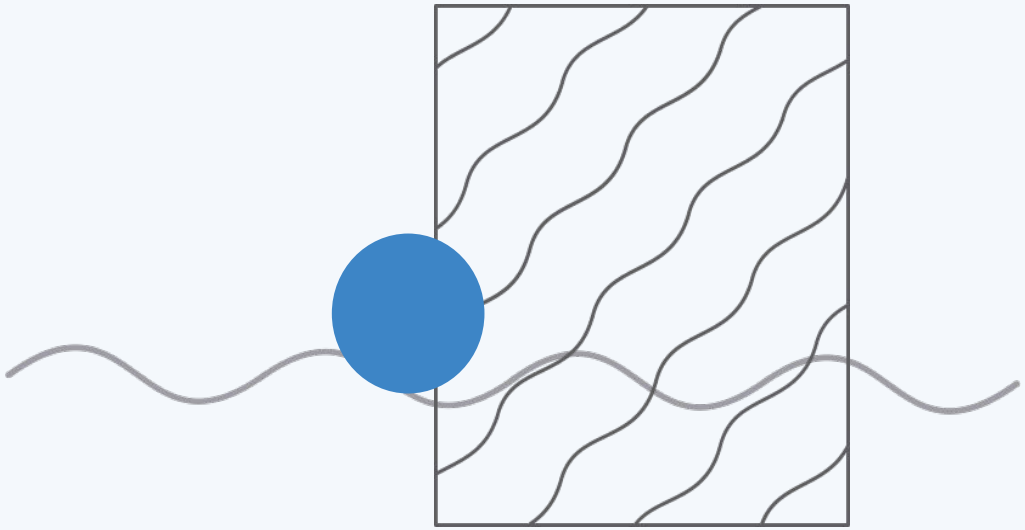


Figure 17. 2021 projected landfill composition (Sustainability Victoria, 2018)

Unfortunately, since Sustainability Victoria's report was completed before the warehouses of unprocessed waste were discovered, this projection likely overestimates the actual recovery rate. The immense backlog of waste left in warehouses is not included in the data used for the report, creating room for error (Oaten, 2019).

Figure 18. Sunshine Landfills. (Carol, 2020)



Stakeholder Research & Interview Results

After researching the issues Melbourne currently faces, we identified organizations and stakeholders with relevance to these issues. After researching them, a profile page for each of 10 different waste management stakeholders was created (SM - A). These profiles were referenced to develop the questions used in the interviews. Six of these stakeholders were interviewed further and invited to participate in a roundtable discussion. Table 8 references the stakeholder's current initiatives and any proposed solutions they offered in their interviews..

A lot of unique points were presented during the interviews. Table 9 provides snippets of interviews with information or viewpoints not found during background research.

Almost all the organizations agreed on a few general ideas; Australia needs to step up its recycling infrastructure, the general public needs to be held more responsible, and the best way to prevent future waste is to educate the youth on proper disposal policies.

Notes taken from the interviews were compared between each other (SM - H-L).

Across the interviews there were many common issues addressed by stakeholders and even fewer solutions offered. After analyzing the interviews separately, four different discussion points were decided on for the roundtable, shown in Table 10.

Table 8: Stakeholder Initiatives

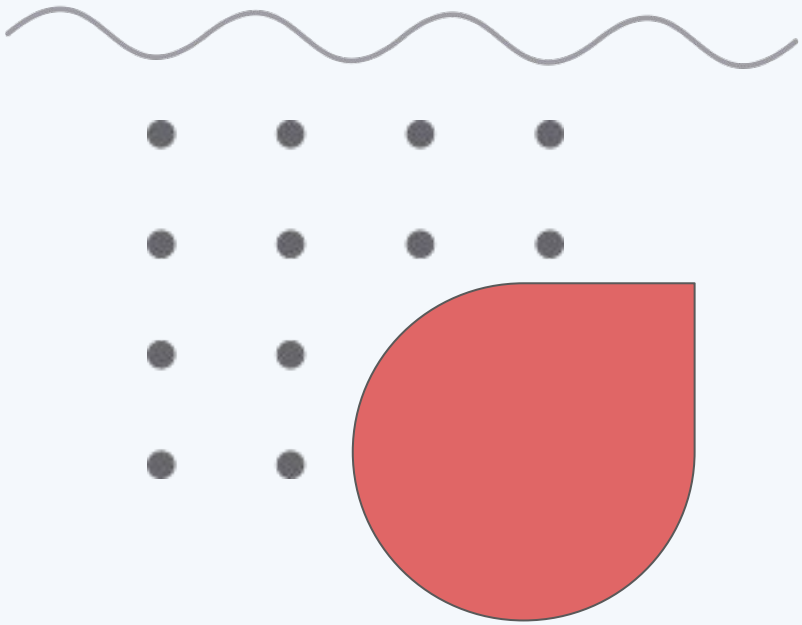
Organization	Current Initiatives	Proposed Solutions
Bayside City Council	• Educating the youth around Victoria on proper policies and techniques to follow when disposing of waste	•
Fieldtech Solutions	• Fieldtech Solutions makes a wide range of biodegradable plastic products including nitrile gloves and well caps.	• Using biodegradable plastics would allow for the plastics sent to landfills to break down over time
Beach Patrol	• Volunteers work one hour a month by walking their local beach picking up litter.	• Manufacturers need to generate plans accounting for the waste they generate • A plastic tax that would have some effect on manufacturers production • The upcoming container deposit scheme Victoria
Cleanaway	• Programs run by Cleanaway engage the kids with games and activities to teach the policies upheld by their council • Using their system called "Bin Tagging", Cleanaway can track people who are repeat contamination offenders • Using social media to increase public outreach	• Continued teaching of workshops at the local schools about proper waste management • An increase in manufacturer accountability by implementing labels with directions on proper disposal
Wormlovers	• Sells worm farming systems for the average Melbourne citizen • Teaches programs educating on composting organic waste	•
Newtecpoly	• Melting down the plastics and recasting the mixed polymer as secondary materials • Working to include semi contaminated waste into recycling streams	• Recycled materials made into plastic modeled park benches or plastic bricks used for affordable building materials
Metropolitan Waste and Resource Recovery Group	•	• Research in organic material fields to identify what would decompose into greenhouse gasses when sent to landfills

Table 9: Interview Data

Organization	Interview Snippet
Bayside City Council	• From last October to this October litter amounts around Metropolitan Victoria has increased 240% while recycling amounts have gone up 100% • Councils around Victoria are seeking a better alternative to landfills because they are simply running out of space for landfills to grow • Littering penalties and fines in Victoria aren't enforced as hard as they should be
Fieldtech Solutions	• Plastic can only be recycled once or twice before it was rendered useless (Pigtail Economy) • Most plastics break up, and scatter into the environment to keep breaking up, whereas biodegradable plastics break down
Beach Patrol	• A majority of litter picked up, excluding cigarette butts, is from packaging and similarly used materials
Cleanaway	• Solving bin contamination can reduce of fire hazards in storage warehouses and increase recycling rates • Using their bin-blitz and tagging system, Cleanaway presents a 30% curbside waste contamination decrease.
Wormlovers	• When people compost at home recycling rates go up and landfill rates slow down.
Newtecpoly	• Newtecpoly is one of a few companies that can recycle cigarette butts, but they don't stop there. Drums with slight oil residue, hay bale wrappings, grain bags and many other single use plastics can now be recycled
Metropolitan Waste and Resource Recovery Group	• It's actually a large population that litters *some of the time* rather than a small population that litters *all of the time*. • Most litter occurs within 5 meters of a bin.

Table 10: Interview Takeaways

Youth Education	Public Bin Standardization
Landfill and Plastic Related Issues	Creating a Separate Glass Stream



"We need more rapid change than minimum participation [from the general public] can offer" - Stan Vermeeren, Metropolitan Waste and Resource Recovery Group

Roundtable Discussion Results

The roundtable workshop hosted six different organizations, the participants are included in Table 11. A full discussion transcript, and analyzed roundtable notes are available for viewing (SM - M-N)

From the workshop, our team was able to split the determined solutions into subcategories, depicted in Table 12. These categories were used to organize the responses of different stakeholders within each talking point.

Table 11: Workshop Participants

Organization	Participants
Port Phillip Bay EcoCentre	Neil Blake, Fam Charko, Cecile van der Burgh
Bayside City Council	Julian Donlen
Cleanaway	Olivia O'Neil
Fieldtech Solutions / Beach Patrol	Ross Headifen
Newtecpoly	Peter Barker
Wormlovers	Richard Thomas

Table 12: Roundtable Analysis Categories

Issues
Broad solutions to issues
Barriers to these solutions
Strategies to overcome these barriers / Current plans

Solution: Increased Youth Education

Increased youth education through workshops and interactive lessons will, in time, result in higher recycling rates. The stakeholders spoke on educating children and the positive impacts youth workshops had on the public. A lot of stakeholders believe that teaching young people about environmental health can be the most effective plan for a cleaner environment.

General Issues and Solutions

Within the workshop, the only issue found was presented by Richard Thomas. Thomas mentioned the financial burden that came with performing workshops and noted that it discourages a lot of small businesses. With the government not providing funding, small businesses have trouble budgeting time and funds towards educational programs for the public.

In response to funding problems, Julian Donlen mentioned an old incentive provided to recycling companies when they accepted contracts with the councils to facilitate workshops for schools. He claimed this came to an end after councils stopped getting paid for their collected recycling just a few years ago. Revival of this program would increase exposure and give funding to more potential workshops. To this, Richard proposed that they continue having lots of workshops, but post the workshop materials and notes online for people to use for free. This way teachers and parents could learn by themselves and educate their children without the organizations having to step in and teach.

One workshop opportunity involved people observing and collecting waste first hand. This shock factor can awaken people to the magnitude of the waste issues by providing them tangible evidence.

Neil Blake spoke about his work with the Scouts program in Melbourne and described having people see the amount of plastic being collected from the ocean first hand. Numbers and headlines read off a webpage or newspaper can easily be dismissed, but having waste recovered from the oceans and landfills presented to you is damning evidence. This has been proven to refocus non-believers of the current waste management crisis Victoria faces.

The final overall solution given was to have a newer EcoCentre program where people perform their own waste audit. This shows people their individual impact on the problem and can inspire them to pay closer attention to their waste habits.

These large, grand scheme solutions unfortunately came with problems that tended to barre their success or implementation.

Barriers and Respective Strategies

A first barrier was making sure appropriate waste management behaviors stick with children further in life. As people age their attitude towards waste behaviors shift and they value recycling less. One strategy proposed to address this was keeping bin lid colors consistent from the workshops children participate in to adult life, including commercial bins. By keeping bin colors consistent workshop lessons would have higher translation to real world applications.

Olivia O'Neil made the statement that adults are less habitual recyclers, she attributed this to a lack of recycling education in their curriculum as kids. Older generations were less likely to have experienced an environmental health workshop as it was less of a pressing issue when they were of age. One proposed solution to this came from Ross Headifen. He praised the plan Wales took: using social media to broadcast sustainable habits to its population. He said this would increase exposure to environmental issues and it could be aimed towards the demographics that lose interest in social issues.

One of the largest barriers workshops involved tracking program results. The EcoCentre pointed out that their programs haven't lasted long enough to see direct results from their efforts. Unfortunately, the only way to measure individual behavior change is by performing individual waste audits before and after a workshop, too big of an endeavor for most organizations. Instead, most councils perform large scale audits and track those statistics yearly. Thus, the direct impact of one workshop is blended with general population trends. This was not met with any direct strategies. These workshops have been proven effective in the past and though the exact degree of impact may not be known, it is clear they need to be continued.

Solution: Bin Standardization

Standardizing bins statewide will result in lower contamination rates of recyclable materials. Having one set of regulations and systems will eliminate the issue of citizens trying to remember different municipal policies.

General Issues and Solutions

Victoria faces increased contamination levels when people travel from council to council as different municipalities regulate their waste bins differently. Tourists and people visiting their friends in different towns have a hard time following their waste codes correctly. The solution proposed involved standardizing the public and residential bins across the entire state. This would create one set of regulations for the whole state of Victoria to follow.

Barriers and Their Solutions

Julian Donlen brought up the first barrier: some people aren't willing to learn new regulations. He began by noting that recreating the system would upset a lot of the general population who were accustomed to the old regulations. This could initially lead to increased bin contamination due to unfamiliarity with the new codes. The best strategies that the group managed to come up involved clearly labeling materials that can and can't go in above bins. Having certain items labeled as inappropriate for that bin could result in people taking extra time to consider what they're throwing away. The second solution was a call for the government to refinance a bin standardization infrastructure now, rather than later, and to back recycling very heavily. Though statewide standardization would be an expensive endeavor, the harm caused by the current system is more expensive long term.

Another barrier found is the diffusion of responsibility amongst citizens. Peter Barker and Fam Charko discussed how people hold themselves to a lower standard when they aren't home. Fam Charko mentioned that tourists living in Airbnb's have no connection to the land or local environment, so they don't dispose of waste properly. She added to this mentioning people simply don't care about what they throw away when they're pressed for time. She said that at train stations people just throw their waste into whatever bin is closest and rush off to their train. Peter Barker agreed and spoke about people not caring about littering if they're not home.

Peter Barker mentioned that it would be almost impossible to get a perfect solution and change everyone's habits overnight.

Instead, he said that it was more about removing barriers preventing people from recycling. He noted that even the smallest inconvenience can cause people not to take the necessary steps to dispose of waste properly. Thus the strategy to overcome diffusion of responsibility became making it easier to follow the respective regulations in high risk public areas.

Solution: Stop Plastics from Reaching Landfills

Movement away from landfills as a primary waste treatment option will open up opportunities for new recycling processes and result in higher recycling rates. There are greener alternative processes to landfills and favoring them will bring higher recycling rates.

General Issues and Solutions

When it came to discussing landfills and plastics there were a lot of issues brought up. The steps people are taking to prevent plastics from going to landfills end up half successful. The first possibility for this came from Julian Donlen when he mentioned that people are attempting to put plastics in roads. The group labeled this as another cosmetic solution. According to Fam, less than 10% of the material in roads can actually be plastic. But the main barrier with putting plastics into roads lies with a road's lifetime; what happens when the road is ripped up to be replaced? There was also little information on what happened when leaving plastic in a road open to the environment. Many theorized that it was still resulting in microplastic creation. Peter Barker said that a lot of people saw putting plastic in roads as another landfill. This solution is far from permanent, simply putting off dealing with the plastic until later. It is well known that plastic only decreases in quality as it ages and is repurposed.

Another solution discussed was for manufacturers to stop using plastics all together. Unfortunately plastic is too useful a material for this to be feasible. There seems to be no clear solution on changing manufacturers policies or self-awareness but one possible solution involved government intervention. As manufacturers follow federal regulations, it would be up to the federal government to enact a policy keeping manufacturers in place. A federal policy change around plastics could result in fewer produced plastics annually.

A final solution was implementing a plastic tax. This would be a tax on any manufacturers using nurdles, plastic microbeads, to cast their plastic products. Nurdles are notorious for escaping factories and spreading into nature, damaging the environment (Callander 2017). This solution aimed to increase manufacturer awareness on their environmental impact by cutting their profits if they choose to use microbeads as a raw material.

Barriers and Their Respective Solutions

The first barrier deals with the properties of plastic materials when recycling. Even the exciting polymer recycling from Newtecpoly doesn't offer a complete solution. As mentioned before the Pigtail Economy is a real barrier when it comes to effective recycling as plastics can't be repurposed infinitely. Creating secondary plastic products only pushes the issues back a few years. As Peter Barker said jokingly, "there are only so many park benches that can be made". He discussed how he was hopeful for product upcycling: recycling one, niche product into a more useful product.

Even though plastic cannot be efficiently recycled time and time again, it can be repurposed a few times for a greater purpose. Plastic forks, cigarette butts, and grain bags can be more than single use plastics. They can be upcycled to a helpful product rather than sitting in a dump to degrade. Ross Headifen agreed with Peter Barker, and noted how it was interesting how their organizations worked on similar issues. A strategy to overcome the Pigtail Economy involved using recycled plastics in non-damaging environments, prolonging their life.

A final barrier comes from trying to impose a tax on manufacturers. Currently there is a plastic tax in place, however, it only gets imposed on domestically produced microbeads. Thus, big time manufacturers import their nurdles and beads so as to get around their material being taxed. Because of this, incentives are not always helpful solutions: sometimes they aren't a better deal for the big organizations. The strategy to overcome this barrier was to keep a closer eye on manufacturers and revise the legislation to patch any loopholes.

Solution: Separated Glass Waste Stream

Isolating glass with its own waste stream will increase the quality of other recycled materials. Implementation of a glass only waste stream will remove glass, a contaminant, from other recycling streams.

General Issues and Solutions

Glass being recycled with general recycling is an issue itself. Glass, plastic, and paper/cardboard involve different recycling processes and cannot be recycled together without being considered contaminants. Similar to plastic, glass has to be melted and recast when recycled. However, glass melts at a much higher temperature than plastic. Thus when glass is mixed into a plastic waste stream - through improper sorting or as a contaminant - it damages the recycled material's integrity. An overall solution for this involves a completely isolated glass waste stream and processing plant. Fam Charko noted that the Netherlands have up to five separate waste streams, showing that it is possible to get a community to follow such guidelines.

Barriers and Their Respective Solutions

Unfortunately, when it comes to creating a circular economy, the general public and governments tend to lose interest. Currently, it seems the Victorian government is occupied elsewhere, and is not keen on fixing the glass contamination issue in the near future. Because of this, change is likely not going to happen without a major push from the general public. There is nothing stopping the government from making no changes from this day on. However, there is already a small scale solution being implemented in Victoria coming soon. The container deposit scheme Victoria greenlighted has already shown success in other Australian states. This will lead to increased retention rates of containers, resulting in higher recycling rates of glass, plastics, and aluminums.

Outcomes

From the research, interviews, and workshop done for this project, an issue paper has been created. This issue paper is intended to educate the reader on the message behind this project and its outcomes (SM - U). An excerpt can be seen on the following page. An interactive map was created to congregate all the stakeholders used for the interviews and workshops.

Figure 19: Waste Management Workshop

Waste Management Issue Paper

This paper outlines Port Phillip Bay EcoCentre and collaborator's perspectives on waste management issues affecting Port Phillip Bay and its environmental health.

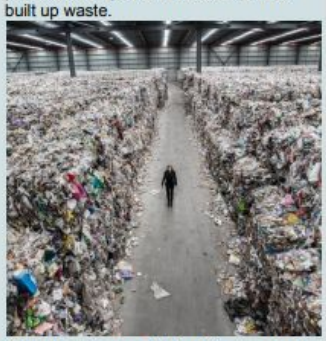
Background

Waste management issues in Melbourne, Victoria have been piling since the 1800's. Until 1850, the general population developed an "out of sight, out of mind" approach to dealing with garbage [1]. People were responsible for their own waste, leading to lots of unregulated dumping and littering. Due to a lack of waste regulations, Melbourne was considered the world's dirtiest city in the 19th century [1]. It was only when poor waste management led to more community problems that action was taken [2].

Today, Melbourne is working to clean up their waste. In 2017, China passed new legislation, updating regulations on imported waste and reducing the acceptable contamination level. As a result, Victorian treatment companies could no longer export waste to China and thus had no way of handling the waste generated by the community [3]. Melbourne now has to deal with thousands of tonnes of waste built up across several different warehouses [4]. On top of this backlog, municipal collection rates all but halted, leading to the majority of waste being sent to landfills instead of proper treatment centres [5]. Looking forward, Victorian waste production is estimated to rise 40% by 2046 from that in 2017-2018 [7].

Melbourne Warehouse

The image in the figure below offers a person in comparison to the amount of built up waste.



Warehouse completely filled by waste pallets [6]

Threat to Community and Bay Health

The issues Victoria faces surrounding waste management come from lack of public awareness and recycling contamination. Unfortunately, the two seem to work in tandem; when one problem gets worse, it develops new issues in the other.

The first issue in Victoria is the lack of accountability by individuals when in public. According to a study done by Sustainability Victoria, M. Ross claims there are 3180 different waste collection bins in Metropolitan Melbourne [9]. These bins can range from solar smart bins to cigarette

bins. Metropolitan Melbourne occupies 9,993 km^2, and if each bin is equidistant there is 1 bin to every 3 square kilometres. Without bins in high risk littering areas, littering only increases.

On top of this, the existing public bins around Melbourne tend to overflow with waste before they are collected. Litter and overflowing trash on the ground is often carried by stormwater systems into Port Phillip Bay, decreasing the water quality and polluting the bay [9]. An estimated 95% of litter on beaches is from urban areas and carried to the sea by stormwater [10].

During COVID19's regulations, these problems were amplified. There was both an increased generation of single use plastics and a decline in collection rates. Coffee shops not allowing the use of reusable cups and an increase in take away food led to significantly higher waste generation. The shutdown also prevented bins from being collected by the workers. Both factors only aggravated the existing problems with public bins.

The second issue Victoria faces is the contamination of recyclable materials. While there are plenty of treatment plants capable of recycling used plastics, recyclable materials are often sent to landfills. Recycling processes are designed to deal with isolated recycling but can tolerate minor contamination. Thus, improper waste disposal by citizens can lead to entire batches of recycling being sent to landfills.

Recycling sent to landfills does more than take up space. When plastics sit in open dumps they react with the sunlight to produce greenhouse gasses – methane and ethane. In 2016, open dumps globally contributed to 5% of all generated greenhouse gas [7].

Responsible Organizations

Our main contact was with the Port Phillip Bay EcoCentre. However, to understand the issues further, we completed background research on ten relevant waste management stakeholders around Victoria:

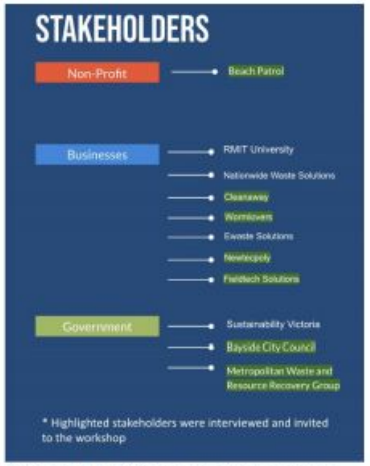


Figure 1: A list of researched stakeholders

Existing policy framework

There are currently several waste solutions being considered. Many organisations have been collaborating to solve smaller pieces of the larger problem. Recently, a new waste management act was proposed for Victoria, adding regulation and policies aimed at environmental protection.

Microplastics

Background

Microplastics are tiny pieces of plastic that are smaller than 5 mm (de Souza Machado, A., et al., 2017). They can be a result of the breaking up of larger plastic items, or directly manufactured in the form of nurdles for use in injection molding. Most microplastics in Port Phillip Bay began as litter on the streets that was washed into the Yarra and Maribyrnong rivers via the storm water systems. Microplastics are extremely harmful and difficult to remove from bodies of water because they cannot be seen by the naked eye. Because of the way in which plastic is produced, they often contain chemical residue on them, which poses a threat to the marine wildlife that often mistakes these floating particles for food.

Stakeholders

Through our research, we identified the following stakeholders as relevant to the microplastics issue: EPA Victoria, the Yarra Riverkeeper Alliance, Melbourne Water, Tangaroa Blue, BioGone, Scouts Victoria, the RMIT Plastics Lab, Love our Street, the Bellarine Catchment Network & Caring for out Bays, and the Department of Environment, Land, Water and Planning. Profiles on each of the stakeholders were created and added to the EcoCentre's interactive network map (SM - A). This is not an exhaustive list, but it does contain a mixture of non-profit, private, and government organizations.

Interview Results

Of the ten stakeholders we identified, four were available for an interview. The full notes for each interview are available for review (SM - O-R). Table 13 summarizes their past initiatives related to this issue and some future initiatives or potential solutions they were interested in. Commonalities are highlighted, with yellow denoting a focus on community education, blue a focus on legislation and green data collection.

Common Solutions

One major commonality among every stakeholder was an interest in engaging and educating the community, highlighted in yellow. Every stakeholder agreed that raising awareness of microplastic pollution is essential in order to change the public's buying and disposal habits. There was also common interest in engaging children specifically, as they are generally more receptive to implementing better plastic habits, and are likely to get their parents engaged in the issue as well.

Additionally, stakeholders agreed that legislation (based on limiting plastic production or incentivising alternatives) is essential for preventing more microplastics from getting into the environment moving forward, as highlighted in blue in the table.

Both Graeme Allinson of the Plastics Lab and Kimberly MacDonald of DELPW felt extensive data on the issue is critical for persuasion, points highlighted in green. There are already many research and citizen-science based groups collecting data, but better coordination is needed

Table 13: Current initiatives and common ideas across stakeholder organizations

Organization	Past / Present Initiatives	Future Goals
RMIT Plastics Lab (Graeme Allinson)	- Engaged students in the issue through the Plastics Lab (analysis of litter samples)	- Raising awareness, specifically among children
		- More research to persuade politicians to address the issue
		- Finding an alternative to single use plastic straws and similar products
Love our Street (Jill Sokol)	- Conducts volunteer-based litter audits to clean trash off the streets	- Getting more children involved and informed of the issue
		- Legislative change is essential to address the problem
DELWP / LitterWatch (Kimberly MacDonald)	- Created a central database so that all litter-related data can be organized in the same place	- Education and networking is critical
		- Collecting more data is essential for telling the whole story
		- A circular-economy structure needs to me implemented
Tangaroa Blue (Heidi Tait)	- Operation Clean Sweep: Working to eliminate plastic resin pellets, or “nurdles”, used in manufacturing	- Legislation is important
		- Educating the community is essential

Focus Groups

Kimberly MacDonald of DELWP was unavailable when we conducted our focus groups, but Graeme Allinson and Jill Sokol attended, as did Carmen Torraca from Tangaroa Blue. The full notes from the focus group are available to the public (SM - S).

Key Problems

The biggest contributor to plastic and microplastic pollution that the stakeholders all identified was single use plastics, particularly cigarette butts. Many people are unaware that the filters in cigarettes are made from plastic, and they simply discard the butts wherever they choose. Additionally, Jill Sokol said that plastic drink cups are commonly found during litter audits, and their numbers have only increased during the pandemic, as many restaurants will not allow people to bring in their own cups.

Another concern was in regards to the use of oxo-degradable plastics, and the misleading advertising that often comes with them, something that we did not have time to discuss in detail during individual interviews. Fam Charko observed that there are many very strict regulations that must be met if a company wants to label their food as “organic”. No such regulations exist when it comes to plastic products that are supposedly biodegradable, meaning that companies can advertise their products as being environmentally friendly, when in fact they are not.

During the focus groups the stakeholders brainstormed solutions, barriers, and ways to overcome those barriers for these two issues. The results can be found in Tables 14 and 15

Table 14: Limiting the Production of Single-Use Plastics

Solutions Identified	• Pushing for legislation limiting the use of plastics in manufacturing and/or incentivising the use of environmentally-friendly alternatives. • Organizing an event where different projects studying microplastic pollution in the bay can present their results • Creating some form of umbrella organization consisting of many stakeholders to more effectively lobby for legislative change
Barriers	• Pushing for legislation is difficult as a smaller organization. A more unified approach among different stakeholders is needed in order to have their voices heard • Most of the stakeholders involved are non-profit, and therefore do not have the resources to organize a large collaboration of the magnitude necessary
Ways to Address Barriers	• An umbrella group could be based around a council system so that the burdens and responsibilities can be spread among the different participants

Table 15: Limiting Oxo-degradable Plastics

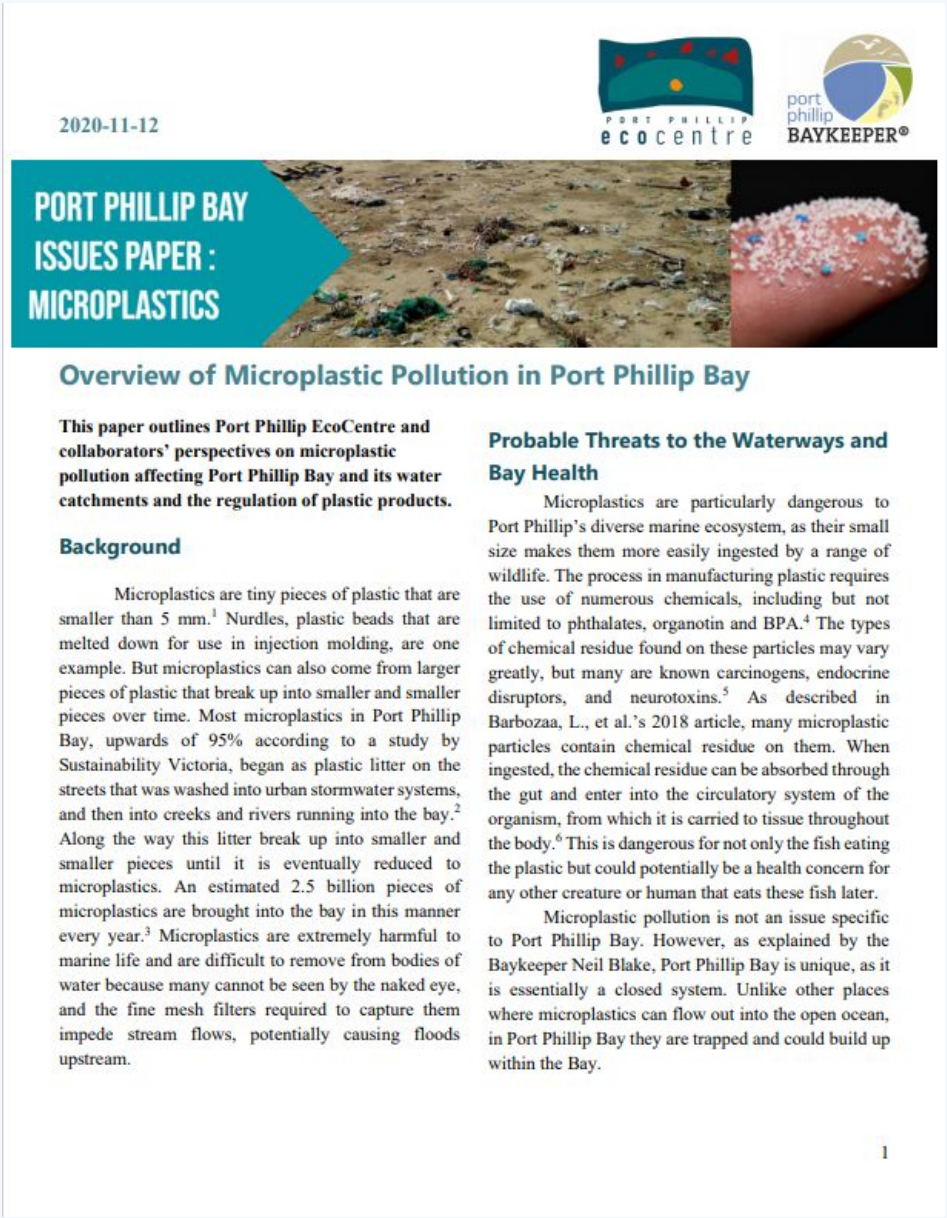
Solutions Identified	• More research needs to be done in order to convince lawmakers to impose regulations on oxo-degradable plastics and similar products
Barriers	• Researching oxo-degradable plastics is difficult, as doing so may require that the sample be destroyed in the process
Ways to Address Barriers	• More time and research could yield more effective ways of studying the plastics

Results

The hope is that this focus group will act as a first step towards a larger collaboration between stakeholders, and that these types of meetings will continue without our group facilitating them. Of the ideas proposed during the focus group, organizing a workshop that allows different projects around the bay to share their results is a good shorter-term goal, as it can be kept to a relatively small scale depending on the resources available. Organizing an extensive umbrella group to try and push legislation is much more long term, as it required a lot of preparation and resources.

Deliverables

All of the information collected on this issue has been condensed into a four page issue paper (SM - V). An excerpt from this paper can be seen on the right.



2020-11-12

PORT PHILLIP BAY ISSUES PAPER : MICROPLASTICS

Overview of Microplastic Pollution in Port Phillip Bay

This paper outlines Port Phillip EcoCentre and collaborators' perspectives on microplastic pollution affecting Port Phillip Bay and its water catchments and the regulation of plastic products.

Background

Microplastics are tiny pieces of plastic that are smaller than 5 mm.[1] Nurdles, plastic beads that are melted down for use in injection molding, are one example. But microplastics can also come from larger pieces of plastic that break up into smaller and smaller pieces over time. Most microplastics in Port Phillip Bay, upwards of 95% according to a study by Sustainability Victoria, began as plastic litter on the streets that was washed into urban stormwater systems, and then into creeks and rivers running into the bay.[2] Along the way this litter break up into smaller and smaller pieces until it is eventually reduced to microplastics. An estimated 2.5 billion pieces of microplastics are brought into the bay in this manner every year.[3] Microplastics are extremely harmful to marine life and are difficult to remove from bodies of water because many cannot be seen by the naked eye, and the fine mesh filters required to capture them impede stream flows, potentially causing floods upstream.

Probable Threats to the Waterways and Bay Health

Microplastics are particularly dangerous to Port Phillip's diverse marine ecosystem, as their small size makes them more easily ingested by a range of wildlife. The process in manufacturing plastic requires the use of numerous chemicals, including but not limited to phthalates, organotin and BPA.[4] The types of chemical residue found on these particles may vary greatly, but many are known carcinogens, endocrine disruptors, and neurotoxins.[5] As described in Barbozaa, L., et al.'s 2018 article, many microplastic particles contain chemical residue on them. When ingested, the chemical residue can be absorbed through the gut and enter into the circulatory system of the organism, from which it is carried to tissue throughout the body.[6] This is dangerous for not only the fish eating the plastic but could potentially be a health concern for any other creature or human that eats these fish later.

Microplastic pollution is not an issue specific to Port Phillip Bay. However, as explained by the Baykeeper Neil Blake, Port Phillip Bay is unique, as it is essentially a closed system. Unlike other places where microplastics can flow out into the open ocean, in Port Phillip Bay they are trapped and could build up within the Bay.

1

Conclusion

A key finding of our project is the need for Stakeholder unity and communication. The issues we addressed in this project are complex and large, requiring organization and careful planning of next steps towards feasible solutions that will make a long-term difference. The workshops held at the end of this project were effective in identifying next steps, including writing to environmental ministers regarding the spider crab issue, creating initiatives to halt microplastic creation at its source, and educating Australian youth on the impacts of litter. [HLD1] The issues papers created during this project can be used to educate a broader audience on the severity of these issues in Port Phillip Bay and some of the initiatives underway to address those issues. They can also provide a useful reference for the future Baykeeper. Ongoing trust and communication among multiple sectors are the only way to develop solutions. We hope our work will be a catalyst for an ongoing dialogue involving the EcoCentre and its partners.

References

Barbozaa, L., Vethaakd, A., Lavorantea, B., Lundebye, A., Guilherminoa, L. (2018) *Marine microplastic debris: An emerging issue for food security, food safety and human health*. Marine Pollution Bulletin.

BinStrap. (2018). Overflowing Bin [Digital image]. Retrieved December 11, 2020, from https://twitter.com/BinStrap/status/1213804723448504323

Callander, L. (2017) *Beach advocates shocked at 'worst case' nurdle plastics pollution at Rye Beach. Herald Sun.* https://www.heraldsun.com.au/leader/south-east/beach-advocates-shocked-at-worst-case-nurdle-plastics-pollution-at-rye-beach/news-story/e20f583e3c0b8bb8d14ad54dc6d066e0

Carol, N. (2020, February 27). [Residents living above Melbourne's Sunshine Landfills potentially leaking toxic gas]. Retrieved October 06, 2020, from https://images.s.7news.com.au/publication/C-720854/7a9be09f424a86c1127236c0a7c60e32046c79df-16x9-x0y220w2121h1193.jpg?imwidth=828&impolicy=sevennews_v2

City of Melbourne. (2020). Reducing litter. Retrieved December 07, 2020, from https://www.melbourne.vic.gov.au/residents/home-neighbourhood/Pages/reducing-litter.aspx

Charko, F. (2018, May 23). *Litter Hotspots: Turn off the Tap!* Retrieved September 17, 2020, from https://ecocentre.com/litterhotspots

Dentch, P., Lombardo S., Morrison S., Shedd N., . (2020). *Encouraging Strategic Collaborations around Port Phillip Bay.*

de Souza Machado, A., et al. (2017). *Microplastics as an emerging threat to terrestrial ecosystems*. Wiley Global Change Biology.

EcoCentre. (2019, June 06). *Baykeeper Impacts*. Retrieved September 17, 2020, from https://www.ecocentre.com.au/baykeeperimpact

Editors of Encyclopaedia Britannica. (2017, March 10). Port Phillip Bay. Retrieved September 17, 2020, from https://www.britannica.com/place/Port-Phillip-Bay

Hayes, L. (2017). [Solar Smart Bins]. Retrieved October 06, 2020, from https://thebeast.com.au/wp-content/uploads/2016/12/jan17-enviro-3_00x200.jpg

Marris, S. (n.d.). *Sheree Marris freediving with the Giant Spider Crabs.* [Photograph found in The Scuba Doctor]. Retrieved from https://www.scubadoctor.com.au/spider-crabs-melbourne.htm

McNicol, E. (2017). Cigarette Butt Bin [Digital image]. Retrieved December 11, 2020, from http://thecityjournal.net/environment/cigarette-butts-polluting-melbournes-waterways/

Murray-Atfield, Y. (2019, July 19). *A huge amount of recyclables will go into landfill if we collapse, embattled recycler warns.* Retrieved September 18, 2020, from https://www.abc.net.au/news/2019-07-19/skm-recycling-warns-of-landfill-crisis-if-it-goes-under/11324116

Oaten, J. (2019, August 21). *Plans to revive SKM plants to ease Victoria's waste crisis.* Retrieved September 18, 2020, from https://www.abc.net.au/news/2019-08-21/skm-recycling-enters-receivership/11433932

[Photograph found in ABC, The NewDaily]. (2019, June 30). Retrieved from https://thenewdaily.com.au/news/state/vic/2019/06/30/spider-crab-slaughter-port-phillip/

References

Port Phillip Bay Marine Life. (n.d.). *Port Phillip Bay Taxonomy Toolkit*. Retrieved September 17, 2020, from https://portphillipmarinelife.net.au/identify

Staff, V. (2020, September 04). Victoria combats trash on city streets with zero waste stations. Retrieved October 06, 2020, from https://www.vicnews.com/news/victoria-combats-trash-on-city-streets-with-zero-waste-stations/

South, J. (2019). *A warehouse in Victoria filled with compacted trash from SKM.* [Photograph]. Melbourne.

Staufenberg, J. (2016, June 17). *Thousands of giant spider crabs gather in Australian port*. Retrieved September 17, 2020, From https://www.independent.co.uk/news/world/australasia/giant-spider-crabs-gather-their-thousands-melbourne-port-a7087281.html

Sulaeman, D. (2018). *We apologize for the inconvenience...* Retrieved September 18, 2020, from https://iopscience.iop.org/article/10.1088/1755-1315/148/1/012028/pdf

Sustainability Victoria. (2018). Waste projection model. Retrieved October 06, 2020, from https://www.sustainability.vic.gov.au/Government/Victorian-Waste-data-portal/Interactive-waste-data-mapping/Waste-projection-model

Swaters. (2018, October 08). New Study Shows Plastics Release Greenhouse Gases, Contributing to Climate Change. Retrieved October 06, 2020, from https://www.surfrider.org/coastal-blog/entry/new-study-shows-plastic-as-source-of-greenhouse-gases-potentially-contribut

Taylor, J., & Butler, B. (2019, August 02). SKM to be wound up and 280,000 tonnes of recycling could end up in landfill. Retrieved October 06, 2020, from https://www.theguardian.com/environment/2019/aug/02/skm-to-be-wound-up-and-280000-tonnes-of-recycling-could-end-up-in-landfill

Victorian Fisheries Authority. (2020, June 23). *Giant Spider Crabs.* Retrieved September 17, 2020, from https://vfa.vic.gov.au/science-in-fisheries/spidercrabs

Victorian Fisheries Authority. (2018, November 26). Retrieved October 5, 2020 from https://vfa.vic.gov.au/about

Vovchok, V. (2018). [Public Litter Bins]. Retrieved 2020, from https://i.pinimg.com/originals/1a/f9/67/1af96796a56b0a9b28d4e78da5dbb18d.jpg

WorldBank. (2020). *WHAT A WASTE 2.0.* Retrieved September 17, 2020, from http://datatopics.worldbank.org/what-a-waste/trends_in_solid_waste_management.html

Bios

Julia Pope is an Architectural Engineering student at Worcester Polytechnic Institute, with a concentration in Mechanical Design. On campus, Julia is President of WPI's Architectural Engineering Institute. She is passionate about climate responsive buildings and energy optimization. In her free time, she can be found drawing, running, or drinking iced coffee.

Charlie Dursin is studying Mechanical Engineering at Worcester Polytechnic Institute. He has a passion for 3D design and manufacturing, as well as writing. He has a lot of experience with various CAD softwares, and hopes to one day become and engineer so put these skills into practice. In his free time he enjoys making content about movies and video games on the internet.

Hailey McCasland is a Biomedical Engineering student at Worcester Polytechnic Institute. She is also a member of the softball team. Hailey is passionate about animals and hopes to use her engineering degree to develop ways to help those in need. In her free time she can be found spending time with her dogs, her friends, and family.

John Laukaitis is a Chemical Engineering student at Worcester Polytechnic Institute. He is always willing to lend a hand or give advice. John is an incredible public speaker and takes charge managing communications between our team, sponsor and stakeholders. John likes to go on hikes and dog walks in his free time.

A list of contributions has been created showing individual involvement (SM - Y).