Partnering with CERES Community Environment Park to Motivate Behavioural Change towards Whole-of-Water-Cycle Management

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Abstract

Melbourne, Australia frequently experiences water shortages and is just recovering from the worst drought since colonization. Therefore, government officials in particular are interested in water-saving infrastructure and practices. Many technologies for water conservation are available to Melbournians, but have not been widely accepted or implemented. To address this issue, the Centre for Education and Research in Environmental Strategies (CERES) received a state-funded grant to update and display examples of water saving technologies and to motivate the public to change their water use behaviours in the face of impending shortages. In our project, we developed educational resources to suggest simple and achievable actions by residents to increase water conservation and to educate visitors about the water-related infrastructure that will be established or updated at CERES. Through interviews of both experts and staff members, surveys from visitors, and background research, we were able to develop designs for a suite of signs and webpages that CERES can use to motivate visitors to conserve water. Along with the mockups of six pairs of signs and webpages, we provided further recommendations to CERES regarding effective implementation of our content and designs.

Executive Summary

Australia is currently the driest inhabited continent on earth, with an average of only 600 millimetres of rainfall per year. With the projected increases in population and effects of global warming, the water shortages in Australia in general, and Melbourne in particular, are only predicted to grow more dire. Many technologies surrounding water conservation are available to Melbournians, but have not been widely accepted or implemented throughout the city. To address this dynamic, the Office of Living Victoria (OLV), a state agency tasked with creating an "integrated and resilient water system," is funding projects in which local communities plan, develop, implement, and showcase "solutions that take advantage of all available water for fit-for-purpose use." The Centre for Education and Research in Environmental Strategies (CERES), a not for profit urban farm and educational organization located in East Brunswick, Melbourne, recently received a grant from the OLV. CERES plans to use the grant funds to update and display examples of water saving technologies, as well as motivate visitors to change their water use behaviours in the face of impending shortages.

At CERES, the first phase of the OLV grant implementation aims to educate and motivate visitors to adopt water saving behaviours. Therefore, our project goal was to motivate CERES visitors to adopt new behaviours in regards to whole-of-water-cycle management by increasing awareness about the relevance, importance, benefits, and implementation of its more efficient strategies. Whole-of-water-cycle management, a term developed by the OLV, refers to policies which integrate urban development and all parts of the water cycle to create a sustainable water future

Methodology

We accomplished our goal by developing educational resources which describe the strategies employed by CERES and the manner in which they can be simply implemented at the individual level. In order to create these resources, we identified the following objectives:

- Determine best practices and examples for communicating whole-of-water-cycle management issues and motivating related behavioural changes;
- Determine current educational practices of the CERES Environmental Park and staff preferences for future whole-of-water-cycle management education resources;
- Gauge preferences of CERES park visitors regarding the content and presentation of educational resources;
- Develop content necessary for whole-of-water-cycle management education resources such as signage and web information;
- Test the efficacy of whole-of-water-cycle management signage mockups with visitors and staff at CERES and amend content based on feedback;

The data gained from the first three objectives, accomplished through site visits, interviews, and surveys, respectively, was combined with a review of relevant literature to determine criteria for the development of the project deliverables. These criteria, regarding content for the materials, effective behavioural change, design of signs, and constraints on the project, guided the creation

of our prototype sign and webpage. These prototypes were then tested via survey of the original interviewees and CERES visitors, and then altered based on feedback. At this point, the remainder of the suite of educational materials were developed for installation when the infrastructure they describe has been updated and the later phases of the OLV grant implementation are completed.

Results and Analysis

The information gained from background research, visitor surveys, staff interviews, and site visits was analysed and the key themes from each identified. These themes are summarized in the fourteen findings, listed below:

1. Content is most effective when relevant to the intended audience.
2. Content is most effective when it is not abrasive, pushy, or off-putting.
3. Content is more effective when simple and easy to understand.
4. Signs with a link to more information appeal to a wider variety of observers.
5. Behavioural change suggestions are effective only when specific, achievable, and individually applicable.
6. Behavioural change suggestions must effectively motivate, particularly by creating an emotional connection.
7. Behavioural change suggestions must effectively address barriers, particularly regarding cost.
8. Images are necessary and most effective when interspersed with text.
9. Photographs are the most preferred type of image, but only when fitting to the information conveyed.
10. Text is most appealing when limited, especially through the usage of bullets.
11. Text is most appealing when easy to read and organized.
12. The most visually appealing ratio of images to text is 1:1.
13. A suite of signs which has a cohesive nature is more effective and appealing.
14. A suite of signs describing a set number of WWCM projects is required by the OLV grant.

The above findings were categorized into content, behavioural change, design, and constraints, and are summarized in Table ES1.

	Element	Finding #(s)
Content	Relevant to CERES and Visitors	1
	Not Abrasive, Pushy, or Off-Putting	2
	Clear and Easy to Understand	3
	Links to More Information	4
Behavioural Change	Specific Solutions to Potential Barriers	5, 7
	Emotional Connections	6
Design	Use Appropriate Figures and Diagrams	9
	Limit Text	10
	Clear Fonts and Headings	11
	Present Text and Pictures Together	8, 12
Constraints	CERES Colour Pallet	13
	CERES Sign Shape	13
	CERES Font Designs	13
	Sign Topics	14

Table ES1: Finalized criteria table

With the above criteria in mind, the next step was to develop the prototypes of the first sign and webpage. We chose the stormwater system at CERES as the topic for the prototype. The initial design for the sign is shown in Figure ES1.

Figure ES1: Stormwater sign mockup

Through the period of testing the materials, feedback from visitors and staff identified several issues requiring modification. They are summarized in Table ES2.

Modification #	Modification Name	Alterations to Sign
1	Too busy	Gradient in background removed
		Extra colours were removed
		Colour coding of words was removed
		Extra text boxes were removed
2	Ineffective Pictures	Changed root zone filter image to clearer image
		Changed bird picture to more graphic image
3	Typos	Fixed spelling errors
4	Pictures too small	Decreased amount of text
		Increased size of pictures

Table ES2: Modifications to stormwater mockup

The finalized version of the prototype sign about the CERES stormwater system is displayed in Figure ES2.

Figure ES2: Finalized stormwater sign

After the prototype sign was completed, the remaining five signs in the suite and the accompanying webpages were completed using the criteria identified and the style chosen in the testing and refining period. The five remaining signs were related to water reuse, reticulated water conservation, rainwater collection, stormwater harvesting, and blackwater. By addressing these topics, the suite describes the most prominent WWCM techniques and describe the various systems in place at CERES.

Conclusions and Recommendations

At the project drew to a close, we developed several recommendations for CERES, both for the implementation of our deliverables and for future projects.

1. CERES should complete the OLV materials developed once additional details become available at the completion of the projects.
2. CERES should hire a graphic designer to update our designs.
3. CERES should print the OLV signs at an increased size.
4. CERES should install the suite of OLV signs at a decreased height and at a 45° angle to the ground.
5. CERES should create an unguided tour throughout the park to direct visitors to water related projects and the accompanying signage.
6. CERES should update its signage plan to more accurately reflect the preferences of both visitors and staff.
7. CERES should utilize our criteria for the development or upgrade of signage for other technologies, such as energy conserving or waste reduction infrastructure in the park.

8. CERES should have another student group analyzes the effectiveness of our designs.

Through the installation of our deliverables and completion of our recommendations, we leave CERES will tools to further advance not only their OLV grant implementation, but also their overarching goal of fostering sustainable behavior in their community. As the water supply in Melbourne becomes more limited, the resources left at CERES provide Australians with alternatives to ensure a sustainable water future for the coming generations.

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1.0 Introduction

Water is essential for the survival of all living things. Not only do we need water to drink, but it is also vital for the growth of the food we eat, the washing of the clothes we wear, and the sanitation of the communities we inhabit (Health, 2012). Despite the importance of water for survival, the supply of fresh water is limited and under constant pressure (World Health Organization, 2014). Although the need is not uniform, chronic water shortages mean that the annual global water usage is 150 km^3 beyond that which can be replaced by underground aquifers or rain (Schultz, 2014). Additionally, the need for water is constantly growing as global warming creates drier climates and the population of the earth expands (Water Scarcity and Global Warming, 2007). experts are projecting that if no changes in water usage are made water supplies globally will fail to meet demands in less than two decades, with some areas already experiencing shortages (Sandra, 1985).

In addition to chronic supply shortages, periodic droughts cause acute water shortages in some locations. Areas which experience the largest degree of chronic shortage, such as countries in sub-Saharan Africa and the Middle East, are particularly affected by droughts which further decrease the supply of fresh, potable water (Water Security Risk Index, 2010). Another continent especially affected by water shortages is Australia, as it is the driest inhabited continent on earth and has suffered six major droughts in the last 100 years (Howden, 2012). Furthermore, Australia has the least river water, lowest runoff, and smallest area of permanent wetlands of any continent on earth (Planning Institute of Australia, 2014). The most recent drought, the "Big Dry," persisted for at least ten years (2002-2012) and was the most severe drought since colonization in the 1700s (Cockfield, 2011).

To counter the threats from acute and chronic water shortages in Australia, local residents have changed behaviours and governments have enacted regulation to reduce water usage and increase efficiency. For example, the National Water Initiative (2006), recently reformed the federal regulation and management of Australia's water resources (Windram, 2009). On a smaller scale, state and local governments in Australia have updated their own programs for conserving water by instituting stricter restrictions on water usage and harsher penalties for violators. Across the continent, residents were encouraged to conserve water by installing rainwater tanks, using water efficient shower heads, and participating in other conservation techniques (Dolnicar & Hurlimann, 2010). These interventions, which are common in urbanized and developed countries, allowed Australia to survive the acute water shortage (Department of Environment and Primary Industries, 2014). After the crisis had passed, however, officials set out to reform water policy to prepare for future shortages. Particularly in Victoria, the government realized that water resources were not being used to their full potential, especially in urban environments.

In response, the Office of Living Victoria (OLV) was established to develop an action plan for large scale reform of urban water usage within the state (Living Victoria Ministerial Advisory Council, 2012). Under this plan, Melbourne's water strategies have been analysed for efficiency and environmental sustainability, and a variety of programs have been developed to protect the city from water shortages during future droughts (Slootweg, n.d.). In 2013, the OLV introduced a plan entitled Melbourne's Water Future, which aims to secure "an integrated and resilient water system to support liveable and sustainable communities, protect the environmental health of urban waterways and bays, provide secure water supplies efficiently, and protect public health and deliver affordable essential water services"(Office of Living Victoria, 2013, pg. 10). This program, designed around the principles of whole-of-water-cycle management, employs all

aspects of the water cycle and all parts of the community to develop effective water management plans. Whole-of-water-cycle management, more often known as integrated water cycle management, takes a holistic approach to water services and accounts for the long-term resilience, affordability, liveability, and environmental sustainability of all water use policies (Melbourne Water, n.d.g.). Melbourne's Water Future is a large supporter of innovative, community-based projects that promote water conservation through whole-of-water-cycle management principles. For example, Melbourne's Water Future supported the establishment of recycled water usage on local sporting grounds and the development of infrastructure to prevent high nutrient load run off in peri-urban farms (Office of Living Victoria, 2013).

Many analogous projects have been developed and implemented at the Centre for Education and Research into Environmental Strategies (CERES) in East Brunswick, Melbourne. CERES Community Environment Park is a not for profit organization which has rehabilitated 4 hectares of landfill to create an urban sustainability centre and is the largest deliverer of environmental education in Australia (CERES, 2012). Among many other environmental projects, CERES is committed to innovating sustainable solutions with regards to all aspects of whole-of-water-cycle management including water conservation, stormwater harvesting, and water reuse. Due to CERES's broad spectrum of projects and large influence, the organization has received a grant from the Office of Living Victoria, and has begun a two year long initiative to repair projects currently scattered throughout the park, install new water-conserving facilities, and develop educational programs to induce actions that aid in the securing of a stable water future for the community. An additional goal of CERES is to motivate behavioural changes with regards to water conservation. If all 350,000 yearly visitors became motivated to change their water use behaviour, technologies and education programs at CERES would improve the conditions the neighbouring city of Melbourne. However, 42% of visitors come merely to explore and leave without a specific pattern of behavioural change to implement in their daily lives (Neilson Surveys, 2014). This more casual audience provides an opportunity to improve CERES's methods for presenting information so as to be more efficacious in producing sustainable behavioural changes. In order for these educational resources to be engaging and motivating, they must contain more than mere factual information, as "campaigns that rely solely on providing information often have little or no effect upon behaviour" (McKenzie-Mohr & Smith, 1999, pg. 7). Instead, an emotional connection that promotes motivation to act is integral to the success of the water-project related signage and web information created in this project.

Therefore, our project goal was to motivate CERES visitors to adopt new behaviours involved with whole-of-water-cycle management by increasing awareness about the relevance, importance, benefits, and implementation of its more efficient strategies. This goal was accomplished through educational resources that describe the strategies employed by CERES and the manner in which they can be simply implemented at the individual level. Specifically, content was created to complete six signs which highlight the major goals of the whole-of-water management and are linked, via QR codes, to more extensive information on the CERES website. This material was developed based the best practices for communication of both whole-of-water-cycle management issues and emotional motivation for related behavioural changes. The preferences of the CERES staff and visitors were incorporated into this deliverable. In this way, our group sought to produce an engaging, informative, and motivating system of information, which sets an example for effective behavioural change surrounding environmental issues. Through this system, CERES larger goal of educating visitors that will be motivated towards positive environmental steps will be advanced.

2.0 Background

In this chapter, we begin broadly by examining the importance of water and the increasing trends of water shortages both globally, and specifically in Melbourne. We will then focus in on water management policy in these areas, including the government agencies that develop them and the strategies they support. Next, we will discuss CERES, the sponsoring agency for this project and their local role in exemplifying water sustainability. Finally, we will survey behaviour change theory and its relevant applications for environmental education at CERES.

2.1 General Importance of Water for life

Water is one of the most fundamental resources for the survival of all known life on planet earth. In fact, a region's biodiversity and biomass is directly correlated to the access and availability of fresh water; regions with a surplus of fresh water have large numbers and variety of flora and fauna while regions with a deficit do not (Wetlands International, 2010). This explains why, when looking for life on other planets, astronomers typically look for signs of water.

Although water is vital to human life, fresh, potable water is relatively scarce. As can be seen in Figure 1, although 71% of the planet is covered in water, only 2.5% of all water is fresh. Of that fresh water, only about 1% is accessible for direct human use (University of Michigan, 2006).
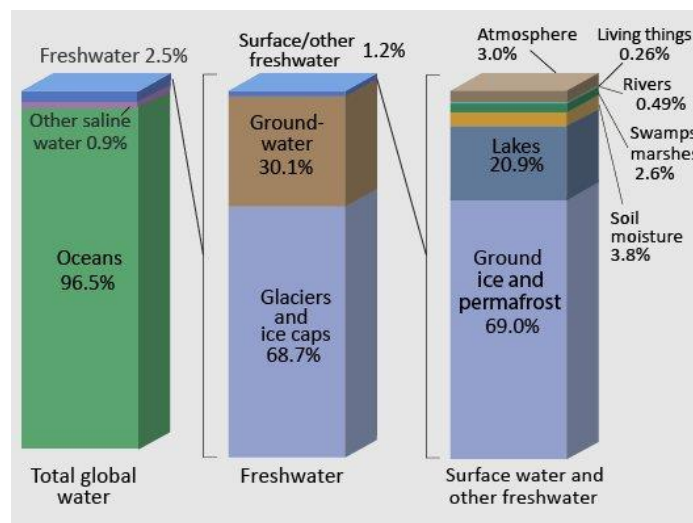
Figure 1: Water distribution on earth

Furthermore, water's fluidic properties allows it to readily pick up contaminants and escape quickly into the ground into waterways. Therefore, water that is naturally pure enough to be drinkable is an extremely scarce resource.

Humans, like many other life forms, require water for survival, prosperity, and privilege. While water is valuable in any form, pure, drinkable, freshwater is extremely valuable to our society and is one of the most cherished commodities, especially in drier climates. In addition to drinking, water is instrumental in many other facets of our existence and has allowed for the present status of the society.

2.1.1 Drinking Water

Probably the most obvious and direct connection humans have with elemental water is for drinking purposes. After all, humans can only survive for three days without drinking fresh water (Binns, 2012). Therefore, every population has its own way of accessing drinkable water. For example, most developed countries employ municipal departments that take charge of supplying drinkable water to residents. These departments often filter and disinfect raw water to ensure the health of the customer. On the other hand, residents of poorer countries may be forced to walk long distances to retrieve potentially contaminated water. Thus, humanitarian efforts have been made to allow residents of poorer nations to access drinkable water through education and aid (Barlow, Bozzo, & Clarke, 2008). No matter where one lives, the continuous need to be drinking water is a universal human condition. However, drinking is not enough; humans also need food for survival.

2.1.2 Growing Crops

While drinking water is directly responsible for our survival, 87% of all water usage around the globe is used in irrigation. While some of this irrigation is ultimately wasted, effective irrigation generally results in the production of crops, some of which are vital to global human needs (University of Michigan, 2006).

Farming has employed methods of irrigation since ancient times. Conclusively, the success of farming past and present has been largely dependent on effective irrigation. Any of our earliest ancestors that mastered the art of farming with irrigation had the ability to cease being hunter-gatherers. The practice of irrigation and agriculture allowed populations to grow, remain in one place, and become less susceptible to changes in weather, seasons, migrations, and supply (University of Michigan, 2006).

The modern model of irrigation and agriculture has evolved to provide enough food for the needs of our current global population of over 7 billion people. With over 5 billion metric tons of crops produced globally each year, our population has to use more water than ever to grow crops for our hungry population (United States Department of Agriculture, 2014). Crops may also go on to feed livestock, which in turn are used for meat, eggs, dairy, and clothing. In this light, it is obvious that water is critical for our wellbeing at a fundamental level. Water, however, does not always need to be used to eat or drink, it provides many other services and conveniences as well.

2.1.3 Public Sanitation and other Miscellaneous Uses

Humans are constantly discovering ever more creative ways to use water in our favour. In today's society, water has an exponential number of uses. We use water:
- In our toilets and showers as a mean of public sanitation and hygiene;
- To run hydroelectric plants to produce electrical energy;
- In electrolysis to produce hydrogen as a fuel and as a coolant for mechanical engines;
- For recreational sports such as fishing, sailing, kayaking, and surfing;
- In forced hot water systems for space heating of buildings in the winter;
- To grow and display fish in aquariums and aquaculture farms;

These are just a few examples of how water can be used directly and indirectly to provide a lot of the modern comforts and conveniences society enjoys today. Unfortunately, with a constantly growing global population, the demand for water and the various functions it provides keeps increasing, to the point some would call unsustainable (U.S. Census Bureau).

2.2 Shortage of Water around the Globe

With an ever expanding population and a finite supply of fresh water, many regions around the globe are experiencing water shortages. Water shortages can be caused for a multitude of reasons. Some regions have historically been dry, while others are becoming drier in recent times. Because of the importance of water, shortages of water are of major concern.

2.2.1 Causes of water shortages

Some regions of the earth, such as the Sahara Desert in Africa or the Arabian Desert in the Middle East, have been dry throughout modern history (Anitei, 2007). Although water is scarce in some of these regions, people have found ways to populate them using water management techniques. On the other hand, some regions that have been historically rich in water are becoming increasingly dry and are adopting the techniques employed in naturally drier regions. The reasons behind environmental shifts are speculative, but global warming, shifting weather patterns, and overuse due to overpopulation are three widely held causes (Brahic, 2007).

2.2.2 Water shortage in Australia and Australians' attitudes thereof

Australia, as the driest inhabited continent on earth, has reason to appreciate water shortages and the countermeasures that can be taken to ensure the survival and success of the population. With less than 600 millimetres of rain per year to meet the needs of 26 million people, the vast majority of the continent experiences the negative effects of water shortages on a continuous basis (Australian Bureau of Statistics, 2012). In fact, the most recent drought, the "Big Dry", lasted for an entire decade. Their constant state of water deficiency, along with periodic droughts has created certain attitudes among Australians about water management. To better understand these attitudes, a national study was conducted.

Probably the most fundamental finding of this recent Australian study on water conservation is that 93% of survey respondents believed that water is a scarce resource and must be carefully conserved (Dolnicar & Hurlimann, 2010). When asked what they believed the underlying causes of scarcity were, respondents stated that population growth was the main reason for water scarcity. To combat the water scarcity and embrace conservation, certain techniques, which are discussed in the following section, have been employed on a national scale.

While these techniques may be effective at conserving water, barriers exist that prevent wide scale acceptance. When asked what the most prominent barrier was for water conservation, the most frequently stated barrier, at 21% of respondents, was "the high expense of purchasing water saving devices." Of particular importance to our project, the study also found "provision of further information was identified as potentially beneficial, with 20% of respondents agreeing that they don't know enough about what they can do to save water" (Dolnicar & Hurlimann, 2010).

2.3 Water Conservation Efforts and Techniques in Australia

Water's shortage has given rise to many different conservation techniques and management methods in Australia. Populations that live in areas undergoing water shortages are forced to manage their water so that continued survival and prosperity is plausible. From a consumer's standpoint, there may also be many benefits to conserving water such as financial,

environmental, or moral. These water management techniques are varied but often fall under whole-of-water-cycle management.

2.3.1 Whole-of-Water Cycle Management (WWCM)

Whole-of-water-cycle management is a holistic term coined by the Office of Living Victoria (OLV) which is synonymous with the industry preferred term of integrated water cycle management (IWCM). "Whole-of-water-cycle management captures the idea that all parts of the water cycle and all parts of the community are intrinsically interconnected" (Office of Living Victoria). The main focus of WWCM is the intersection of urban development and the normal functions of the water cycle. A key component on the OLV plan is Water Sensitive Urban Design, which aims to minimize the impact of urban development and allow the water cycle to function as closely to its natural condition as possible. In this way, it is believed that WWCM will protect and improve the health of local waterways.

The OLV has traditionally defined five separate elements of the water cycle:
- water supply;
- wastewater;
- stormwater;
- river, creek, and stream management;
- greening our suburbs and managing our parks

"In practice, each of these elements is part of an interconnected system that spans multiple organisational, neighbourhood and regional boundaries." The management techniques that fall into each of these elements must be considered together to achieve the ultimate success of WWCM (Office of Living Victoria). Some of these management techniques (especially those relevant to this project and CERES) are discussed below.

2.3.2 Rainwater Harvesting

One type of water that can be harvested to supplement mains water supply is rainwater. According to Melbourne Water, "if rainwater tanks are used to water the garden there is the potential to reduce consumption of water from the reticulated (mains) supply by up to 20%." Rainwater is often one of the purest forms of fresh water and can be used for many different purposes. If a region experiences very infrequent rainfall, it is helpful to catch and retain any precipitation for future use (Rainwater Knowledge Centre, 2010). In this way, residents may store water that falls freely and use it without consequence. Therefore, they are not bound by the restrictive legislation concerning their infrequent rainfall and can store intermittent rainfall to use it in the future for a more consistent supply.

There are many different methods for harvesting rainwater. Often rainwater is captured on roofs and funnelled into large holding tanks, like the one in Figure 2, where it is held until needed.

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Figure 2: Rainwater storage tank at CERES

These holding tanks range in size based on consumer needs, but usually range from 100 to 25,000 gallons (Melbourne Water, n.d.f). Once the rainwater is needed, it can filtered and pressurized to supplement reticulated water supply or it can be used for auxiliary purposes, such as watering gardens, washing cars, and taking showers.

Residential consumers are mostly concerned with water of a high quality for their household needs. On the other hand, a golf course, for example, may be more concerned with volume and less concerned with purity. Dirty water may be unhealthy to drink for humans, but not for golf course grass. While rainwater is of extreme value, it may be more convenient or practical to capture the lower quality storm water, especially for agricultural, commercial, industrial, recreational, or municipal interests.

2.3.3 Stormwater Harvesting

Another type of water that can be harvested to reduce reticulated water demand is stormwater. If and when rainwater reaches the ground, it becomes stormwater (Melbourne Water, n.d.e). Often, stormwater becomes runoff and can be retained for future uses. Water's physical properties make it an excellent solvent, which means it easily picks up particulates. Therefore, stormwater is typically contaminated with soil, litter, and chemicals which make it unsafe to drink. These contaminants are dependent on many factors, including the type of surface the water contacts, the environment these surfaces are in, and the contaminants present. For example, stormwater that flows on a farm may carrying soil, fertilizer, and organic matter, while

stormwater that flows in a city may carry automotive chemicals and rubbish (Melbourne Water, n.d.e). Nevertheless, this does not mean that stormwater is invaluable.

Often, stormwater will be retained instead of rainwater because its collection can be done more easily and on a larger scale. While convenience of collection renders a trade-off in purity, this may not be a concern if the stormwater is ultimately used for some process that does not require purity or even prefers impurity, like irrigation (Melbourne Water, n.d.e). For example, urban runoff is easily utilized because it is incidentally captured and funnelled by a city's impervious infrastructure, such as roads and sidewalks. Conversely, rainwater is often intermittent and requires clean capturing surfaces to maintain its purity. Urban runoff is more impure than rainwater, but it is still worth capturing because it may be suitable for other uses where purity is not of utmost importance, such as flushing toilets. Stormwater can be collected in numerous ways including retention ponds, urban drainage, and tankage. Figure 3 displays a typical urban water drainage site, polluted with various debris, in the Central Business District of Melbourne.

Figure 3: Stormwater drain in Melbourne, AU

2.3.4 Water Reuse

Another important method for water management is water reuse. Reused water is defined as water that has already been used for some purpose and is used again for another purpose, without intermediate treatment. Often the quality of water is degraded after its first use, but it can sometimes be used subsequently in a situation that does not require high quality water. In this way, theoretically, water can go from being of pure quality to completely unusable in a sequential manner, being used for valuable purposes along the quality ladder. This concept of water reuse is summarized in Figure 4.
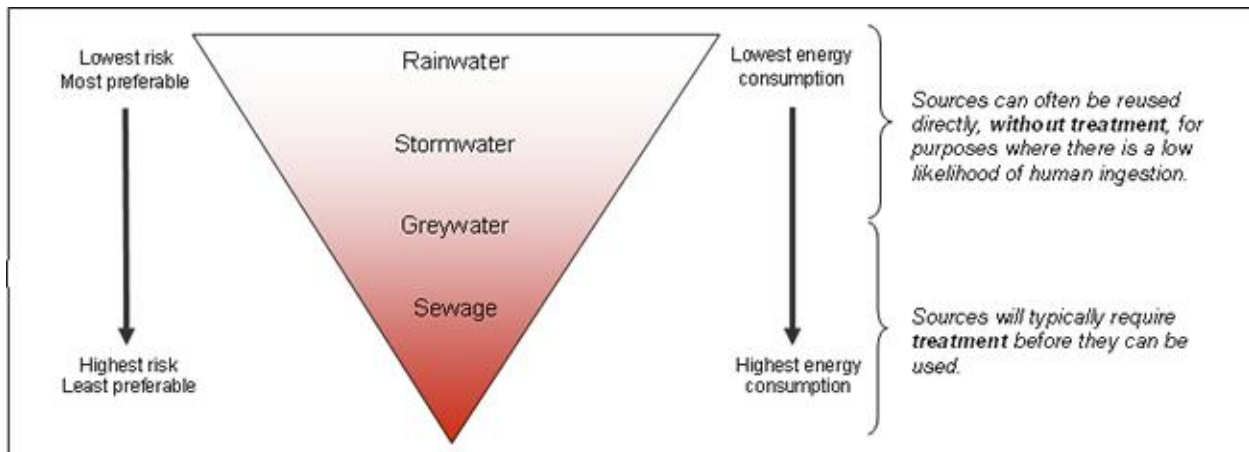
Figure 4: Water reuse hierarchy

For example, drinking water can be used to wash hands. After hand washing, water is qualified as greywater. Greywater can then be used appropriately for a toilet. After it is used in a toilet, it becomes black water. Blackwater is generally considered unusable (EPA Victoria).

2.3.5 Water Usage Reduction

To conserve water, one remedy may be simply using less of it such that combined usage matches or is less than supply. This can be accomplished through technological alternatives to traditional devices such as dual flush toilets or low flow shower heads. In addition, water usage reduction can also be accomplished through simple changes in every day behaviour, such as encouraging people to brush their teeth without running the sink. Both are effective means at reducing water usage, especially in the residential sector (EPA Victoria, n.d.).

Typically, technological solutions will have only an initial cost, one time installation, and no ongoing drawbacks for the consumer (McKenzie-Mohr & Smith, 1999). They are simple solutions meant to conveniently reduce water usage without major negative impacts on the consumer. For example, a trigger nozzle on a garden hose uses less volume overall than without one, but still allows the consumer to sufficiently water their garden. These devices are usually designed by engineers, and then sold by privatized companies (McKenzie-Mohr & Smith, 1999).

Simple changes in current behaviours are less concrete than physical remedies, but equally important. In fact, these less technological solutions are more appropriate in certain situations because they are the only option, can be applied instantly with no cost, or are more practical for consumers. For example, when a consumer simply decides to shower for 10 minutes instead of the usual 20 minutes, water is conserved. This achieves a similar result as if a low flow showerhead was installed, but it does not require the consumer to physically purchase and then install something. This is just one example, but the key is to educate consumers about the best behaviours they can have to reduce water usage.

Sometimes there are barriers to acceptance of these alternative behaviours and gadgets, so the key to wide scale acceptance is entails outweighing barriers with benefits through marketing programs.

2.3.6 Water Recycling

Finally, another water management method is water recycling. Often, water of a lower quality can be filtered, distilled, or disinfected to make it of a higher quality. In this way, water can theoretically be continuously used in a closed loop system where high quality water is used, becomes low quality, is filtered, becomes high quality again, and goes through the cycle again. Because it usually requires the input of time, effort, or energy, water recycling usually only conditions water to an acceptable quality for its next intended use (EPA Victoria, n.d.). While water recycling is key to water management techniques, it is often more inconvenient or impractical than methods mentioned above. However, recycled water is used within Melbourne, but is often clearly demarcated with a sign such as the one seen in Figure 5.

Figure 5: Sign indicating usage of recycled water

2.4 Water Policy in Victoria and Melbourne

Only two years removed from the "Big Dry", Victoria, and Melbourne specifically, are still recovering from the drought. The lessons learned during the decade long dry period have led to extensive changes in water policy. These changes were designed to mitigate the damage of future droughts. In this section, the policies of the Office of Living Victoria (OLV), specifically Melbourne's Water Future, and the water wholesalers and retailers in Melbourne will be discussed.

2.4.1 Office of Living Victoria

In 2011, the Victorian Government appointed the Living Victoria Ministerial Advisory Council to provide an independent analysis on the changes needed to better manage urban water in Victoria (Department of Environment and Primary Industries, 2012). From their analysis the Council developed a road map and an implementation plan for their proposed changes. The government's response to these recommendations was to fully commit to urban water reform and establish the OLV to be the driving force behind reform.

The actions of the OLV are centred on whole-of-water-cycle management (WWCM), also known as integrated water cycle management (IWCM), and three key objectives. First, the

OLV aims to "integrate urban planning and water cycle planning at a city/regional scale" (Office of Living Victoria, n.d.). Traditionally urban planning and water cycle planning have been done separately. However, combining the two will allow for more innovation and new sustainable solutions for the reuse of water. Second, the OLV seeks to "embed integrated water cycle management in Victoria's precincts and buildings" (Office of Living Victoria, n.d.). As cities continue to expand and grow the demand for water usage grows. As communities expand, it is essential that they are developed with IWCM approaches in mind and allow for the integration of future sustainable water cycle services. Third, the OLV wants to "deliver a common and informed understanding of IWCM" to the community (Office of Living Victoria, n.d.). While the use of IWCM programs and policies is growing across Australia and the world at large, the public does not have a solid understanding of what these policies entail. The OLV aims to educate the public on the ideas they are proposing and the practical implications of WWCM. Melbourne, as the largest and capital city of Victoria, has been targeted for a specific plan, known as Melbourne's Water Future, for integrating WWCM into the city.

2.4.2 Melbourne's Water Future

By 2050, Melbourne's population is predicted to grow by 58.5% to 6.5 million people. If Melbourne experiences another an extended drought with the expanded population, the water system will certainly not be able to supply the needed water. In fact, as can be seen in Figure 6, even with the population during the Big Dry, Melbourne would have run out of water in the summers of 2009 and 2010 without effective water usage reductions in the city.
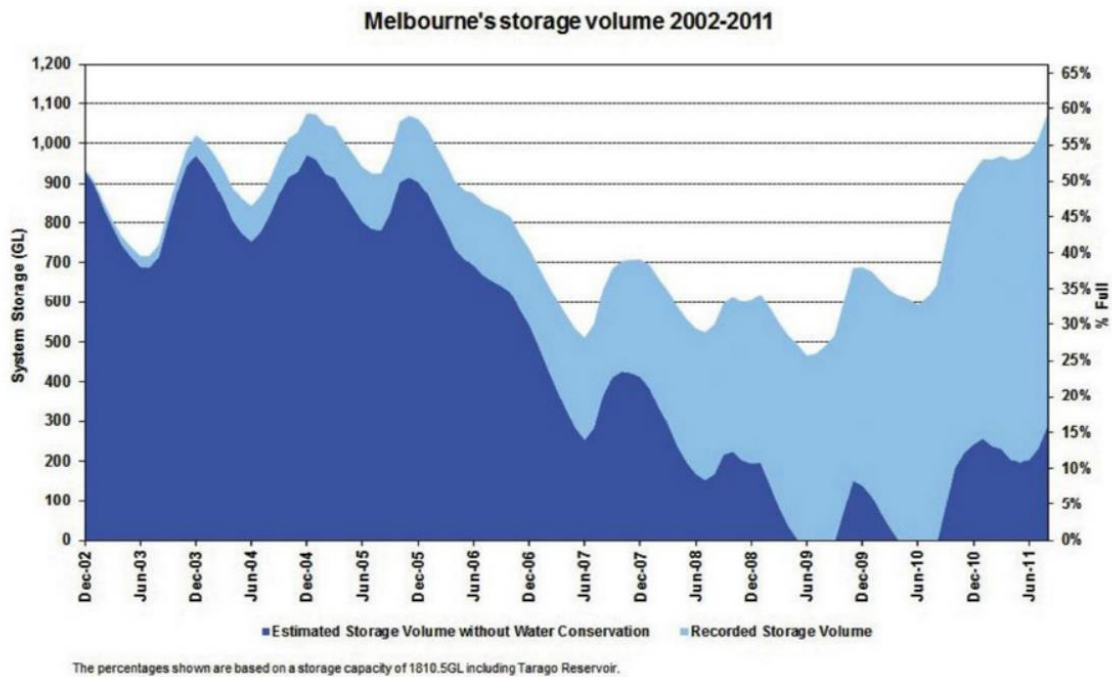
Figure 6: Percent capacity of dam with and without water conservation efforts (Australia Water Management Review, 2013)

Melbourne's Water Future was therefore developed by the OLV to create a resilient water system that will be environmentally friendly while supplying liveable, sustainable, and affordable water services to the future community (Office of Living Victoria, 2013). To reach this goal, the developers of Melbourne's Water Future included engaging the community in the

concept of WWCM by developing new areas and altering old areas with water in mind, encouraging the sensible use of water in homes and businesses, and reducing inefficiency and waste (Office of Living Victoria, 2013).

Before revising the water policy in Melbourne, the OLV determined the attitude and perspective of the community towards water and the manners in which it is used. Through their research, the OLV found that the public is very positive about the benefits of WWCM and the usage of stormwater to water public gardens. The community also supports a new approach to water management that makes use of alternate water sources and technologies (Office of Living Victoria, 2013). In order to maintain community involvement throughout the entire process, the OLV seeks to improve transparency and provide the public with more information on the process and the cost. They have also set up the Living Victoria Fund to support local community activities and projects that promote WWCM initiatives.

Because the population of Melbourne is expected to grow so dramatically, new areas are being developed and urban precincts are being actively refurbished. As the expansion planning occurs, the OLV anticipates that by keeping in mind the idea of WWCM, the cost of achieving a sustainable approach to water management can be reduced. The collection and use of stormwater should ensure the irrigation of parks even during droughts, alleviating some of the most demoralizing effects of droughts. Furthermore, since 70% of the water used in Victoria is used for irrigation, the stormwater used for this purposes will alleviate the strain on the reticulated water supply. This will also support environmental sustainability by preventing the adverse impacts of stormwater in the waterways and reducing the risk of flooding (Office of Living Victoria, 2013).

Information gathered by Melbourne Water, a public utilities company, showed that in 2011 and 2012, 65% of Melbourne's water was used was for residential purposes, 25% was used for non-residential purposes including businesses and parks, and the remaining 10% was non-revenue water used for firefighting, lost from pipe bursts, or inaccurate water meters (Melbourne Water, n.d.b). Melbourne's Water Future outlines a plan for the Victorian Government to pursue local water solutions for their government buildings in Melbourne and work with local sporting facilities and the many other businesses in Melbourne to adapt cost-effective local water options (Office of Living Victoria, 2013). Incentives have been developed to support these changes by reforming the structure of water bills so they are more flexible and reward water efficiency. With the OLV leading the way, other local water companies begun to integrate WWCM principles into Melbourne.

2.4.3 Water Companies

Part of Melbourne's Water Future involved the partnership with local councils and agencies to help plan the specific details of what technologies should be implemented, when they should be implemented, and where they should be implemented (Office of Living Victoria, 2013). Local water companies have adopted this plan and, with the support of the OLV, created policies and programs to integrate WWCM initiatives into Melbourne.

2.4.3.1 Melbourne Water

Melbourne Water is a water wholesaler, owned by the Victorian government that manages the dams and provides water to three retail water companies: Yarra Valley Water, City West Water, and Southeast Water. These retailers than provide the water directly to business,

and households in and around the city of Melbourne. Their services include supplying water, treating sewage, and promoting liveability and the environment (Melbourne Water, n.d.c).

As the major supplier for water in the Melbourne area, Melbourne Water has adopted the WWCM policy outlined in Melbourne's Water Future. For example, Melbourne Water provides consultation to developers as they plan the construction of new buildings. Through this process, Melbourne Water ensures the new property is safe from potential flooding and does not have a negative impact on local waterways (Melbourne Water, n.d.d). They also promote Water Sensitive Urban Design (WSUD) to promote the integration of WWCM into urban planning (Melbourne Water, n.d.a). Information is provided to designers about how to select different WSUD treatments to minimize the impact of stormwater, created from urban development, on the environment. These treatments include greywater harvesting and reuse, rainwater tanks, and rain gardens. Besides providing information to developers and designers, Melbourne Water has worked in conjunction with Yarra Valley Water and academic experts to identify new opportunities to integrate WWCM that minimize the impacts of urban development on the environment (Yarra Valley Water; Melbourne Water, 2013).

2.4.3.2 Yarra Valley Water

Yarra Valley Water is the water retailer that provides water and wastewater services to the northern and eastern Melbourne suburbs (Yarra Valley Water; Melbourne Water, 2013). Like the rest of Victoria, they aim to integrate new solutions to water management to help diminish the damages caused by droughts and protect the environment from runoff.

In a study completed by Yarra Valley Water and Melbourne Water, five different options and their effects on water usage and stormwater runoff were compared. These options included the continuation of the current system, the use of recycled water, and different options that include the management of stormwater (Yarra Valley Water; Melbourne Water, 2013). When determining the best option going forward, they analysed both the impact the options have on the water cycle as well as also the cost for implementing the different options. In the end, it was found that the options that WWCM was better for the environment, but were more costly than the other two options. Going forward, they plan to continue looking for a solution that integrates stormwater management and supports local projects where they are economically feasible to reduce the overall cost (Yarra Valley Water; Melbourne Water, 2013).

2.5 Centre for Education and Research into Environmental Strategies

One organization that has actively adopted Living Victoria's policy of whole-of-water-cycle management is the Centre for Education and Research in Environmental Strategies (CERES). CERES Community Environment Park is an award winning model of sustainability with over 350,000 yearly visitors (CERES Community Environment Park, n.d.a.). In recent years, the park has undertaken the development of an Integrated Water Cycle Management Plan (IWCM) which is the basis for our IQP project. This section contains a description CERES, their goals, and their water-related projects.

2.5.1 CERES History and Goals

CERES Community Environment Park is a sustainability centre located on 4.5 hectares of rehabilitated landfill in East Brunswick, Melbourne. Developed in the 1980's along the Merri Creek, CERES is a truly unique centre that combines urban farming, extensive environmental

education, and green technologies. It provides a place for the community to connect with one another, share, and learn. CERES's vision is "to be a place where the environmental consequences of our consumer culture can be addressed within a philosophy of social justice" (CERES Community Environment Park, n.d.a.).

As an organization, CERES holds to four primary goals: addressing the causes of climate change, promoting social well-being and connectedness, building local and global equity, and embracing and facilitating rapid change. These goals permeate all the programs CERES facilitates, from educational excursions for school children, to a daily organic market and cafe, to an EcoHouse that models carbon neutrality for the community (CERES Community Environment Park, n.d.a.). CERES's fourth goal of embracing and facilitating rapid change has motivated the adoption of a large number of water-related projects, although as regulation has caught up to technology, several projects have been removed.

One way that CERES impacts their community is through a dedication to teaching and motivating behavioural change in the rising generation. They accomplish this through educational incursions, held in local schools, and excursions, in which the students travel to the park for up to a whole day. These programs focus on five major areas: sustainability, waste, energy, biodiversity, and water. The water excursions include programs like "Water Keepers", "Water for All", "Merri Creek Study", and "Water Management" and include school children from about 5 to 17 years of age (CERES Community Environment Park, n.d.b.). Not all visitors, however, come to the park as part of a formal school tour. In fact, around 42% of visitors come to CERES merely to have a look around (Neilson Survey, 2014). It is these more casual visitors that may be particularly affected by signage and thus, are a large target population for informal education in the park.

CERES firmly believes that the intersection of two factors necessitate the proactive development of Integrated Water Cycle Management (IWCM) plans. The first is that climate change is likely to influence the climate of South-Eastern Australia such that rainfall would decrease and temperatures, and therefore the evaporation rate, would increase. The second is that the population will continue to expand, causing the demand for clean, potable water to continuously grow (CERES Community Environment Park, 2013). Therefore, they have identified water management, and the WWCM model, as a key component of their educational programs and research future.

2.5.2 CERES IWCM and Water Management Activities

Across the park, dozens of water-saving projects have been installed. These range from installing semi-permeable paving in the car park, to aquaponics systems, to stormwater collection tanks. Many of these projects, however, remain unfinished, in disrepair, or untested for efficacy. In the coming years, several of these projects will be renovated and showcased as effective means of WWCM.

At CERES, every drop of water has value. Therefore they have adopted the following integrated water management policy, which mirrors that of their principal stakeholder, the Moreland City Council. In this hierarchy, the first option is most preferable and the last option is least preferable.

1. Avoid unnecessary water use.
2. Reduce water consumption (use the most efficient means when water use is required).
3. Reuse stormwater/ rainwater.

4. Recycle greywater/blackwater.
5. Dispose of water so that streams/ waterways are not adversely affected.

This integrated water management plan sets the direction for all the water management activities on site. However, the infrastructure for many of the most preferential options is either not functioning or not in place at all. Due to these unmet needs, wide-spread community impact, and many examples of sustainable technologies, they received a grant as part of the OLV WWCM plan (CERES Community Environment Park, 2013).

2.5.3 OLV Grant Utilization at CERES

The grant received from the OLV is being implemented at CERES in a four-phase plan over the next two years. These phases contain specific objectives that advance CERES's IWCM plan and focus on the most preferential options in the water use hierarchy. The first objective, "Behaviour Change", is designed to create programs that will motivate visitors to augment their actions based on demonstrations of the IWCM projects displayed at CERES. The second, "Water Conservation", involves installing or upgrading to the most water efficient technology when water use is necessary. This includes the replacement of leaky pipelines, installation of a rainwater treatment system, improvement of the toilet system to low flush, installation of power mains to the underground water storage tank. The third phase, "Stormwater Retention and Filtration", involves the sealing of the car park for stormwater collection and upgrading the root zone filter already in place. The final phase, "Reuse", involves a commercial greywater filtration system for the cafe. By accomplishing these objectives in the four-phase plan, CERES seeks to provide a place where the best practices of WWCM can be exemplified to their visitors (CERES Community Environment Park, 2013).

The "Behavioural Change" phase of the program is currently active at CERES. These initiatives draw off of the influences of the most recent drought. During the "Big Dry", the government led a campaign to avoid unnecessary water usage and reduce water consumption through a mixture of legislation and public communication strategies. However, the final three tiers of CERES's water hierarchy, stormwater reuse, greywater and blackwater utilization, and proper disposal of contaminated water, remained largely unaddressed (CERES Community Environment Park, 2013). This phase seeks to communicate behavioural change primarily regarding water reuse and stormwater management through the integration of the CERES narrative. These parts of the IWCM are particularly undesired by the local community, and therefore effective, educational, and motivational intervention is of key importance at CERES (CERES Community Environment Park, 2013).

2.6 Behavioural Change Theories

One of the main goals of CERES is not only to educate the hundreds of thousands of people who visit the park every year, but also to instil behaviour change within their visitors so that visitors leave the park and actively look for ways to be more environmentally friendly within the community. Therefore, knowledge about psychological theory regarding behaviour change based on information is paramount to our project's success. In the section below we cover some of the broader theories associated with behaviour and learning. We then go into behavioural change theories more specific to fostering sustainable behaviour with our project.

2.6.1 Theory of Reasoned Action and Theory of Planned Behaviour

Two theories which seek to explain why people act the way they do are, the original Theory of Reasoned Action (TRA), developed by Icek Ajzen and Martin Fishbein, and the adapted Theory of Planned Behaviour (TPB), developed solely by Ajzen. The original theory, TRA, suggests that behavioural decisions are made based on intention, which is affected by two factors: an individual's attitude towards a behaviour and the subjective norms surrounding that behaviour. In TPB, Ajzen adds a third factor that affect intention, perceived behavioural control (Morris, Marzano, Dandy, & O'Brien, 2012).

An individual's attitude towards a behaviour is how they feel about the behaviour, for example when it comes to recycling rainwater an individual can have a positive or negative attitude towards that behaviour. A positive attitude would be they approve of that behaviour and are inclined to do it, while a negative behaviour would be they disagree with recycling rainwater and do not want to do it. Subjective norms are social pressures resulting from their perception of what others think they should do. These norms can be either for or against a specific behaviour and the individual can respond be either following the perceived attitude of others or go against it. Perceived behavioural control is the idea that an individual must believe they have the ability to change their behaviour.

Studies indicate that the sum influence of these three factors account for 20-30% of the variance in behaviour (Morris, Marzano, Dandy, & O'Brien, 2012). TPB, and by association TRA, are most frequently employed, particularly in relation to health, to predict and analyse behaviour. Further analysis has shown a strong correlation between attitudes towards a behaviour, perceived behavioural control factors, and the resulting behaviour, but there is weaker correlation between behaviour and the subjective norms factor (Morris, Marzano, Dandy, & O'Brien, 2012).

Research has been done into the effect of perceived social norms discussed in TPB. A study done by Terry and Hog in 1996 found that perceived social norms were a better predictor of behaviour and attitude than personal factors. However, this finding was only true for people who identified themselves with a group. For the people who did not identify themselves with a group the personal factors were better at predicting their behaviour and attitude (Wellen et all, 1998). For example, an individual in a group that visits CERES will be more inclined to reacts in accordance with the rest of the group to the information presented to them, whereas, if they visit alone, they would react in without any influence from others.

2.6.2 Health Belief Model

Another theory which both describes why people behave in a certain manner, and prescribes how to modify that behaviour is the Health Belief Model (HBM). Unlike TPB and TRA, the HBM is a behaviour model that postulates behaviour develops from two variables: beliefs about the threat to an individual's well-being and the effectiveness or outcomes of different actions and behaviours (Morris, Marzano, Dandy, & O'Brien, 2012). According to this theory, an individual's perceived susceptibility of vulnerability to a threat greatly influences how they behave. The degree to which the threat is deemed serious and the individual feels susceptible to the risk, dictate the likelihood of an individual to adopt behaviours to mitigate the threat.

When a threat is serious and imminent enough to change behaviour, the resulting change is influenced by both the perceived benefits and the perceived consequences of the new behaviour. An individual will adopt a new behaviour which is both perceived as being efficient

at reducing the threat and has as few negative side effects as possible. It is not enough for an individual to perceive a specific behaviour is good they must also believe they have the capacity to adopt said behaviour (Morris, Marzano, Dandy, & O'Brien, 2012). Once the motivation for a behaviour change is understood, this change can be induced by two types of 'cues to action': internal and external (Morris, Marzano, Dandy, & O'Brien, 2012). Internal cues are the feeling and beliefs of an individual related to threats while external cues can be media campaigns or the reception of information from other outside sources. These cues can affect how an individual perceive threats and can trigger the change or continuation of a given behaviour.

2.6.3 Multimedia Learning Theory

Teaching is an integral part of society, and therefore, a multitude of theories describing the different ways people learn have been hypothesized and tested. The Theory of Multimedia Learning that relates to the development of our project designs. The theory says that people learn more deeply from the combination of both words and pictures instead of merely one or the other (Mayer n.d.). Furthermore, this theory states that state retention and learning are improved when words and pictures are presented simultaneously without any extraneous material (Metiri Group, 2008). Subsequent studies have shown that these principles hold true even when more complex ideas and skills are taught (Metiri Group, 2008).

Using words and pictures together will increase retention and learning but only if they are used correctly. Clark and Lyons defined six different types of visuals:

- Decorative - used for added aesthetic appeal and should be used minimally;
- Representational - portray a single element and should also be used marginally;
- Organizational/Relational - portray relationships between multiple variables;
- Transformational - illustrate a change in an object over time;
- Interpretive - illustrate invisible relationships such as an animation of fuelling a car with arrows that show the flow of gas from the pump to the tank

These types of graphics help the reader understand relationships and material easier (Clark & Mayer, 2008).

The type of graphic that is used is also dependent on the content that is being taught. Table 1 shows five content types, their description, and the types of graphics that research shows works best.

Content Type	Description	Graphics
Facts	Unique and isolated information such as specific application screens, forms, or product data.	Representational, Organizational
Concepts	Categories of objects, events, or symbols designated by a single name	Representational, Organizational, Interpretive
Processes	A description of how something works	Transformational, Interpretive, Relational
Procedures	A series of steps resulting in completion of a task	Transformational
Principles	Guidelines that result in completion of a task; cause-and-effect relationships.	Transformational, Interpretive

Table 1: Graphics to teach different content types (Clark & Mayer, 2008 pg. 75)

2.6.3 Environmental Behavioural Changes

More specifically to this project, there are certain techniques for instilling behavioural change to make people live more sustainably. According to *Fostering Sustainable Behavior* by Doug McKenzie-Mohr, one of the main reasons people do not adopt sustainable behaviour is because "people do not know about an activity or its benefits" (McKenzie-Mohr & Smith, 1999, pg. 2). This is where the value of educational resources comes into play. To successfully influence what people do, it is critical to highlight benefits in the educational resources we ultimately create. Furthermore, it's also important to identify potential barriers of sustainable practices and suggest solutions to overcome these barriers in our deliverables. Showing people that they have control over the situation and that their efforts matter are some methods to get past psychological barriers. To uncover the benefits and barriers involved with sustainable behaviour, there are specific methods Doug McKenzie-Mohr suggests. We have considered these suggestions in the creation of our methodology. (McKenzie-Mohr & Smith, 1999)

In communicating information for educational purposes, there are certain techniques that research shows are important to follow for effective retention and subsequent behavioural changes. For example, the Elaboration Likelihood Model of Persuasion (ELM) assumes that how extensively an individual thinks about a message is determined by their motivation and ability to process that message (Behavior Works n.d.). When motivated to think about a message carefully, an individual will scrutinize the message to see if it makes sense and will be beneficial to him or her. If the arguments in the message are good, the individual will have a favourable attitude toward the message, whereas, if the arguments are lacking they will have an unfavourable attitude (Behavior Works n.d.). An unmotivated individual will not carefully examine the message. The cues in a message, such as the number of arguments for the message, are more important than the quality of the arguments when impacting the attitudes of the unmotivated individual. 42% of the visitors to CERES come to only walk the grounds, so they may not be motivated enough to critically read the information on the signs found around the park. In order to engage a large percentage of visitors, signage must utilize captivating information. Only when

our IQP group can attract and hold someone's attention will we be successful in communicating our messages and being persuasive. Otherwise, they would simply glance and look away unfazed. "All persuasion begins with capturing attention. Without attention, persuasion is impossible" (McKenzie-Mohr & Smith, 1999, pg. 84). To capture someone's attention, our content needs to be vivid, concrete, and personalized. Another technique dictates that we need to know our audience. "Before you craft the content of your message, you need to know the attitudes, beliefs, and behaviours of your intended audience" (McKenzie-Mohr & Smith, 1999, pg. 87). Table 2 contains a checklist for effective communications adapted from *Fostering Sustainable Behavior.*

A Checklist for Effective Communications
Make sure that you message is vivid, personal, and concrete
Explore the attitudes and behaviour of your intended audience prior to developing your message
Have your message delivered by an individual or organization who is credible with the audience you are trying to reach
Frame you message to indicate what the individual is losing by not acting, rather than what he/she is saving by acting
Make your communication, especially instructions for a desired behaviour, clear and specific.
Make it easy for people to remember what to do, and how and when to do it
Integrate personal or community goals into the delivery of your program.
Provide feedback at both the individual and community levels about the impact of sustainable behaviours

Table 2: A checklist for effective communications

While not an exhaustive list, the above criteria summarize many of the most important factors for initiating behavioural changes, particularly in regards to sustainability.

2.7 Background Conclusion

The background discussed above summarizes some of the preliminary research pertinent to our overall project. As with any research project, it was necessary for us to educate ourselves so as to provide a comprehensive understanding of relevant topics so that we had enough knowledge to effectively complete our goal and create our deliverables. It was also helpful to conduct background research that justified our efforts and helped us realize the value of our project. The topics include the general importance of water, shortage of water around the globe, water conservation efforts and techniques, water policy, CERES, and behavioural changes. We used a variety of literature resources to conduct this background research. To accomplish our goal and produce our deliverables, we used the knowledge and information we had gathered to create an effective methodology, which is discussed below.

3.0 Methodology

The goal of this project was to partner with CERES to inform visitors and promote behavioural change with regards to whole-of-water-cycle management. In order to support the efforts of CERES, we created content for sign and web-based educational resources that are related to the strategies employed by CERES.

To achieve this goal we identified five research objectives pertinent to this research project's goal and deliverables:

- Determine best practices and examples for communicating whole-of-water-cycle management issues and motivating related behavioural changes;
- Determine current educational practices of the CERES Environmental Park and staff preferences for future whole-of-water-cycle management education resources;
- Gauge preferences of CERES park visitors regarding the content and presentation of educational resources;
- Create content necessary for whole-of-water-cycle management education resources such as signage and web information;
- Test efficacy of whole-of-water-cycle management signage mock-ups with CERES visitors and staff and amend content based on feedback;

Our deliverables were based on both the background literature review and the empirical data collected through these research objectives. The following sections outline the methodology utilized to gather the empirical data needed, create our deliverables, and test the efficacy of our deliverables.

3.1 Determination of Best Practices and Examples

To begin our empirical research, we gathered information from other organizations already in Melbourne whose goal it is to promote behaviour change in the public. Yarra Valley Water, Merri Creek Management Committee, and the OLV were selected because they each promote water management and conservation with the public. We also explored the Melbourne Museum and the Melbourne Zoo to learn how they used signs to inform their visitors on the exhibits. Exploring these organizations provided a better idea about the practices of similar campaigns that have already been implemented. At Yarra Valley Water and Merri Creek Management Committee, we interviewed a member of their staff about the work being done there. At each interview, one team member read the interviewee the consent script, seen in Appendix A, one team member asked questions and one team member recorded responses and observations.

3.1.1 Yarra Valley Water

Yarra Valley Water is one of three water utilities companies in the Melbourne area. They provide water and sewage services to the northern and eastern suburbs. Along with water services Yarra Valley Water also provides programs and materials to their customers about water usage.

An interview was set up with Jenny Hiller, the Education Program Manager at Yarra Valley Water. The interview lasted approximately an hour. Our preliminary questions as well as a short summary of our project were emailed to Ms. Hiller prior to the interview to allow for any necessary preparation. The topics covered in the interview were their urban water cycle programs, the effectiveness of their programs to promote changes in the public's water use behaviours, and what she thought was most important message for us to promote. We also asked

for feedback on how we initially planned to lay out our signs. The list of questions can be found in Appendix B. The project summary can be found in Appendix C.

3.1.2 Merri Creek Management Committee

Merri Creek Management Committee (MCMC) is an environmental coordination and management agency for the Merri Creek Catchment. MCMC works with the community to restore and protect the Merri Creek. Many of the programs MCMC run involve planting indigenous plants to retain the natural and cultural aspects of the Merri Creek.

An interview was set up with Jane Bevelander, the Waterwatch Coordinator, and Angela Foley, the Catchment Program Officer, of Merri Creek Management Committee. The duration of this interview lasted for one hour as their water management education programs and any opinions they had on programs run at CERES were discussed. We also asked for feedback on how we initially planned to lay out our signs. Our preliminary questions were emailed to Jane and Angela along with a summary of our project prior to the interview to allow for any necessary preparation. The list of questions can be found in Appendix D.

3.1.3 OLV Meeting

The OLV is the government organization behind the grant that funds the restoration and improvement of the water programs at CERES. We were able to sit in on a meeting between our sponsor and the OLV where we were given more background information on what the OLV does within the community to promote Melbourne's Water Future. In this meeting we were also able to ask a couple of questions about what they think our main message to visitors should be and whether or not we could use their logo on our signs.

3.1.4 Melbourne Museum

To get an idea of how other organizations use signs to convey information to visitors our group visited the Melbourne Museum to walk through the exhibits and observe the types of signs the museum utilizes. We walked through all the different exhibits including the children's gallery to get insight on how the use of signs changed for different audiences. An observation form was used to standardize how we recorded our observations, which can be found in Appendix E.

3.1.5 Melbourne Zoo

The last site visit was to the Melbourne Zoo. The zoo partners with City West Water to find ways to reduce their water use. A water discovery trail has been created at the zoo to inform visitors about the different water initiatives at the zoo including rainwater collection and a water recycling plant. We looked at the trail as well as the signs displayed for the different exhibits. We used the same observation form that was used at the Melbourne Museum to standardize how we recorded our observations.

These, and all other future interviews, were analysed using grounded content analysis. This was accomplished by coding sections from the minutes of each interview and grouping them into categories based on the content of that quote. These categories were then combined into larger groups and the most common themes across the interviews were analysed.

3.2 Determination of CERES preferences

Before creating mock-ups and recommendations, we determined the preferences held by the staff at CERES on how the signs and web pages should be laid out since these educational

resources will be used by the educators at CERES, especially when they bring school groups around the park. To determine the preferences of the staff we participated in some of the excursions that are done at the park and observed first-hand how CERES teaches their visitors and interviewed a number of the staff members to get their individual opinions on the education programs and our project.

3.2.1 Excursions

To gather first-hand knowledge about the educational practices at CERES, we participated in four excursions offered by CERES. Table 3 lists the four excursions, the grade of the students, and the different teaching methods we observed during the excursion.

Excursion	Grade	Teaching Methods Used
Water for Life	$5^{th} - 6^{th}$	Verbal, Props
Organic Gardening	$5^{th} - 6^{th}$	Kinaesthetic, Verbal
Site Tour	9th	Verbal
Organic Gardening	9th	Kinaesthetic, Verbal

Table 3: Excursions and different teaching methods utilized

In the Organic Gardening excursion the students went into CERES's organic garden and learned about worm farms, soil, and different plants. The Site Tour was a tour around CERES where the students learned about many of the different programs at CERES, such as the Eco-House and water harvesting. In the Water for Life excursion the students learned about the scarcity of water around the globe and how important it is for different cultures.

Two team members observed each excursion so we did not disrupt the students by having three people following them around. While observing, we paid close attention to how engaged the students were throughout the program and took note of which teaching methods kept their attention. The techniques the educators used when explaining the technologies at CERES and their use of signage in teaching were also observed closely as they are both directly related to the project. An observation form was used by each group member to standardize our observation notes, which can be found in Appendix F.

3.2.2 Staff Interviews

To learn more about what the staff at CERES would like to see in our deliverables we performed interviews with three staff members at CERES, one excursion leaders, the communication director, and the bookings coordinator.

After we participated in the excursions we set up an interviews with Ian Colburd, one of the two educators that had led the excursions we went on. The interview was an hour long and consisted of a series of questions that can be found in Appendix G. The topics discussed include the different education programs at CERES and their effectiveness, the use of signs in the education programs, and their ideas about the layout of current signs.

An interview was set up with the Greta Muhleisen, the booking coordinator at CERES. The interview was a half hour long and consisted of a series of questions that can be found in Appendix H. The topics discussed include the water-related programs at CERES, the key components of signage, and her ideas about the layout of current signs.

An interview was arranged with Sieta Beckwith, the communication manager at CERES. This interview was approximately a half hour long and consisted of a series of questions regarding how CERES communicates with their visitors and what we should incorporate in our

designs to communicate with visitors effectively. The list of questions can be found in Appendix I.

All of the interviews were performed by one team member reading the interviewee the consent dialogue, one team member asking questions, and one team member recording responses and observations. All of the relevant information discussed in the interviews as well as our observations from the excursions can be found in Chapter 4.

We were met with some validity challenges in the data from our interviews with both CERES staff and other experts. We recorded the interviews by taking notes on the responses instead of using a tape recorder. This resulted in data that was biased because we only kept notes on what we thought was important and may have missed some information that we thought was less important. Also we performed only six interviews which is a very small number and extrapolating from this small pool may not be entirely accurate.

3.3 Determination of Visitor preferences

After determining the current practices of other establishments and CERES, the preferences of the visitors were explored. Since the main purpose for developing our mock-ups is to engage visitors in learning about the different programs at CERES, it was important to gain insight into their opinion on the CERES education. To gain this insight, we surveyed visitors to record their thoughts about the various types of signs displayed throughout CERES.

3.3.1 Visitor Survey

To gain feedback on the visitors' experiences with CERES's education programs, we designed a survey and walked around the park asking visitors to participate. Before each participant was given a survey a team member read the consent script, as seen in Appendix J, to inform the participant about the purpose of the survey.

Each participant was given a free "Be Smart Choose Tap" refillable water bottle from the Yarra Valley Water for participating in the survey. A photograph of this incentive can be seen in Figure 7.

Figure 7: Survey incentive

In these surveys, we asked a series of questions that can be found in Appendix K. These questions were posed to give us insight into their preferences in signs and their attitudes towards conservation of water.

CERES has a variety of signs set-up throughout the park. Some of these signs are more technical with text explaining different systems accompanied by diagrams of the systems, while others have less technical writing and more pictures. To gather information on what types of signs visitors prefer part of our survey had questions on the three signs, seen in Appendix L, which can all be found around the park.

We had pictures of each sign set up for the participants to look at. In the survey, we asked the participants which sign caught their attention and why, as well as which sign they learned more from and why.

Each question on the survey was multiple choice, so to analyse the data we recorded the responses for each question and graphed out which response was most chosen most frequently. By determining which answers were most popular we were able to learn valuable information for how our signs should be designed and the type content we needed to include. All of the information relating to the surveying of the visitors can be found in Chapter 4.

Our group also encountered validity challenges with our visitor survey. One validity challenge was the fact our sample population does not necessarily represent all the visitors that come to CERES. Our survey was done throughout two rainy days where few people came here. Most of the visitors were only here for the café so our sample included very few people who come for other activities. Also due to time constraints we only surveyed 51 visitors which is a very small number and it may not have been accurate to make assumptions based on this small sample size.

3.4 Creation of Content

After the background as well as the data collection and analysis were completed, our group developed a criteria table, seen in Table 4, for designing our signs and webpages.

	Element
Content	Relevant to CERES and Visitors
	Not Abrasive, Pushy, or Off-Putting
	Clear and Easy to Understand
	Links to More Information
Behavioural Change	Specific Solutions to Potential Barriers
	Emotional Connections
Design	Use Appropriate Figures and Diagrams
	Limit Text
	Clear Fonts and Headings
	Present Text and Pictures Together
Constraints	CERES Colour Pallet
	CERES Sign Shape
	CERES Font Designs
	Sign Topics

Table 4: Sign criteria table

This criteria sheet was used as a checklist of features that we needed to include in our designs based on all of our research. We then took this criteria table and developed the drafts for our deliverables. These drafts included layers of information, the most concise being for signage and the most elaborate for the web information. The content for each sign described the system and related it to the CERES park while providing information to visitors on similar things they could do in their homes to help conserve and manage water.

3.5 Testing and refining

After developing our initial designs for both the web pages and signs, it was important to gain feedback from the staff at CERES and the visitors to be sure the designs met the goal of CERES and ensure that we could make any necessary changes to improve on our preliminary layouts.

3.5.1 Staff and Expert Feedback

When we finished designing the initial design for our signs, we asked the staff at CERES and the experts we interviewed for criticism on the design. We emailed out a survey that asked the participants how well our design fulfilled six key requirements and for any recommendations on how to improve the content or the overall design. A copy of the survey and our proposed sign design can be found in Appendix M.

3.5.2 Visitor Feedback

To gain staff feedback on our proposed sign designs, we set up another study similar to our first. We combined pictures of the three current signs from our first survey with our proposed design. With the original signs acting as a control, we presented this combination as an experiment to test the effectiveness of our own product. Similar to the staff and expert survey, the visitor survey asked how well we met our criteria and what could be done to improve the overall design. A copy of the survey can be found in Appendix N. By including the old signs and using some of the same questions as in the first survey, we could compare our design with the existing signs and understand if and how we had improved on the old designs.

After analysing the data we received from the staff and visitor feedback, we improved upon our initial sign design and gathered more feedback on the changes. For the web based information we made changes based on direct feedback from our sponsor, as well as, the related ideas feedback on our sign design. All of the information relating to the surveys can be found in Chapter 4.

3.6 Methodology Conclusion

In conclusion, our team created resources to aid CERES in its larger goal of motivating behavioural changes concerning whole-of-water-cycle management through the preceding methodology. In order to accomplish this, we explored other examples and practices from different agencies within the same area, gathered preferences and ideas from our sponsor, and responded to feedback from visitors throughout the project. This methodology is summarized below in Table 5.

Research Objective	Format	Source	# of Participants	Appendix #
1: Best Practices	Interview	Yarra Valley Water (Jenny Hiller)	1	B
1: Best Practices	Interview	Merri Creek Management Facility (Angela Foley & Jane Bevelander)	2	D
1: Best Practices	Meeting	Office of Living Victoria (Luke Ouvaroff & Greg Charter)	2	n/a
1: Best Practices	Observation Forms	Melbourne Museum	n/a	E
1: Best Practices	Observation Forms	Melbourne Zoo	n/a	E
2: CERES Preferences	Interview	Excursion Leader (Ian Culbard)	1	G
2: CERES Preferences	Observation Forms	Excursions (Site Tour & Organic Gardening & Water for Life)	n/a	F
2: CERES Preferences	Interview	Bookings Coordinator (Greta Muhleisen)	1	H
2: CERES Preferences	Interview	Communications Department (Sieta Beckwith)	1	I
3: Visitor Preferences	Survey	CERES Visitors	51	K
5: Testing	Survey	CERES Staff and Experts	n/a	M
5: Testing	Survey	CERES Visitors	26	N

Table 5: Methodology summary

The sum of this research was used to create a suite of six signs and larger content for web use for future implementation at CERES.

4.0 Results and Analysis

       In this chapter, the results of our analysis will be presented. In the first phase of our study, we identified the preferences of CERES staff and visitors, as well as best practices in the field. Based on this information, we created a draft of one sign and its accompanying webpage. In the second phase of our study, the first drafted sign and webpage were finalized after being tested with both CERES staff and visitors and altered based on feedback. The remaining five signs and web pages were then developed in accordance with the first.

       The findings in this section are organized thematically. Using our surveys, interviews, and observation forms, we identified key findings regarding effective content creation, appealing sign design, and the constraints placed upon the project by both CERES and the Office of Living Victoria. These findings are then summarized and the drafts of both the sign and webpage displayed. Finally, the feedback on the original design and the alterations to the deliverables are presented.

4.1 Content Creation Findings

       The information presented in the sections below represents the analysis of the empirical data we collected that is relevant to creating content for both the signs and webpages. This data was drawn from the site visits, interviews, and surveys.

       The data gained from site visits and interviews were analysed by content analysis to identify the most common topics (Krippendorff, 1989). We interviewed six people, four CERES staff members and two site representatives. Each interview was analysed for key topics of a similar nature and differences of opinion. These key topics or themes were then grouped and quantified by frequency, as displayed in Figure 8.
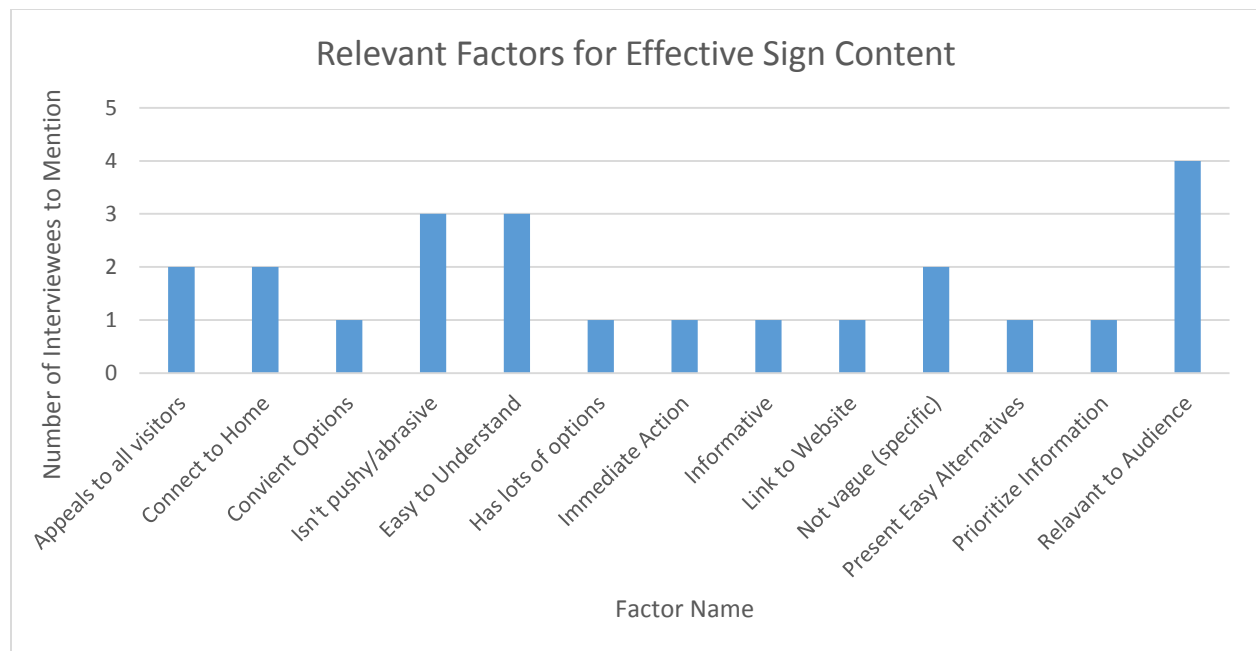

Figure 8: Interview Results: Relevant factors for effective sign content histogram (n=6)

The most frequently stressed topics informed the requirements for our content development. The connections between our survey responses, the best practices observed, and the above themes are discussed in the following subsections.

Finding 1: Content is most effective when relevant to the intended audience.

CERES visitors, staff members, and experts agree that content needs to be presented in a manner relevant to the intended audience so as to captivate and maintain the observer's attention. As can be seen in Figure 8 above, four interviewees, the most of any topic, mentioned the relevance of the signs as being key when developing effective content for educational materials. When developing content relevant to a specific audience, it is important to analyse the audience and understand their interests. As can be seen in Figure 9, most visitors visited CERES for purposes other than pure education. For example, 80% ate at the café, 41% came to generally browse, and 50% came to shop in the nursery.
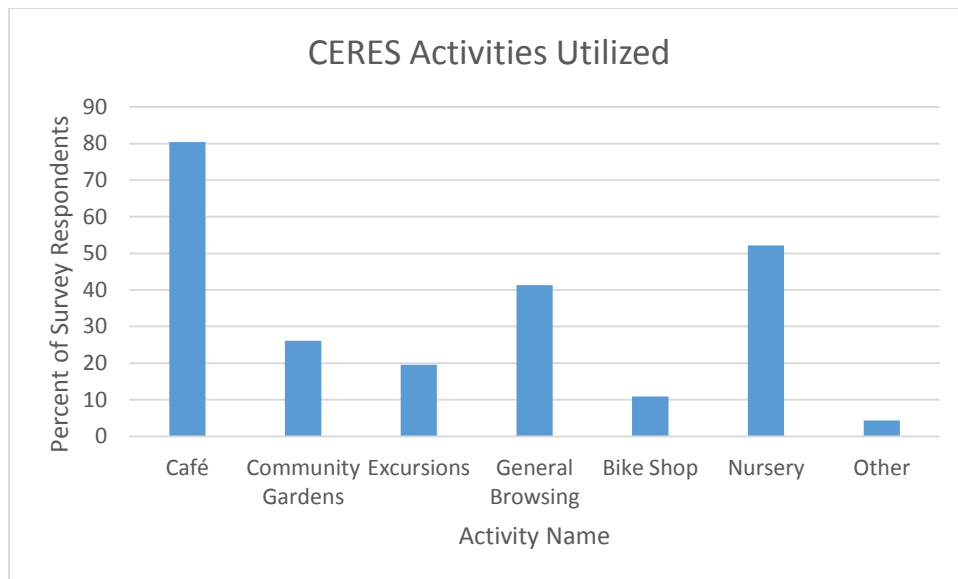
Figure 9: Survey Results: CERES activities utilized (n=51)

While the respondent pool in the survey may have skewed this data, the results are consistent with a recent survey completed by Neilson Surveys. One general conclusion of both the Neilson survey and ours is that many CERES visitors are just casual observers; they do not come specifically to learn. According to our project liaison, Judy Glick, these are the visitors that CERES seems to be less effective at motivating towards behavioural changes and are therefore a key target of the OLV water-related signs.

Finding 2: Content is most effective when it is not be abrasive, pushy, or off-putting.

One finding of particular importance to CERES staff for content phrasing was that it not be pushy, abrasive, or off-putting. As can be seen in Figure 8, three interviewees mentioned the need to not be pushy or abrasive. According to one of these interviewees, a CERES employee named Greta Muhleisen, "CERES is a place where people can feel comfortable relaxed, and at

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home with nature. This feeling leaves space for inspiration rather than guilt." CERES does not have an overt political message and prides itself on being an oasis in an urban environment. On the same note, another CERES employee, Sieta Beckwith, recommended we do not focus on the negatives associated with environmental impacts, but on the positives of alternative behaviour and how it can benefit someone at the personal level; we should not broadcast a doom and gloom status where reconciliation seems unachievable to the individual.

Finding 3: Content is more effective when simple and easy to understand.

The next major finding regarding content dealt with the depth of information that should be included on the signs. In the visitor survey, respondents were asked to rate various factors in sign development on a scale of 1 to 5 based on importance. Respondents felt that having a sign which was "not too technical" had an importance of 3.8 out of 5. The opinion of the CERES visitors was supported by interview responses as well. "Easy to understand" or "simple" was mentioned as a key component of signage three times throughout the course of the interviews. Clearly, creating deliverables that are not so technical as to lose the more casual or younger CERES visitors is deemed essential by both the general public and education experts. Furthermore, in the interviews, two professionals mentioned the importance of appealing to all ages of visitors, which dictates a level of simplicity.

Finding 4: Signs with a link to more information appeal to a wider variety of observers.

With a wide variety of visitors reading the signs around CERES, the next major finding dealt with linking the simple information on the signage with more technical information for the more motivated reader. In the visitor's survey, respondents felt that having a link to more information had an importance of 4.1 out of 5. While a large percentage of CERES visitors are casual observers, some are tertiary students or even professionals in their fields who are looking for much more information that can be provided, even in a very wordy or technical sign. Therefore, a way to link the sign to more information is often achieved through the utilization of QR codes. These codes were suggested during an interview with CERES's Communications Manager, Sieta Beckwith, as a concrete way to link the signs with their corresponding web pages. As can be seen in Figure 10, QR codes were also being used on site in the Melbourne Zoo.

Figure 10: QR code use at the Melbourne Zoo

At the zoo, many of the newer signs had QR codes which linked a simpler sign or sign geared towards younger visitors to a webpage with information for the more motivated or educated visitors. According to both CERES staff and industry leaders, QR codes provide a means of creating layers of information, which appeals to a variety of visitors and their varying desires.

4.2 Behavioural Change Motivation Findings

The next findings addressed general ways in which to motivate behavioural changes, rather than merely educate, when creating the content for educational materials. These characteristics, primarily identified through the interviews of staff at CERES and other industry professionals, included connecting the information on an individual level and being specific when suggesting behavioural changes.

Finding 5: Behavioural change suggestions are effective only when specific, achievable, and individually applicable.

The first finding regarding behavioural change, derived primarily from the interviews, was that observers are more likely to accept a new behaviour if the one suggested is not vague, unachievable, or only applicable on a large, expensive scale. As can be seen in Figure 8, two interviewees stressed the importance of suggesting specific and attainable behavioural changes, rather than sweeping generalizations. For example, at Yarra Valley Water, Jenny Hiller described a water saving initiative which was run as part of the "Water Learn It Live It" campaign. This campaign included a number of buttons with slogans, some of which were specific, such as install a dual flush toilet, while some were much more general, such as "save water today". The buttons having to do with specific, achievable tasks were much more effective than the general buttons for motivating behavioural change. In the same way, she suggested that the behavioural changes suggested in our signage and web pages needs to be specific and achievable rather than simply pithy statements. It is also critical to our project liaison, Judy

Glick, that the suggested behavioural changes on our signs be connected to the visitor on the individual level. CERES prides itself on celebrating regeneration, biodiversity, and a connection to nature. All these ideals are applicable on an individual level. These suggestions are consistent with the Theory of Planned Behaviour, discussed in section 2.6.1, in which an individual's feelings of self-efficacy or ability to change their behaviour are critical to his or her decision to mitigate the effects of a threat.

Finding 6: Behavioural change suggestions must effectively motivate, particularly by creating an emotional connection.

Furthermore, we found that when behavioural changes are suggested, they are more effective when they contain emotional hooks, which engage the reader on more than a simply intellectual level. As discussed in section 2.6.2, according to the Health Belief Model (HBM), in order for an individual to adopt a behavioural change, he or she must believe the old behaviour poses a threat, there are little or no downsides to the new behaviour, and that the new behaviour is attainable. From our surveys, site visits, and interviews, we found that all three of these factors were important when suggesting behavioural changes.

There is little doubt in Australia that water shortages are a large threat. Only two years removed from the "Big Dry", the worst drought since colonization, Australians view water as a limited and precious resource (Dolnicar & Hurlimann, 2010). There are always baseline water use restrictions in effect that increase dramatically as the levels in the dams drop every summer. In our survey, we addressed this first factor of the HBM by asking which water amenity was most important to visitors. The results can be seen in Figure 11.
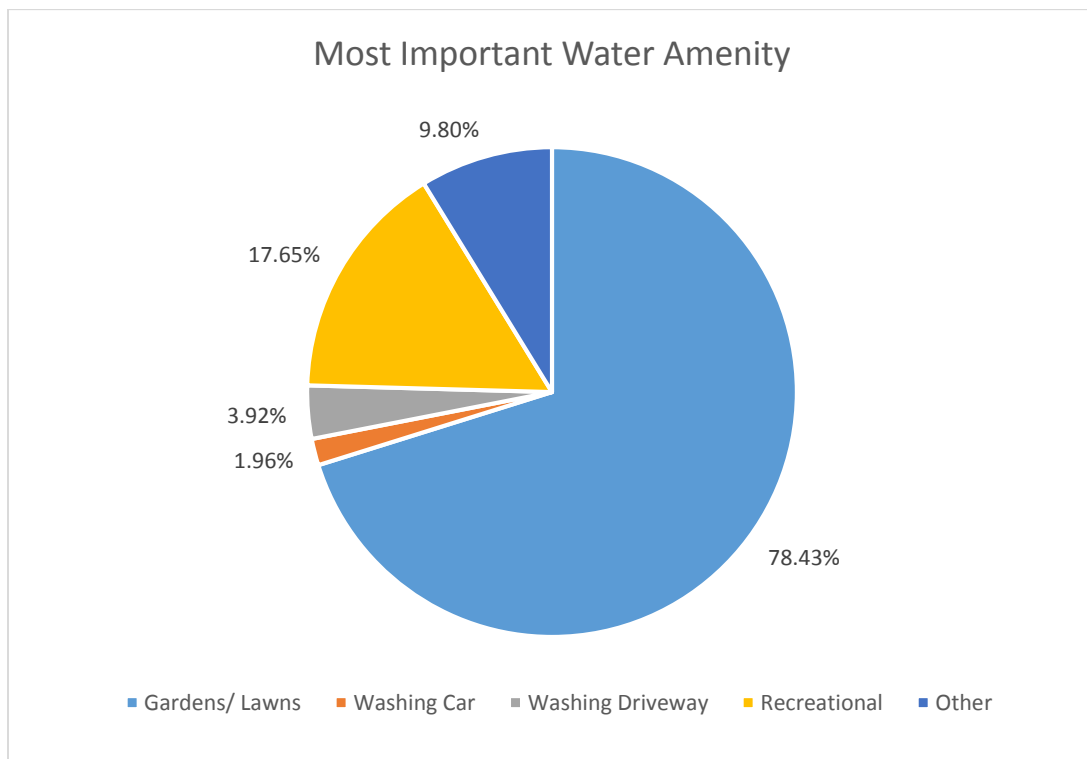
Figure 11: Survey Results: Most important water amenity (n=51)

At 78.43% of respondents, "watering a garden or lawn" was overwhelmingly the most popular response, followed by "recreational uses (pools, sprinklers, etc.)" at 17.65%. Our survey's portrayal of the importance of gardens and lawns to Melbournians was consistent with the information gathered in the Office of Living Victoria meeting. In this interview, Luke Ouvaroff and Greg Charter explained that the OLV particularly targets people who enjoy gardening because, in their experience, they tend to be extremely willing to conserve water by changing their behaviour and by using alternative technologies. They believe that this is due to the strong emotional connection people have to their garden and keeping it green throughout summer.

Finding 7: Behavioural change suggestions must effectively address barriers, particularly regarding cost.

While an emotional connection is key, we also found that behavioural changes are more likely to be adopted when the common barriers to adopting that behaviour are addressed. The second and third factors of the HBM involve communicating that the new behaviour has few downsides and is attainable. In the survey, we asked respondents to identify the biggest barrier towards conversion to water saving technologies, in order to better target the barriers which prevent the adoption of the last two factors of the HBM. The results are displayed in Figure 12.
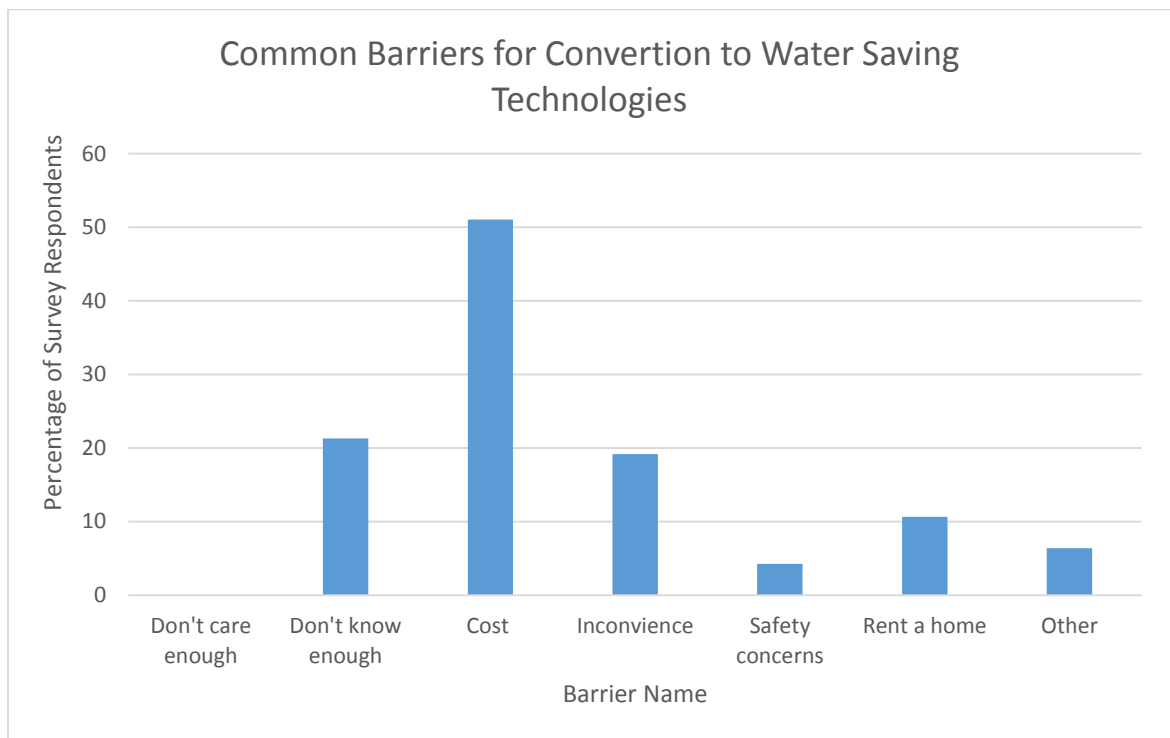
Figure 12: Survey Results: Common barriers to water behavioural changes (n=47)

The largest barrier was "cost", followed by "don't know enough", then "inconvenience", and so on. Interestingly, no survey respondents indicated that they didn't care enough about water conservation to change their behaviours, which supports the concept that a lack of water is already perceived as a large threat. Similarly, in the interview with Yarra Valley Water, Jenny

Hiller encouraged us to suggest only low cost alternatives, rather than expensive infrastructure changes.

4.3 Sign Design Findings

The information presented in the sections below represents the analysis of the empirical data we collected that is relevant to designing and formatting both the signs and webpages. This data was drawn from the site visits, interviews, and surveys conducted. Each subsection represents a specific finding derived from all our data, and draws connections found in evidence for each finding.

In the site visits and interviews, the themes for sign design were identified as before and the frequency of the mention of each theme is displayed in Figure 13.
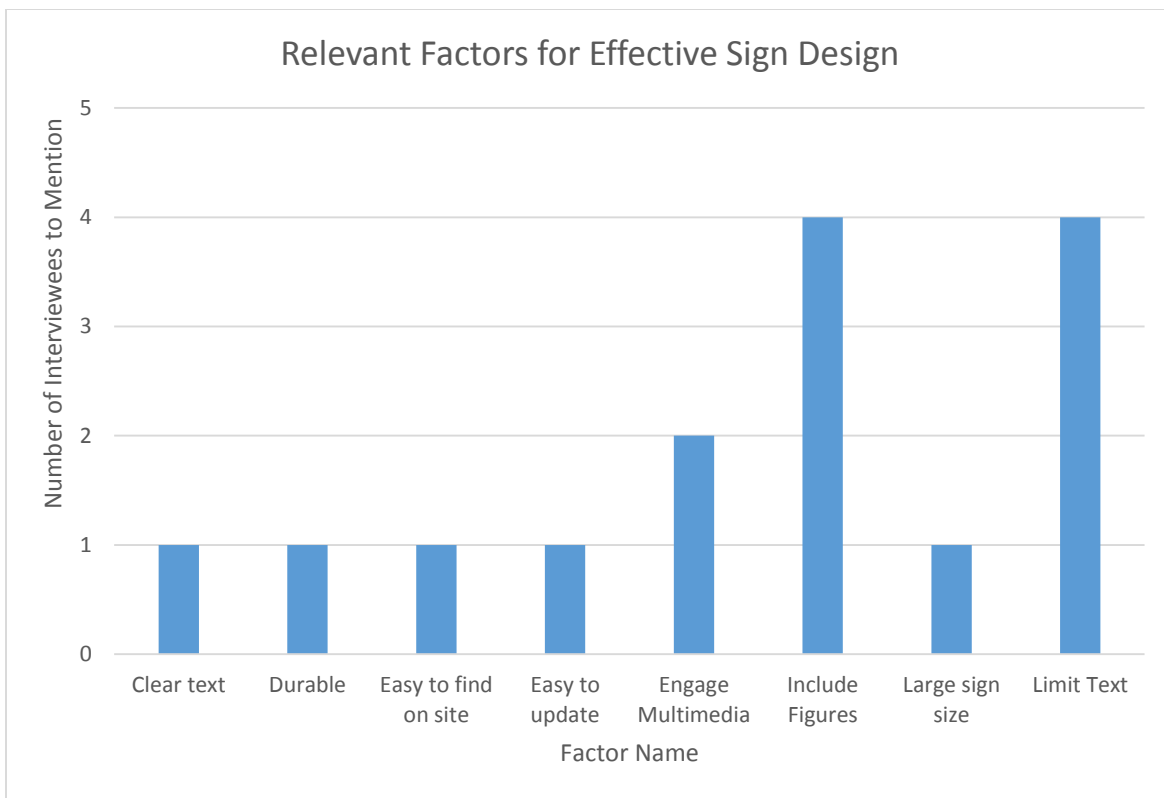
Figure 13: Interview Results: Relevant factors for effective sign design histogram (n=6)

In the visitor survey, questions 1-4, 5a-c, 5e, and 6-7 addressed design. The results from Question 5, in which participants rated the importance of a given feature on a scale of 1 to 5 are displayed in Figure 14.In the following subsections, the implications of this data are discussed.
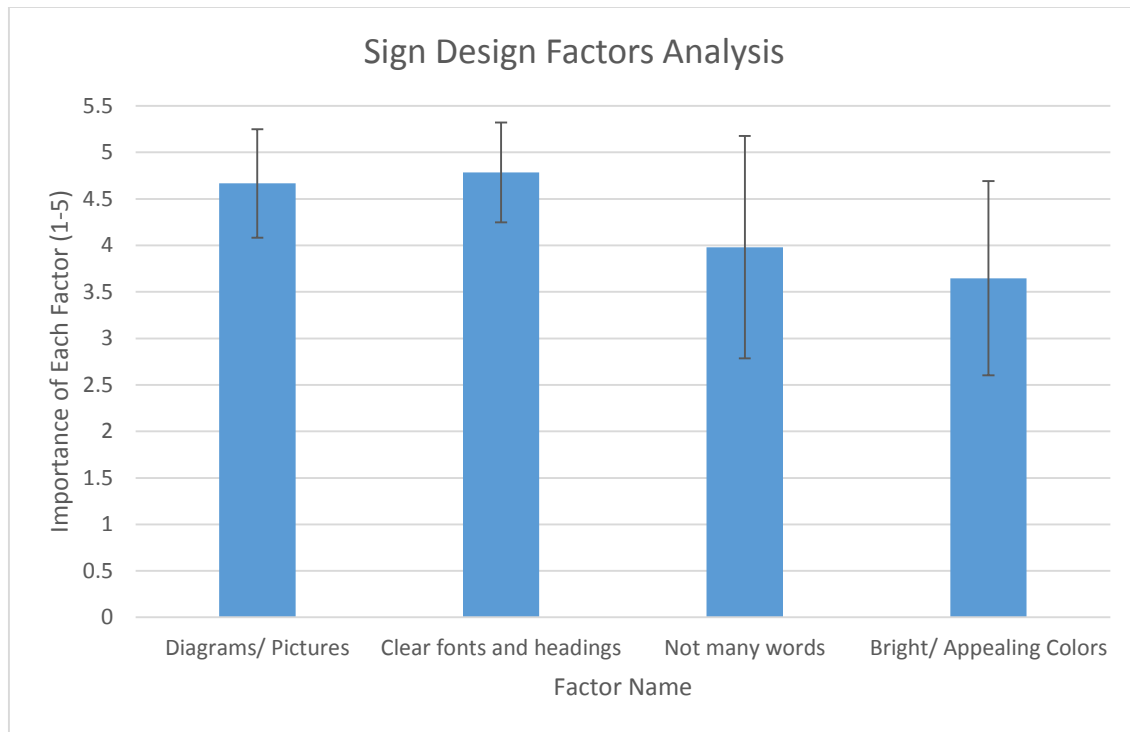
Figure 14: Survey Results: Most important sign design factors (n=51)

The findings regarding design can be divided into two groups, findings regarding the usage of pictures and findings regarding the usage of text. The connection between our survey responses, the best practices observed, and the above themes are discussed in the following subsections.

4.3.1 Usage of Pictures

The first finding regarding deliverable design was in regards to the usage of pictures, including the necessity of images, placements of images, the types of images, and the most effective use of images.

Finding 8: Images are necessary and most effective when interspersed with text.

CERES staff, visitors, and industry professionals agree that effective signs employ pictures to convey and reinforce information. In the interview data displayed in Figure 14, four interviewees addressed the need to include pictures as a necessary factor in effective design. Furthermore, as can be seen in Figure 15, "includes diagrams or pictures" was rated 4.6 out of 5 for importance. In at both the Melbourne Zoo and Melbourne Museum, nearly all signs contained at least one image, with many containing several more. Including images was perhaps the biggest theme throughout all of the information gathering. The mere presence of an image, however, is not enough to create an effective sign; the image must be the placed correctly, contain the information in an appealing and interesting way, and be used in conjunction with text.

According to the Multimedia Learning Theory, as discussed in section 2.6.3, images are most effective when displayed interspersed with text. This placement of pictures was observed extensively in the site visits. For example, a sign from the Melbourne Zoo is displayed in Figure 15.

Figure 15: Melbourne Zoo: "A Unique Aussie" sign

As can be seen, the pictures in this sign are displayed on the same level as the text and are used to separate and explain the limited text.

In the CERES visitor survey, respondents were shown three signs, displayed in Figures 16-18 below, and asked to choose which one best accomplished several factors.

Australia is the driest inhabited continent and rainfall patterns are highly variable. Over several years CERES has installed a wide range of water harvesting, reuse, collection and reduction technologies. This area is the hub of many of those initiatives.

Rainwater to toilets:
Rain water on the surrounding eight roofs is collected and stored in localised tanks. Water overflow from the tanks then travels via an system of pipes into a 50,000 litre underground tank buried under the turnaround next to the Village Green. This water is pumped up to a header tank next to the Multicultural Classroom so it can gravity feed to the toilet block next to the cafe and to five garden taps. The toilets in this block are fitted with a full/half flush valves in place of cisterns. The toilets use 6 litres for a full flush and 3 litres for a half flush but can be converted to a reduced level of 3 litre full flush and 2 litre half flush when appropriate pan technology is available. In preparation for this change the toilet block has been fitted with a Drain Wave unit. This is a horizontal tank used to clean out sewage pipes when the toilets are fitted with this greatly reduced flush volume. The toilets are connected to the sewer in compliance with Moreland Council requirements.

Creative reuse of building materials is a distinctive feature of the toilet block. The walls are made from reclaimed doors and the sinks from second hand urinals

Stormwater and greywater:
Stormwater from Lee Street is channelled into the ephemeral or temporary wetlands in front of you, retaining this water on our land instead adding to the peak flow burden of the Merri Creek.

Up to 1100 litres per day of grey water from the CERES Cafe flows into this Victorian Environmental Protection Authority (EPA) approved commercial greywater treatment system provided by Rootzone Australia. The beds are planted thickly with Baumea Articulata (Jointed twig rush) and are sealed from the surrounding soil. The roots host nearly 2,500 types of bacteria and 10,000 types of fungi. Oxygen percolates from the roots allowing the microorganisms to aerobically oxidize the organic matter in the effluent. The process of absorption of oxygen through the leaves and passing it down to the roots through their hollow stems acts as a bio-pump. The soil provides filtration and anaerobic digestion also takes place. This system of plants regenerates itself as the old plants die and form useful humus.
The system is energy efficient and provides a natural habitat for animal species.

Underground tanks: www.cubicsolutions.com.au

CERES 50,000 litre underground tank

CERES Cafe Rootzone filter system, April 2012

Waste water from our cafe Septic tank

To Sub-surface irrigation

Figure 16: Greentech sign

Figure 17: Food trail sign

Figure 18: Migratory birds sign

One question in the sign survey was to ask respondents to choose the most "visually appealing" sign from a set of three signs. The results of this question can be seen in Figure 19.
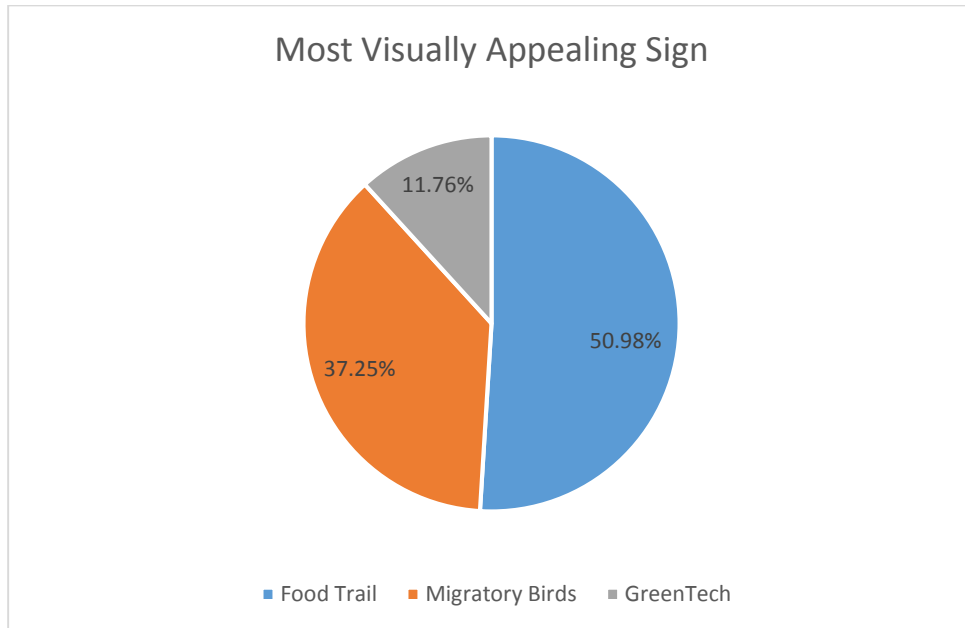

Figure 19: Sign Study: Most visually appealing sign results (n=51)

According to CERES visitors, the most visually appealing sign was the Food Trail, followed by the Migratory Birds sign. In both of the signs, pictures are interspaced with text. However, the GreenTech sign, were the pictures and text are completely separated, was chosen as the least visually appealing. In this way, our survey results reflect both the Multimedia Learning Theory and the best practices in the field.

Finding 9: Photographs are the most preferred type of image, but only when fitting to the information conveyed.

The next finding was related to the type of image, such as photographs, maps, technical diagrams, or charts to use in sign design. In order to find out what type of pictures people preferred, the CERES visitors were asked about their preferred type of image. The survey results from this question are displayed in Figure 20.
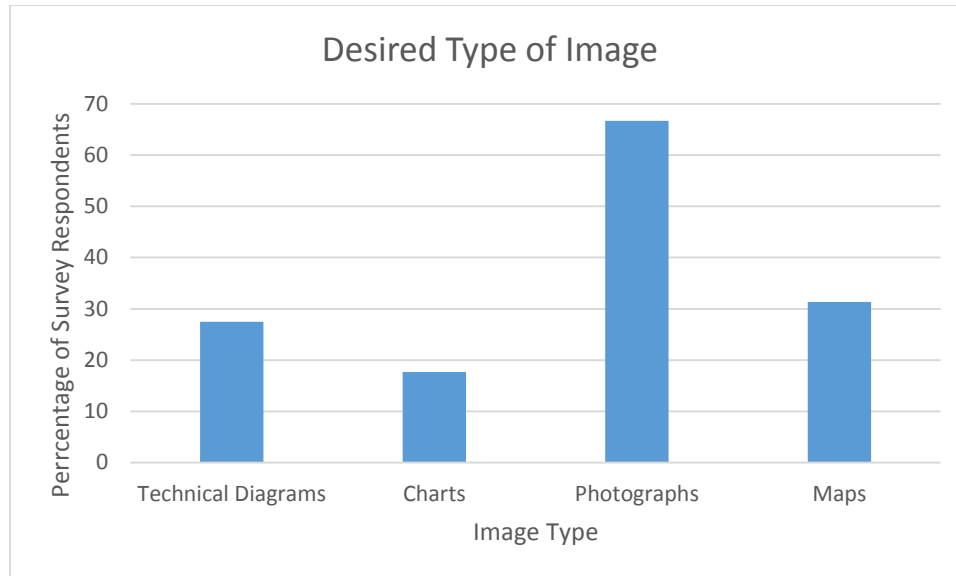
Figure 20: Survey Results: Desired type of images survey (n=51)

As can be seen above, the most popular type of image was photographs, followed by maps, then technical diagrams, and finally charts.

Often, however, an image other than a photograph is most effective at displaying different types of information. To illustrate, there was a large discrepancy between the signs chosen as most visually appealing (Figure 19) in the sign study and the signs chosen as having the most effective use of pictures, which can be seen in Figure 21.
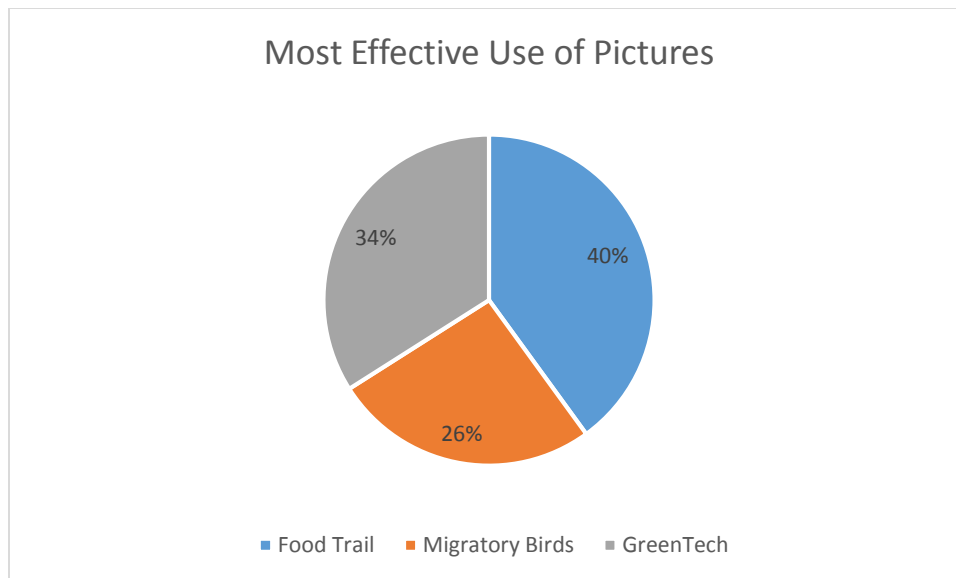
Figure 21: Sign Survey: Most effective use of pictures results (n=50)

Although CERES visitors found the GreenTech sign the least visually appealing, over double that number said the sign had the best use of images. Furthermore, the Migratory Birds sign was selected as most visually appealing, but far less thought its purely decorative images were the most effective use of images. The discrepancy between these two questions is summarized in Table 6.

Sign Name	Most Visually Appealing %	Most Effective Use of Pictures %
GreenTech	11.76	34
Migratory Birds	37.2	26
Food Trail	50.98	40

Table 6: Comparison of "most visually appealing" and "most effective use of pictures" responses

 Although photographs were the most popular type of image, these data suggest that it is most important to visitors to use an image that effectively displays the content while remaining visually appealing. This concept is supported by psychological theory, such as the Multimedia Learning Theory, which suggests that difference types of images are more appropriate for different types of content.

4.3.2 Usage of Text

The second group of findings regarding sign design related to the usage of text, including the form of text, the style of text, the utilization of headings, and relative amount of text.

Finding 10: Text is most appealing when limited, especially through the usage of bullets.

Interviewees and survey respondents agree that limiting text increases the appeal of a sign and the likelihood it will be read. Almost all signs and webpages contain at least some text, but in interviews "limited text" was a theme four times (Figure 13). Furthermore, in the visitor survey, "not too many words" was ranked at 3.98 out of 5 for importance for sign design. While some text is essential in conveying information, limiting text was of key importance to both experts and the public.

Since the amount of text desired on the signs was so small, the format of the text was of critical importance. CERES visitors were surveyed and asked to choose their desired form of text. The results are shown in Figure 22.
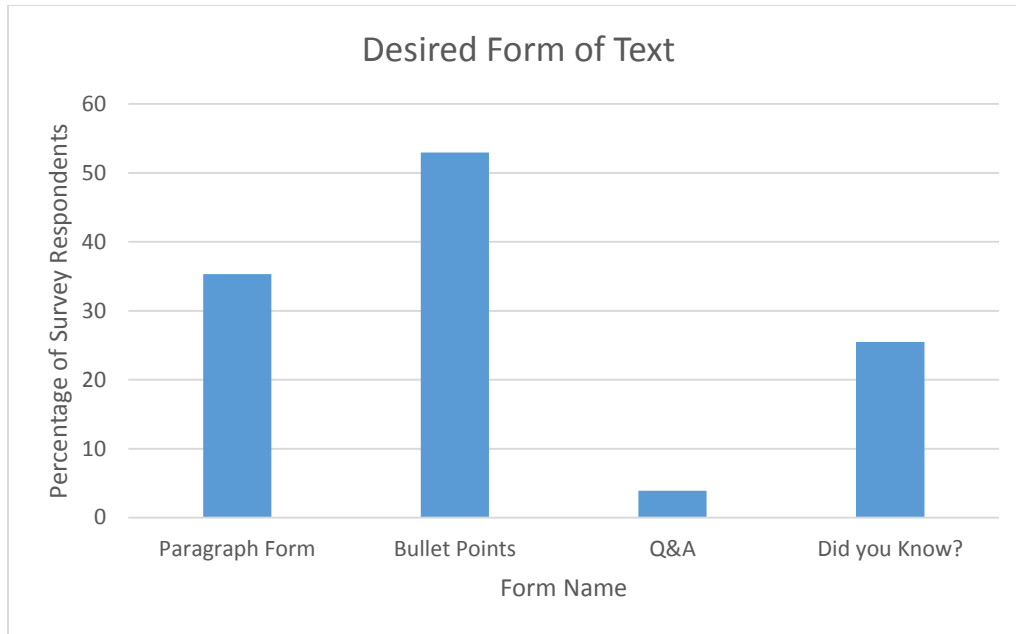
Figure 22: Survey Results: Desired form of text (n=51)

The preferred form of text was bullet points, at 59.9%, which is consistent with the goal of limiting text. Paragraph form was also relatively popular at 35.3%, followed by "Did you know?" at 25.9%. In the creation of our deliverables, there was a variety of forms of text used on various signs, but bullet points were most heavily utilized.

Finding 11: Text is most appealing when easy to read and organized.

The next major finding related to the style and format of text used on the signs, including font sizes, readability of styles, and the use of headings. In the survey, "easy to read (clear fonts and headings)" was scored highest in importance with a score of 4.78 out of 5. Through our observations during the site visits, it was found that effective design creation required fonts that were legible and clear in both style and size. For example, in Figure 23, the font sizes make is easy enough to read without having to stand too close. Furthermore, a variety of font styles provides emphasis without being distracting.

Figure 23: Melbourne Zoo: "Saving Koalas" Sign

In this sign from the Melbourne Zoo, a zoo wide theme of "Saving [an animal] One Flush at a Time", which encourages the use of recycled toilet paper, is highlighted by being many times larger than the accompanying text. There is also a common symbol or mascot with the tag line "Wipe for Wildlife". Therefore, one finding regarding sign design was to highlight the most important information using larger font size or capitalization.

The preferences of visitors regarding the usage of text is most clear from the sign survey in which respondents were asked to identify which sign, of the three displayed in Appendix L, they were most likely to read based on the way the text appears. The results are displayed below in Figure 24.
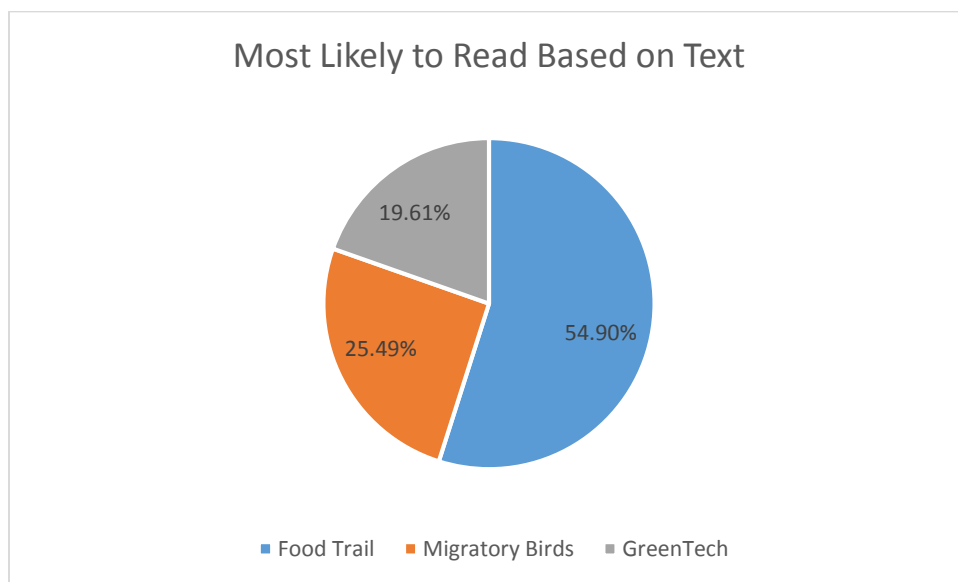
Figure 24: Sign Survey: Most likely to read based on text results (n=51)

By a large margin, the text which was most appealing was on the Food Trail sign. This text was in a combination of paragraph and bullet form, in a readable size and font, with clear headings.

Finding 12: The most visually appealing ratio of images to text is 1:1.

When designing signs, people across the board suggested that both images and text should be included, but the ideal balance between the two was identified through visitor preferences and best practices observed. In the visitor sign survey, respondents were asked to pick the sign with the most appealing ratio a pictures to text. The results can be seen in Figure 25.
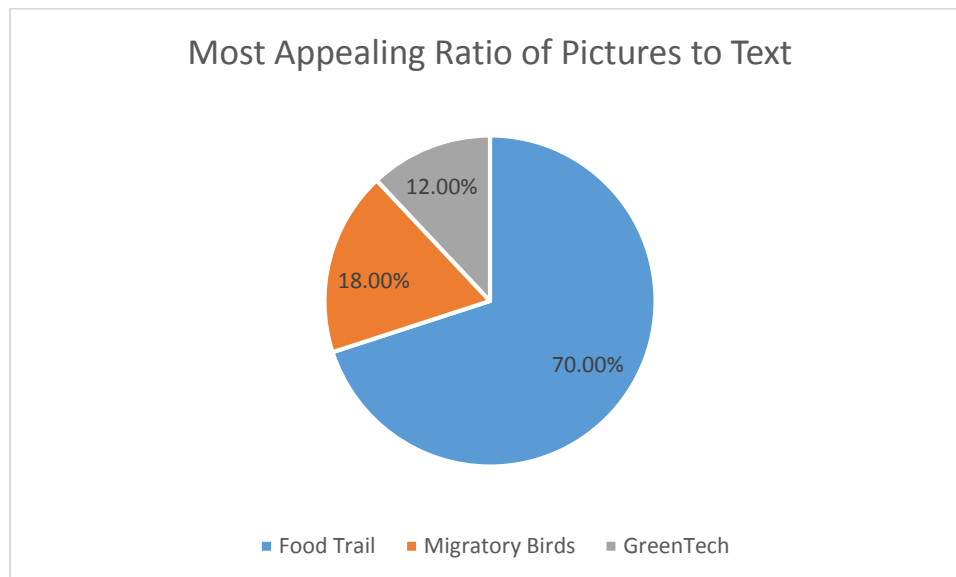
Figure 25: Sign Survey: Most appealing ratio of pictures to text results (n=51)

Once again, the most preferred sign was the Food Trail sign, with about 70% of respondents choosing this sign as the most appealing. The Food Trail sign has approximately a 1:1 ratio of pictures to text, with a relatively large amount of negative space. The Migratory Bird sign, which was chosen 18% of the time, has a much larger percentage of pictures; the GreenTech sign, which was chosen 12% of the time, has a much larger percentage of text.

The examples observed at the Melbourne Zoo and Melbourne Museum generally supported the preferences of the CERES visitors that participated in the survey. For example, two signs from the zoo and museum can be seen in Figures 26 and 27, respectively.

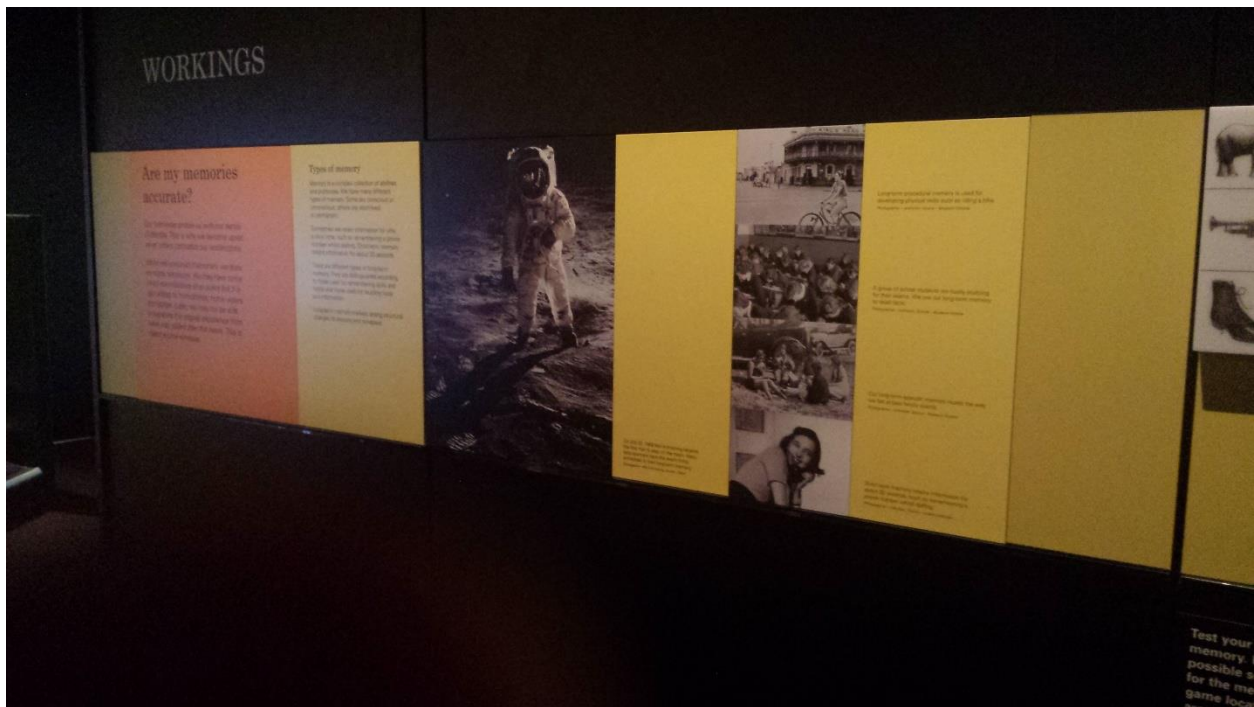*Figure 26: Melbourne Zoo: Sustainability sign*

Figure 27: Melbourne Museum: "Workings" sign

In both of these signs, there is approximately a 1:1 ratio of pictures to text. The pictures are also intermixed with the text. It is also noteworthy that both signs include a very large degree of blank space which break up both the pictures and text.

4.4 Constraint Findings

The next set of findings were in regards to the constraints placed upon the project by both CERES and the specifics of the OLV signage grant. These findings were drawn primarily from meetings with our project liaison, Judy Glick, and documentation at CERES, including the OLV grant proposal.

Finding 13: A suite of signs which has a cohesive nature is more effective and appealing.

Our first finding regarding the constraints of the project came from the CERES signage plan which set guidelines to insure cohesive and appealing signs were installed throughout the park. Through this signage CERES is seeking to develop "visual identity and legibility" in order to increase the ease of traveling around the park (CERES Community Environment Park, 2010, pg. 1). The stated goal of the signage plan is "to deliver a signage system that is adaptive to the needs of CERES now and into the future and can consolidate existing information into easily understandable amounts" (CERES Community Environment Park, 2010, pg. 1).

One unifying aspect of all the signage is the shape of the sign. Each sign is rectangular with three curved corners and one right corner. The right corner is always placed in one of the two top corners and the radius of the curved corners is always one third the smallest width of the sign. The size of the sign, however, could be altered as necessary and oriented in either portrait or landscape.

A second unifying aspect of the signage in the font options. While we were free to choose the size of the font, we were limited in the styles for the headings and the body of the sign. The style guide outlines a list of font styles that match the theme at CERES.

A third unifying aspect from the signage plan was the colour pallet available. The colour pallet, displayed in Figure 28, displays all the options available in sign development.

Figure 28: CERES colour pallet

The usage of each colour is also dictated by the signage plane. For example, the shades of grey were to be used as the neutral base that does not dominate the rest of the sign. The font colour, for the text in the body of the sign, is restricted to different shades of dark brown which are easy to read in smaller sizes.

The last constraints put on the design for our signs was the use of a unifying symbol and the placement of the logos of all the organizations that sponsored the project. While CERES

wants all of their signs to have a similar shape and colour scheme, they also want to delineate between the different trails and types of signs throughout the park. To do this each design has a symbol in the top corner that matches the other signs in that trail. Each sign also has a place at the bottom of the sign to display the logos of the different organizations that sponsor CERES and their projects.

Finding 14: A suite of signs describing a set number of WWCM projects is required by the OLV grant.

A different category of constraint on this project was the topics of the signage. Our project centred on the creation of six predetermined signs for the water management projects at CERES. These six projects were placed into four categories, which are summarized in Table 7.

Topic	Projects
Water Conservation	Replacement Pipes
	Toilets
Rainwater Harvesting	Rainwater Tanks
Stormwater	Car Park
	Lee Street Dam
Reuse	Blackwater

Table 7: Summary of WWCM projects for signage

Projects Related to Water Conservation

There are two water conservation projects at CERES that will be addressed in our signs. The first is the replacement and updating of the water lines throughout the park. By updating the water lines, CERES hopes to replace old leaking water lines with pipes that will not leak, thus reducing the amount of water they use. Replacing the pipes also allows CERES to separate the water used for different purposed. While, some of their water is returned through the sewers, a significant amount of water is used for irrigation. By being able to show how much water is used for each purpose CERES will be able to reduce their water bill significantly as irrigation water costs half as much as water that returns to the sewers. The second water conservation project is updating the toilets used at CERES. Dual flushing toilets have implemented at CERES and the water used to flush in them will come from collected rainwater reducing the amount of water used from the city mains.

Projects Related to Rainwater Harvesting

The next project which will be described by our signage is rainwater harvesting at CERES. On site, they have installed about 20 rainwater tanks that collect rainwater from the roofs of the buildings. This collected rainwater is filtered and then used for a number of purposes including flushing toilets and watering the gardens. CERES is also in the process of approving a project that would use rainwater in rinse basins for employees and visitors.

Projects Related to Stormwater

Our signs will also include two for stormwater harvesting. CERES has created a dam system that takes the stormwater runoff from the street, filters it, and prevents it from running into the Merri Creek. The dam provides water to the native trees planted around it to promote biodiversity within CERES. By preventing it from running into the creek, it also helps prevent the flooding and the pollution of the creek. CERES is also updating a stormwater project that harvests the stormwater from their car park for irrigation purposes. This water is filtered through a root zone filter and used to water part of the garden.

Projects Related to Reuse

The last of the six signs will be for a display on blackwater. Legally, CERES is not allowed to have any blackwater projects on their site, but they still wanted to inform their visitors about its applications. Part of the OLV grant will be used to create a related display, such as modern art with toilets, which our sign will be beside. Our sign will provide information on the uses of blackwater as well as information on the composting toilets that used to be part of CERES.

4.5 Determination of Deliverable Requirements and Prototype Deliverables

In the section, the twelve preceding findings are summarized, categorized, and combined with the constraints of the project. These constraints of include a CERES signage plan, completed in 2010, and the Office of Living Victoria grant specifications. All of this information was summarized in a criteria table, which served as the basis for the development of the prototype deliverables.

4.5.1 Criteria for the Development of Signs

After analysing the data from our interviews, surveys, and site visits, as well as establishing the constraints placed on our project by our sponsor, we took our findings and created a list of criteria that we found to be necessary for an effective design. The category of the criteria, the key elements, and corresponding finding numbers are displayed in Table 8.

	Element	Finding #(s)
Content	Relevant to CERES and Visitors	1
	Not Abrasive, Pushy, or Off-Putting	2
	Clear and Easy to Understand	3
	Links to More Information	4
Behavioural Change	Specific Solutions to Potential Barriers	5, 7
	Emotional Connections	6
Design	Use Appropriate Figures and Diagrams	9
	Limit Text	10
	Clear Fonts and Headings	11
	Present Text and Pictures Together	8, 12
Constraints	CERES Colour Pallet	13
	CERES Sign Shape	13
	CERES Font Designs	13
	Sign Topics	14

Table 8: Finalized criteria table

Our criteria table was divided up into four sections, content, behavioural change, design, and constraints, which reflected the results of our research.

Criteria Related to Content

Criteria related to content are based on findings 1-4**.** Firstly, our results indicated that making sure that the information we presented was relevant to both CERES and the visitors was a high priority. Therefore, the information provided on our signs needed to be related to the problems and solutions being addressed at CERES and relate to the problems faced by the visitors in the Melbourne area. Through our survey, we found that most of the people that visited CERES did so for a reason besides pure education. The nature of this serendipitous audience requires certain considerations when creating signage content to target them. To communicate

with these people we need to develop content captivate their interest, retain their attention, and be relevant to their lives.

Secondly, our results also showed that the messages we present in our signs need to not be pushy or abrasive. CERES as an organization prides itself on not being overtly political or offensive. Since our signs are a reflection of the values and attitude of CERES, we felt it was critical that our signs also contain an informative and motivating message without being too intense or offensive in anyway.

Thirdly, our results also indicated that our writing needed to be clear and easily understood. Using language that is not too technical was an important factor to visitors when choosing whether or not to read a sign. CERES caters to a variety of visitors with variable education and interest levels. To appeal to as wide of a group as possible, we decided that the content for our signs would be aimed at the education level of grade 5 to grade 8.

Fourthly, although the signs were geared towards younger visitors, our results also showed that a link to more information was very important when writing content. To achieve these layers of information on the sign, we utilized a QR code which brought the reader to a CERES webpage with more information. On the webpage, we implemented links to even more technical information for the most interested visitors to CERES.

Criteria Related to Behavioural Change

Criteria related to behavioural change are based on findings 5-7. The first finding regarding behavioural change suggestions was that in order to be effective, they must be specific, achievable, and individually applicable. The infrastructure at CERES is on a much larger scale than may be reasonable for a residential building. However, the infrastructure at CERES are examples of what can be done in a residential area. For example, at CERES, all of the stormwater which runs down the Lee Street is collected into a man-made dam and used on the CERES site rather than running into the neighbouring creek. A system like this involves large catchment systems, landscape renovations, and infrastructure to pump the water from the dam. On an individual level, however, people can install rainwater tanks to capture the water that falls on their roofs and reuse that water for irrigation with limited cost. These types of simple and individually applicable suggestions were made on our signs so as to increase the likelihood that a new behaviour would be adopted.

The second finding regarding behavioural change suggestions was that in order to effectively instil changes, they should utilize motivators such as emotional connections. The results of our survey of CERES visitors showed that the use of water for gardens and lawns was most important dispensable water amenity to CERES visitors by a large margin. In our signage and web information, we highlighted the inability to water gardens during drought and the ways in which capturing rainwater or stormwater could free them from this loss. We also selected emotional picture to supplement the text in our signage. In these ways, we sought to create emotional hooks in our materials to motivate the adoption of behavioural change.

The third finding regarding behavioural change suggestions was that in order to be most effective, they must address the major barriers towards adopting a new behaviour. From our surveys we found that cost, lack of knowledge, and inconvenience were the three largest barriers that prevented visitors from changing their behaviour when using the reticulated water supply. Our designs needed to provide ways for visitors to overcome these different barriers. It was important that we provided specific examples that were simple for visitors to implement in their

lives. The more specific and simple the methods, the more likely visitors would be to implement them. For example, while the cost of a rainwater collection tank may be quite costly, placing a bucket in the shower to collect excess water to use for irrigation is essentially free and can be used in a rented residence.

Criteria Related to Design

Criteria related to design are based on findings 8-12. The first finding regarding design was that images are necessary and most effective when interspersed with text. Across the board, including images was the most important feature of sign design. In our signage in particular, we sought to include several large pictures. Rather than placing them all in one portion of the sign, however, we used them in conjunction with the text to increase the effectiveness and appeal of our signs.

The second finding regarding sign design was that photographs were the most preferred form of text, but only when fitting to the information displayed. In our survey, the majority of responders selected photographs over all other types of figures. In the sign survey, however, visitors didn't chose the sign with photographs as having the most effective use of pictures. This support the claims of the Theory of Multimedia, which suggests that certain types of figures are best for displaying certain types of information. When we developed our signage, we utilized this theory, summarized in Table 1, and used the correct type of image to convey the information on that sign.

The third finding regarding sign design was that text should be used sparingly. In order to accomplish this in our signs we utilized a combination of short sentences and bullets. This also had implications for the amount of information that could be displayed in our signs, and supported linking the signs to more information through QR codes.

The fourth and final finding regarding sign design was that the text needs to be organized and easy to read to be effective and engaging. In our signs, we utilized text boxes with headings to organize the sign and tried to make the font as large as possible. With the target of a ten year old reading level, it was important to make the text as clear and easy to read as possible while still conveying the information.

Criteria Related to Constraints

Criteria related to constraints are based on findings 13-14. The final two findings were in regards to the constraints placed on the project by both the 2010 CERES signage plan and the specifics of the OLV grant. These constraints included the types of fonts and colours available in sign design as well as the topics of the signs and webpages developed. By following these criteria in the development of our sign, we created a suite which clearly fit in with the other signage at CERES while still looking unique.

4.5.2 Prototype Signs and Webpages

After the data from the first phase of our methodology had been analysed, the criteria table developed, and the constraints determined, the next step was to create a prototype of one set of the final deliverables. This sign in particular, and also webpage, would be utilized in the feedback portion of the methodology.

The sign regarding the upper root zone filter for runoff from the CERES car park was chosen to be subject matter for the first prototype. The sign created is displayed in Figure 29.
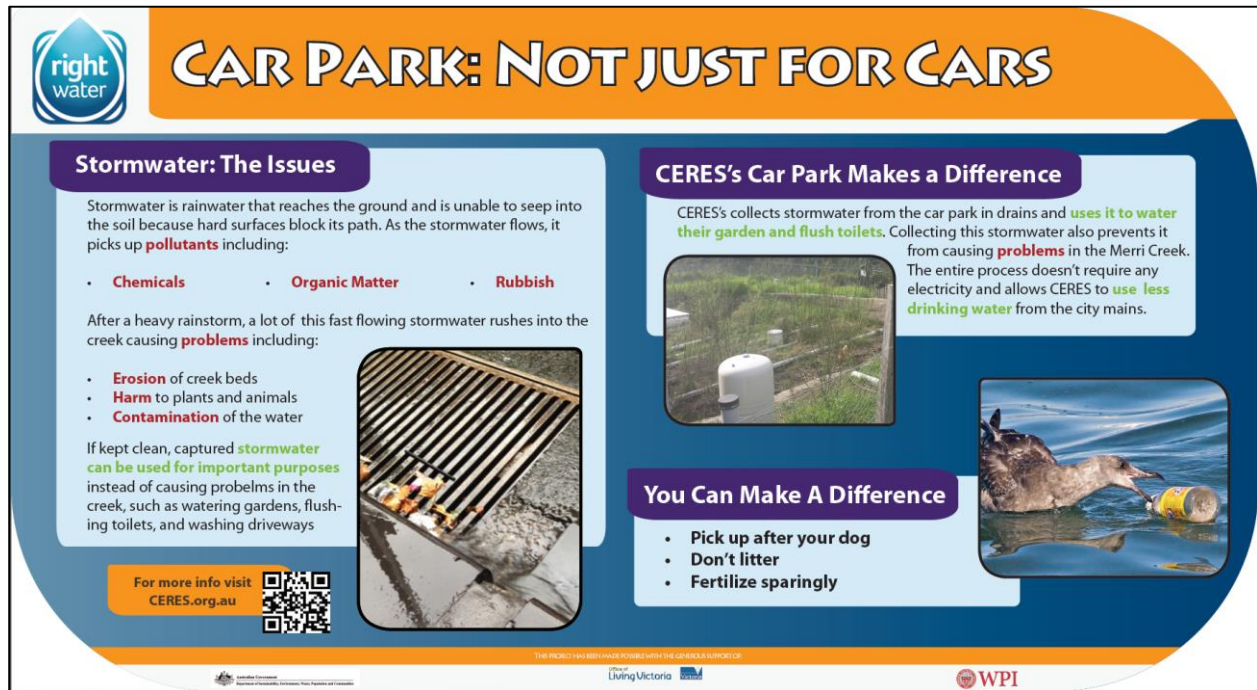

Figure 29: Sign prototype mockup

When developing the Car Park sign, the criteria table (Table 6) was key as the sign had to fulfil each subsection of the table regarding content, design, and constraints.

When writing the content for the sign, we sought to ensure the text was clear to understand, had a link to more information, included motivators, was relevant, and contained specific solutions. For example, the text on the sign does not utilize water or biology jargon, such as "loss of biodiversity", but instead uses simple phrases like "harm to plants and animals". Similarly, the sign contains a QR code which will redirect visitors to the CERES webpage on stormwater harvesting. The behavioural change section of the sign also contains specific and attainable tasks, such as picking up after a domesticated dog, rather than generalizations like preventing pollution of waterways.

When completing the sign design, we used appropriate figures and diagrams, limit text, present text and figures side-by-side, and use clear headings. Each subsection of the Car Park sign was placed in a different text box so as to clearly organize the text and create a flow in the sign. The sign currently utilizes all photographs, the most desired type of figure according to our results, but the picture of the root zone filter will likely be replaced later by a schematic of the system. Critically important in the development process was limiting amount of text, particularly through the utilization of bullets. Pictures were also utilized to break up the text rather than being separated into one section of the sign.

Finally, all of the constraints were followed in the prototype of the Car Park sign. The sign is the correct shape and only uses CERES fonts and colours, with the exception of the light blue in the content text boxes which has already been used in other signs throughout the park. By the end of the design process, each of the important criteria for the signs had been met and the prototype was ready to be tested with CERES visitors, CERES staff, and the experts previously interviewed.

4.5.2.2 Webpage

While the majority of our efforts were focused on the design of signs, creating layers of information was key from both our individual research and the original project description. We accomplished a link to more information by utilizing QR codes on the signage which lead to webpages with much more advanced information. Therefore, when designing our prototypes for testing, we also developed the webpage which would accompany the sign about the car park. Part of the resulting webpage can be seen in Figure 30.

Figure 30: Website prototype mockup

This sign describes more broadly the usage of stormwater for WWCM projects. It differs from the sign in that it contains much more technical information, has more text, and utilizes multimedia in the form of imbedded videos.

4.6 Review of Prototype and Completion of Final Deliverables

With the development of the first drafts of the sign and webpage, the first phase of our project drew to a close. Moving forward, we focused on getting outside feedback on our designs, altering them, and using the information gained to complete the rest of the suite of signs and webpages. The results obtained from this second phase of our project, including the analysis of the feedback on the prototypes, the alteration of the prototypes, and expansion to the remaining five signs and webpages are presented in the following subsections.

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We received feedback on our original sign in two primary ways: through a survey of CERES visitors and an online survey of the people we interviewed in the first phase of the methodology. In the visitor survey 26 respondents were asked to rate on a scale of 1 to 5 how well the mockup accomplished several key criteria from our Phase 1 findings. The results of this question are displayed in Figure 31.
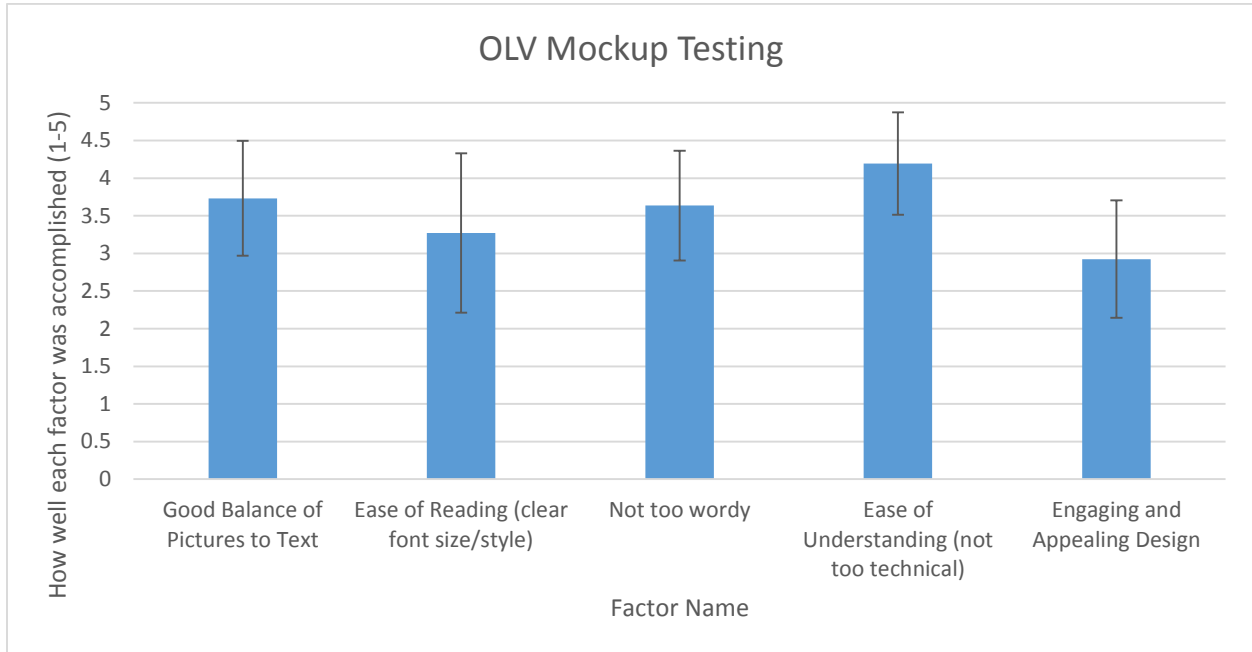

Figure 31: Mockup Visitor Survey: How well the sign accomplished the criteria (n=26)

In the survey, our mockup tested well as being easy to understand, not too wordy, and having a good ratio of pictures to text. The implications of this data, however, as they apply to areas in which the prototype needed to be improved are discussed under the following modifications.

Modification 1: Our mockup was too busy, and therefore was distracting from the content.

The first major group of alterations that needed to be made to the mockup of the sign came from feedback that the sign was much too busy, and therefore difficult to read. In the visitor survey, there was a free response question in which visitors were asked in which ways the sign could be improved. Three visitors mentioned that the sign was too busy directly, and five more mentioned that all of the colours used were distracting. Also in the visitor survey, people were also asked to choose between the three signs from the original survey as well as the OLV mockup regarding which sign accomplished different characteristics the best. When asked which sign was most visually appealing, nearly all the visitors agreed the OLV sign was not very visually appealing at all. The results from this question can be seen in Figure 32.
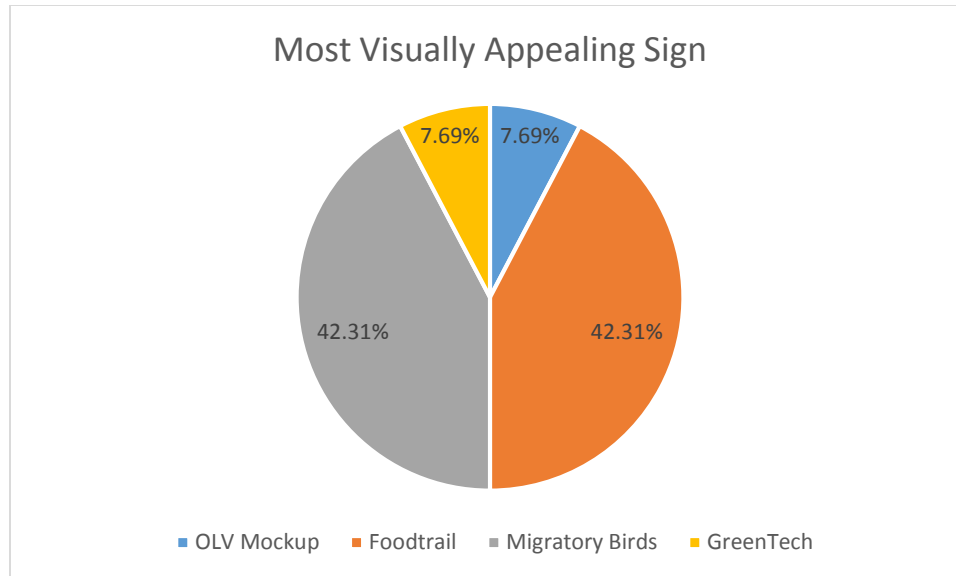
Figure 32: Mockup Sign Survey: Most visually appealing sign (n=26)

In this part of the visitor survey, the OLV Mockup was only chosen as most appealing 7.69% of the time. This is most likely due, at least in part, to the busyness of the sign. Furthermore, as can be seen in Figure 31, the ease of reading the sign was only rated at 3.3 out of 5. From the testing with the visitors, we found that the original mockup was much too busy to be effective with visitors.

Modification 2: Our mockup did not utilize pictures efficiently, and therefore failed to create "emotional hooks"

The second set of major alterations to the mockup dealt with increasing the effectiveness of the photographs used. As can be seen in Figure 33, when asked which on the four signs used pictures most effectively, visitors chose to OLV Mockup 46.2% of the time.
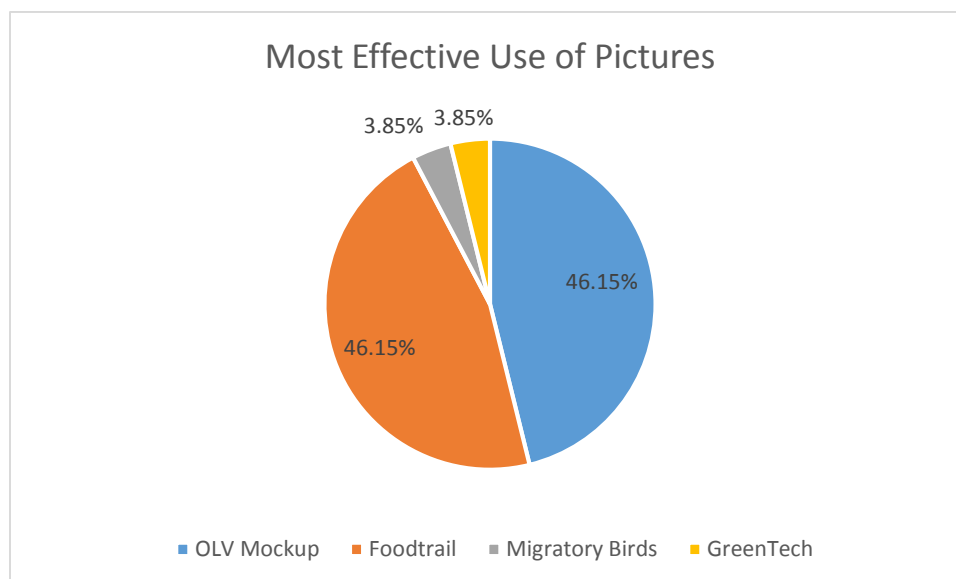

Figure 33: Mockup Sign Survey: Most effective use of pictures (n=26)

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Although the visitors felt the sign used pictures somewhat effectively, the response was not overwhelming. Furthermore, the experts suggested that the sign could be improved by changing the pictures to be either more informative or more appealing. In this way, the behavioural change criteria of creating emotional hooks could be strengthened in our signs.

Modification 3: Our mockup contained American spellings rather than Australian ones.

The third major modification had to do with the relevancy of the sign to the intended audience. The sign was written using American spellings and terms, rather than the Australian spellings relevant to the intended viewers. This feedback came primarily from the online expert survey, where experts pointed out some of the differences and alterations that needed to be made. Even in the visitor survey, this was suggested by the answers to the question, "Based on the way the text looks which sign would you be most likely to read?" The answers to this question are shown in Figure 34.
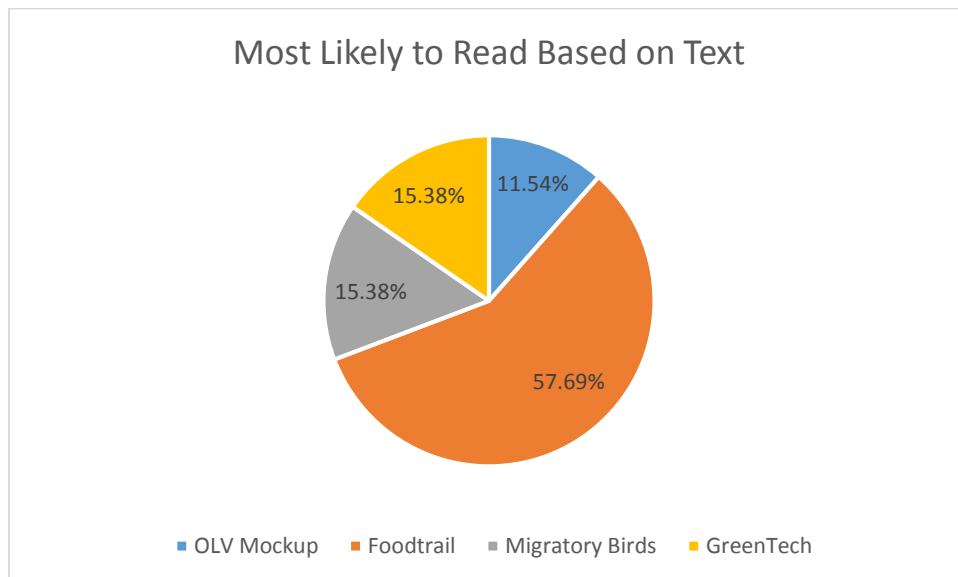

Figure 34: Mockup Sign Survey: Most likely to read based on text

In this section of the visitor survey, the OLV mockup was chosen only 11.5% of the time, the least of any of the signs in the survey. While this may be due to a large number of factors, some of this is most likely due to what was perceived as typos.

Modification 4: Our mockup contained too much text to have the pictures be large enough.

The fourth group of modifications to the signs dealt with the ratio of images to text, and the correspondingly small size of the pictures. In the ranking data, displayed in Figure 20, the mockup was only rated 3.6 out of 5 for being "not too wordy". Furthermore, in the survey free response question, seven people mentioned that the pictures were too small to be seen clearly. This may have been partially due to the size of the printout used in the survey, but also still likely reflects a need to increase the size of the pictures and correspondingly decrease the number of words.

4.6.2 Final Deliverables

With the feedback from both visitors and previous interviewees, we updated our sign based on the modifications described above. The physical alterations to the sign made based on each principle of modification described above are displayed in Table 9.

Modification #	Alterations to Sign
1	Gradient in background removed
	Extra colours removed
	Colour coding of words removed
	Extra text boxes removed
2	Changed root zone filter image to clearer image
	Changed bird picture to more graphic image
3	Fixed spelling errors
4	Decreased amount of text
	Increased size of pictures

Table 9: Alterations made to mockup based on feedback

The finalized version of the car park sign, after the alterations described in Table 9, is displayed in Figure 35.

Figure 35: Finalized stormwater sign

Once the first sign was developed, the remaining five were designed using the principles and criteria described above. These signs were related to water reuse, reticulated water

conservation, rainwater collection, stormwater harvesting, and blackwater. These remaining signs and webpages are in the appendices described in Table 10.

Sign Title	Webpage Title	Sign Appendix	Webpage Appendix
What if the Dam Went Dry?	Water Reuse	O	T
Waste Not, Want Not		P	
From the Roof to the Garden	Rainwater	Q	U
Car Park: Not Just for Cars	Stormwater	n/a	V
The Lake from Lee St.		R	
Blackwater is the New Green	Blackwater	S	W

Table 10: Summary of OLV signs and webpages

4.7 Results Conclusion

The results described above summarize the information gathered throughout the course of our methodology, which led to our final deliverables. In the first phase of the project, we surveyed CERES visitors and interviewed CERES staff, as well as experts in the field of environmental education. The analysis of these results lead to the development of the criteria table, which summarizes the preferences and best practices regarding signage content, design, and requirements. These findings were used to create the first mockup of a sign and webpage. In the second phase of our project, we tested our original mockups by surveying the experts we interviewed in Phase 1, the larger staff at CERES, and the CERES visitors. The analysis of these results lead to the revision of the prototypes and then the development of the remaining signs and webpages in the OLV suite.

5.0 Recommendations

At the conclusion of our project, we identified six future recommendations for CERES Community Environment Park. Some of these recommendations are specific to the OLV grant implementation of our signs and webpages, while others are applicable to CERES at large.

Recommendations regarding OLV Grant Implementation:

1. We recommend that CERES complete the OLV materials developed once additional details become available at the completion of the projects.

The implementation of the Office of Living Victoria grant is not scheduled to be completed until 2016. Therefore, space was left on the signs for specifics of each project that must updated as the projects are completed. For example, when the car park stormwater system is completed, technical specifications about the amount of water collected and the materials used should be added to the sign. A seventh sign, with the same style and format, also needs to be developed to describe the grey water usage system at either the newly renovated café or the EcoHouse. We recommend that, when the new systems are installed and the old ones are upgraded, our signs be completed with all the necessary information.

2. We recommend that CERES hire a graphic designer to update our designs.

Once the content has been finalized, CERES should hire a graphic designer to update the designs before they are installed. Particularly, we recommend that the colour scheme of the signs be altered to maximize the aesthetics of the design, and therefore increase the ability of the signs to attract and hold a visitor's attention. Throughout the testing and refining stages of the project, the colours used in our prototype design were repeatedly mentioned as being unappealing or not complementary. Due to time constraints, a lack of expertise, and the constraints of the CERES colour pallet, we were unable to solve this issue during the redesign process.

3. We recommend that CERES make the OLV signs large.

When the time comes to install the updated suite of OLV signs, we recommend that CERES increase the size of the signs from the standard size utilized throughout the park. This would enable larger font size and pictures to be used, allowing easier reading and increased visibility of the signs. It should also increase the coherency of the suite of signs since they will be distinct from the other signs in the park, not only by the landscape orientation, colour scheme, and "right water" mark, but also by the size of the sign. Furthermore, this should address the concerns in the second visitor survey that the pictures were too small or unclear since they will be at an increased size.

4. We recommend that CERES install the suite of OLV signs at a lower height and at a 45° angle to the ground.

When the signs are updated, printed, and ready to be installed, we recommend that CERES install the signs in a way that would increase the ease in which the signs can be read by audiences. For example, we recommend CERES orient the signs at an angle of 45° from the ground, rather than the standard 90° used with other signs. This practice was observed during the site visits to both the Melbourne Zoo and Melbourne Museum. Lower signs increase the visibility of the sign and decreases the effort required to read the sign. Furthermore, since the signs were written simply, to be understood by primary school children, we recommend that the signs be placed at a lower height. This is would ensure all visitors with the capacity to read the sign would have the ability to see the sign. One the signs have been installed, the corresponding webpages should also go live on the updated CERES webpage.

5. We recommend that CERES create an unguided tour throughout the park to direct visitors to water related projects and the accompanying signage.

Throughout our research, it was mentioned to us that the signs at CERES are often ineffective, not due to a lack of interest, but because they cannot be easily found. Some of the water projects are in particularly obscure places in the park, and therefore are likely to be missed by the more casual visitor. Consequently, we recommend that CERES develop a means of directing people to the water signs, through the creation of an unguided trail. This could be done by making a water themed map that utilizes the water logo placed on all the signs to denote the location of all the whole-of-water cycled related projects on site. In this way, a visitor could easily go around the park and see all the water-related products and signs. These maps should be located at the entrance to the park and be laminated for repeated usage.

Recommendations for CERES:

6. We recommend that CERES develop a new signage plan which reflects the desires of the staff, is more aesthetically pleasing, and has more options.

Throughout the design process of our signage, we received a large degree of feedback from CERES staff and visitors that we were unable to incorporate into our project due to the signage plan constraints. In particular, people appear not to approve of the colour pallet and fonts which were available. Before many signs are installed using the current signage plan, we recommend that CERES considers updating the plan to include more popular options.

7. We recommend that CERES utilize our criteria for the development or upgrade of signage for other technologies, such as energy conserving or waste reduction infrastructure in the park.

The water related signs are not unique amongst CERES signs in their need to be upgraded and replaced. Many signs are outdated or generally disengaging or unappealing. With the exception of the "Food Trail" suite of signs, few signs contain any specific behavioural change initiatives. Therefore, we recommend that CERES continues the process of updating signage with the use of the criteria table we developed. This criteria summarizes the key components of

effective sign design and content creation from our research, and therefore has value when creating future signs.

8. We recommend that another student group analyzes the effectiveness of our designs.

While our signage and webpages were based on the criteria developed from the best practices in the field, CERES staff preferences, and CERES visitor preferences, there is no guarantee of their effectiveness. Therefore, we recommend an evaluation of the overall effectiveness and visual appeal by another student team, perhaps through completing a second round of the testing and refining stages of the project. Pending their results, changes should be made to the criteria sheet and to the deliverables of this project. In particular, if the signage plan is updated, our signage should be updated to reflect the new plan.

One challenge we faced in creating effective signage was the inherent tension between communicating all of the information necessary, while still limiting the text on the sign. This tension is one that CERES will face moving forward, and should consider when updating signs. For this reason, CERES may want to utilize alternative methods for communicating information to more effectively accomplish their goals.

6.0 Conclusion

Australia is currently the driest inhabited continent on earth, with an average of only 600 millimetres of rainfall per year. With the projected increases in population and effects of global warming, the water shortages in Australia in general, and Melbourne in particular, are only predicted to grow more dire. Many technologies surrounding water conservation are available to Melbournians, but have not been widely accepted or implemented throughout the city. Therefore, CERES has received a grant from the Office of Living Victoria to display water conservation infrastructure on site. Our project supported this first part of the grant implementation. The goal our project was to motivate CERES visitors to adopt new behaviours in regards to whole-of-water cycle management by increasing awareness about the relevance, importance, benefits, and implementation of its more efficient strategies. In order to accomplish this, we created display materials, including six signs and corresponding web pages, for the whole-of-water-cycle management projects at CERES Community Environment Park. These materials reflect CERES's history of water conservation and are based on the best practices in the field, preferences of CERES staff, and preferences of CERES visitors. Through the creation of criteria for our educational materials, our deliverables effectively not only communicate the specifics of each project, but what it is an example of, why it is important, and how its principles can be applied on the individual level. By utilizing various layers of information, our deliverables are intended to appeal to a wide variety of CERES visitors and provide a working foundation for future signage around the park.

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Appendices

A) Interview Consent Script

Our project is focused on determining the best way to provide visitors with information about the integrated water cycle management projects at CERES. In this interview we are going to ask questions about a number of the following topics: Water Management, Behavioural Change, and Sign Creation. This interview should take about 30 minutes. This research will be published. We may want to use quotation from your interview. If you wish we will not use your name or position at (). However, if acceptable to you we would like to attribute information you give us to you directly. Would you be willing to let us use your name? This interview is voluntary. You do not need to participate. You can stop at any time and can skip any question that you do not want to answer. Do you have any questions before we begin?

Name of Representative:

1. What is Yarra Valley Water doing with regards to whole-of-water-cycle management education? What has worked? What hasn't? Why?

2. Have you any success with respect to promoting changes in people's water use behaviours through campaigns? What methods what methods have you found to be most effective? Why or Why not?

3. We are familiar with your "Be smart, chose tap" campaign. Can you give us a brief summary of why you chose this initiative, how you chose this tag line, and how effective you think it is?

4. What can the average consumer do to manage water usage in an environmentally friendly way? What methods do you favour and promote?

5. We are thinking about having a "catch phrase" for each sign… then layers of information:
   ○ What is this?
   ○ What is this an example of?
   ○ Why is this important? / What can I do about it?

   Do you think this is an effective model? Would you suggest any changes? Do you have any ideas for what makes an effective "catch phrase" in your field?

6. Do you have any thoughts about CERES, the programs at CERES, and/or how CERES currently educates people? What do you like? What don't you like? Why?

7. Overall, what do you think is the most important message we can communicate to visitors?

<div align="center">***</div>

8. Do you have any recommendations with regards to our specific deliverables? What YVW issues are most important to highlight in our design of our project deliverables?

9. Are there any specific challenges with regards to water management that your organization faces in this region? If so, what are they and what are you doing to address them?

10. Do you think that governmental incentives and restrictions are effective at encouraging WWCM behaviours in the population? Do you favour these restrictions? Do you think they are necessary? Are they too strict or too lenient?

Partnering with CERES to motivate behavioural change towards whole-of-water-cycle management

      As a three student team from the United States, we have travelled to Melbourne, Australia to partner with the Centre for Education and Research into Environmental Strategies (CERES). The goal of this trip is to aid CERES in motivating behavioural changes concerning whole-of-water-cycle management (WWCM) by increasing awareness about the relevance, importance, benefits, and implementation of its more efficient strategies.

      At CERES, every drop of water has value. Therefore, they have adopted an integrated water management policy (IWCM) to guide their efforts and have successfully applied for a grant for its implantation from the Office of Living Victoria. In this hierarchy, the first option is most preferable and the last option is least preferable.

1. Avoid unnecessary water use.
2. Reduce water consumption (use the most efficient means when water use is required).
3. Reuse stormwater/ rainwater.
4. Recycle grey water/black water.
5. Dispose of water so that streams/ waterways are not adversely affected.

      This integrated water management plan sets the direction for all the water management activities on site. However, the infrastructure for many of the most preferential options is either not functioning or not in place at all. In the next year or so, CERES plans to upgrade and complete much of its infrastructure so as to be an example for all of the visitors about the practical ways WWCM strategies can be implemented. As a project team, we are seeking to develop the signage and web-based information necessary for communicating these projects once they are completed. The goal of this communication plan is to go beyond mere education to motivation of behavioural changes in CERES visitors and the larger community.

      This signage communication plan, which will be expanded upon for other deliverables, is designed to contain 6 signs throughout the park:

1. Replacement of leaky water lines
2. Low flow/ dual flush toilets
3. Rainwater collection and reuse
4. Storm water collection for biodiversity preservation
5. Grey water reuse
6. Black water reuse

Through the development of engaging, informative, and motivating content, it is our goal to increase community awareness and action regarding the need for holistic water conservation in Melbourne.

Name of Representative:

1. What WWCM issues are specific to the Merri Creek and the surrounding area?

2. What is being done at MCM with regards to whole-of-water-cycle management education? Have these programs been successful in changing people's behaviours surrounding creek conservation and restoration?

3. What can the average consumer do to prevent runoff and pollution of waterways such as Merri Creek? What methods do you favour and promote?

4. We are thinking about having a "catch phrase" for each sign… then layers of information:
   ○ What is this?
   ○ What is this an example of?
   ○ Why is this important? / What can I do about it?

   Do you think this is an effective model? Would you suggest any changes?

5. Overall, what do you think is the most important message we can communicate to visitors?

   ***

6. Do you have any thoughts about CERES, the programs at CERES, and/or how CERES currently educates people? What do you like? What don't you like? Why?

7. Are there any specific challenges with regards to water management that your organization faces in this region?

E) Observation Form

Name of Exhibits Visited:

What would you say is the approximate text to graphics ratio?

What is the signage orientation: portrait or landscape?

Is the font size/style difficult to read?

Based on observations around you, does the signage seem to have visitor popularity?

Was behaviour change in any way part of signage? If so, how?

On a scale of 1-10, how attractive and engaging is the signage?

Are they any unusual or interesting techniques employed in how they convey information?

General Notes:

F) CERES Excursions Observation Form

Name of Excursion:

Leader of Excursion:

Number of Students Participating in Excursion:

Education Level of Students in Excursion:

What form of learning was most utilized during the course of the excursion?

What teaching methods were effective during the excursion? Ineffective?

Where there any written materials utilized during the excursion? If so, what was the balance of text to pictures?

Was behaviour change a main focus of the excursion? If so, how?

On a scale of 1-10, how much did students seem to enjoy the excursion?

On a scale of 1-10, how effective did you think the education of the students was during the excursion?

On a scale of 1-10, how motivated to change their behaviour do you think students were from the excursion?

General Notes:

Name of Excursion Leader:

1. What exactly does an excursion leader do? What is your role at CERES?

2. What excursions do you usually lead? Which is your favourite, the most valuable, or most popular? Why?

3. Can you describe the demographic that usually participates in these excursions? What are the participant's background? What's the best way to reach this demographic?

4. Why do you think the excursions are valuable? What makes them better than other education techniques?

5. Do you use signage on excursions? Do you just point them out or actually read them?

6. Do you have any critiques of the current design or the use of signs in excursions?

7. Do you find that these excursions are effective at promoting behavioural change in the students that participate in them?

8. We are thinking about having a "catch phrase" for each sign and layers of information for each system: what this is an example of, why this is important, and what one can do about it. Do you think this is an effective model? Would you suggest any changes?

9. Overall, what do you think is the most important message we can communicate to visitors?

CERES Bookings Coordinator Interview Questions

Name of Representative:

1. What is your current role at CERES? What have your roles been in the past?

2. What kind of demographic most frequently participates in excursions?

3. What water-related programs are currently run at CERES? Which of these are the most popular?

4. We are thinking about having a "catch phrase" for each sign… then layers of information:
   - What is this?
   - What is this an example of?
   - Why is this important? / What can I do about it?

   Do you think this is an effective model? Would you suggest any changes?

5. Do you have any critiques of the current signage used at CERES?

6. Overall, what do you think is the most important message we can communicate to visitors?

1. What methods of communication have worked effectively, which have not? Why?

2. We are thinking about having a "catch phrase" for each sign… then layers of information:
   - What is this?
   - What is this an example of?
   - Why is this important? / What can I do about it?

   Do you think this is an effective model? Would you suggest any changes?

3. How effective do you think CERES has been in instigating behavioural changes in its visitors? How do you think it can do better in the future?

4. Do you have any advice on how to communicate ideas in a manner that is both informative and fun for people?

J) Visitor Survey Consent Script

Hello, we are three students performing a study for a research project here at CERES would you like to participate in a survey?

Our project is focused on determining the best way to provide visitors with information about the integrated water cycle management projects here at CERES. We are looking for information about your experience at CERES today as well as your opinions on three different signs that can be found around the park. This survey should take about 10 minutes. This research will be published but it will not include your individual response, name, or other identifiable information. This survey is voluntary. You do not need to participate. You can stop at any time and can skip any question that you do not want to answer. Do you have any questions before you begin?

CERES Visitor Survey

Take a moment to observe the three signs in front of you; **there is no need to read them**. Each sign has a shape in the upper left corner. Circle the shape that corresponds to the sign you choose when answering the following questions.

1. **Which sign do you find most visually appealing?**

2. **Which sign uses pictures most effectively?**

3. **Based on how the text looks, which sign would you most likely take the time to read?**

4. **Which sign has the most appealing ratio of pictures to text?**

---

5. **How important are each of the following attributes for creating a good sign?**

	Unimportant				Important
a. Includes diagrams or pictures	1	2	3	4	5
b. Easy to read (clear fonts and headings)	1	2	3	4	5
c. Not too many words	1	2	3	4	5
d. Not too technical	1	2	3	4	5
e. Uses bright or appealing colors	1	2	3	4	5
f. Includes a way to get more information	1	2	3	4	5
g. Orientation (portrait or landscape)	1	2	3	4	5

h. Other (please explain: _____)

6. **On a sign, which method do you like written information to be presented in?**
   a. Paragraph form
   b. Bullet form
   c. Q&A
   d. Did you Knows?
   e. Other (please explain: _____)

7. **On a sign, what type of pictures do you most like to see?**
   a. Technical Diagrams
   b. Charts
   c. Photographs/ Pictures
   d. Maps
   e. Other (please explain: _____)

8. **During the "Big Dry", which of the following water conservation techniques did you use?**
   a. Installing a rainwater tank
   b. Not watering lawn/ garden everyday
   c. Not washing car
   d. Installing a low flow shower head
   e. Other (please explain: _____)

9. **After the "Big Dry", which conservation techniques do you still use?**
   a. Installing a rainwater tank
   b. Not watering lawn/ garden everyday
   c. Not washing car
   d. Installing a low flow shower head
   e. Other (please explain: _____)

10. **What amenity is most important to you with regards to water usage?**
    a. Gardens/Lawn
    b. Washing Car
    c. Washing Driveway
    d. Recreational (Sprinkler, Pool, etc.)
    e. Other (please explain: _____)

11. **When it comes to conserving water, what mostly prevents you from changing your behavior or using alternative technology?**
    a. I don't care enough
    b. I don't know enough
    c. Cost of changing
    d. Inconvenience
    e. Safety Concerns
    f. Other (please explain: _____)

Background Information: Please circle all that apply.

Age Bracket: 0-15   16-25   26-35   36-55   55+

Highest Level of Education Completed: Primary   Secondary   Tertiary

CERES Activities Utilized:

a. Café

b. Community Gardens

c. Excursions

d. General Browsing/ Reading Signs

e. Bike Shop

f. Nursery

g. Other (please explain: _____

L) Survey Signs

INTEGRATED WATER SYSTEMS

Australia is the driest inhabited continent and rainfall patterns are highly variable. Over several years CERES has installed a wide range of water harvesting, reuse, collection and reduction technologies. This area is the hub of many of those initiatives.

Rainwater to toilets:
Rain water on the surrounding eight roofs is collected and stored in localised tanks. Water overflow from the tanks then travels via an system of pipes into a 50,000 litre underground tank buried under the turnaround next to the Village Green. This water is pumped up to a header tank next to the Multicultural Classroom so it can gravity feed to the toilet block next to the cafe and to five garden taps. The toilets in this block are fitted with a full/half flush valves in place of cisterns. The toilets use 6 litres for a full flush and 3 litres for a half flush but can be converted to a reduced level of 3 litre full flush and 2 litre half flush when appropriate pan technology is available. In preparation for this change the toilet block has been fitted with a Drain Wave unit. This is a horizontal tank used to clean out sewage pipes when the toilets are fitted with this greatly reduced flush volume. The toilets are connected to the sewer in compliance with Moreland Council requirements.

Creative reuse of building materials is a distinctive feature of the toilet block. The walls are made from reclaimed doors and the sinks from second hand urinals

Stormwater and greywater:
Stormwater from Lee Street is channelled into the ephemeral or temporary wetlands in front of you, retaining this water on our land instead adding to the peak flow burden of the Merri Creek.

Up to 1100 litres per day of grey water from the CERES Cafe flows into this Victorian Environmental Protection Authority (EPA) approved commercial greywater treatment system provided by Rootzone Australia. The beds are planted thickly with Baumea Articulata (Jointed twig rush) and are sealed from the surrounding soil. The roots host nearly 2,500 types of bacteria and 10,000 types of fungi. Oxygen percolates from the roots allowing the microorganisms to aerobically oxidize the organic matter in the effluent. The process of absorption of oxygen through the leaves and passing it down to the roots through their hollow stems acts as a bio-pump. The soil provides filtration and anaerobic digestion also takes place. This system of plants regenerates itself as the old plants die and form useful humus.
The system is energy efficient and provides a natural habitat for animal species.

Underground tanks: www.cubicsolutions.com.au

CERES 50,000 litre underground tank

CERES Cafe Rootzone filter system, April 2012

THIS PROJECT HAS BEEN MADE POSSIBLE WITH THE GENEROUS SUPPORT OF:

Australian Government
Department of Sustainability, Environment, Water, Population and Communities

Hills.   LWG   ClayTech   elg   CUBIC SOLUTIONS
drainwave

NURSERY

Permaculture gardens work with nature to provide us with a healthy, home grown harvest. It begins with good design, healthy soil and an understanding of the local environment and what suits it. A permaculture garden will use less water and no man-made chemicals.

You can buy Australian native bushfood plants, seasonal fruit and nut trees, vegetables and herbs at CERES Permaculture and Bushfood Nursery. It Is is a good place to start to learn about growing food and connecting with nature in your daily life.

WHAT YOU CAN DO

- Grow your own edible garden.

We are migratory birds moving around in a set pattern every year.

In winter we fly to warm places like Queensland and return south, to Melbourne, in spring.

1. **How well does the sign accomplish each of the following?**

	Very Poorly				Very Well
a. A good balance of text to pictures	1	2	3	4	5
b. Ease of reading (clear font size/style)	1	2	3	4	5
c. Not too wordy	1	2	3	4	5
d. Ease of understanding (not too technical)	1	2	3	4	5
e. Engaging and appealing design	1	2	3	4	5

2. Do you think this sign accurately explains stormwater? If not, what information is mission for incorrect?

3. Do you think this sign will motivate people to change their behaviours regarding stormwater? Why or why not?

4. Do you have any recommendations about how the content of the sign could be improves? If so what are they?

5. Do you have any recommendations about how the design of the sign could be improved? If so, what are they?

<u>CERES Visitor Survey</u>

Please take a moment to observe the four signs in front of you; **there is no need to read them**. Each sign has a shape in the upper left corner. Circle the shape that corresponds to the sign you choose when answering the following questions.

1. **Which sign do you find most visually appealing?**   ○ ☆ ▭ △
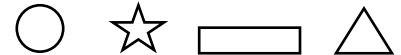
2. **Which sign uses pictures most effectively?**   ○ ☆ ▭ △

3. **Based on how the text looks, which sign would you most likely take the time to read?**   ○ ☆ ▭ △

4. **Which sign has the most appealing ratio of pictures to text?**   ○ ☆ ▭ △

Now, please answer the following question based solely on the "Car Park" sign.

5. **How well does the sign accomplish the following?**

	Very Poorly				Very Well
a. A good balance of text to pictures	1	2	3	4	5
b. Ease of reading (clear font size/style)	1	2	3	4	5
c. Not too wordy	1	2	3	4	5
d. Ease of understanding (not too technical)	1	2	3	4	5
e. Engaging and appealing design	1	2	3	4	5

6. Do you have any recommendations about how the sign could be improved? If so, what are they?

O) What if the Dam Went Dry Sign
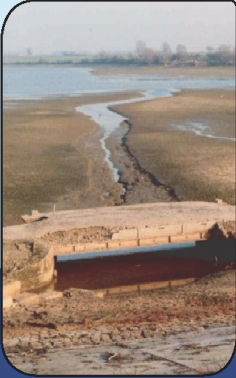
WHAT IF THE DAMS WENT DRY?

Every Drop Of Water Has Value

It is important to use each drop of water wisely. There are multiple **methods** of conserving water including:

- **Using Less**
- **Reusing Water**
- **Recycling Water**

During a drought, the water level in the dams can get very low. If everyone uses less water, than the level in the dams will remain high enough so everyone has enough water.

For more info visit
CERES.org.au

CERES Makes A Difference

There are many ways CERES saves water ...

You Can Make A Difference

- Install low-flow shower heads
- Don't leave the water running
- Use dual flush toilets
- Take shorter showers

P) Waste Not, Want Not Sign

WASTE NOT, WANT NOT

Wasting Water is a Problem

Large amounts of water are wasted on a daily basis. From over watering the lawn, taking long showers, and leaky pipes water is constantly getting wasted. Some **common household leaks** include:

- **The toilet**
- **The tap**
- **Hose valves**

The water saved from being wasted could go on to be used for drinking or watering our plants for food.

For more info visit CERES.org.au

CERES Makes a Difference

CERES recently completed a major project to replace old pipes and fix leaks....

You Can Make A Difference

- Fix leaky pipes and taps
- Wash full loads of laundry
- Take shorter showers

Did You Know?
Enough water is wasted around the world annually to fill the Melbourne dams twice over!

THIS PROJECT HAS BEEN MADE POSSIBLE WITH THE GENEROUS SUPPORT OF:

Office of Living Victoria   WPI

Q) From the Roof to the Garden Sign

FROM THE ROOF TO THE GARDEN

Harvest The Rain

Rainwater harvesting usually involves catching and storing the rainfall off roofs into large holding tanks so it can be used later. Collecting rainwater has a number of **benefits** including:

- **Keeps dam levels high**
- **Reduces stormwater flow**
- **Eases drought restrictions**

CERES Makes A Difference

Most roofs at CERES collect rainwater and store it in tanks. This water can then be used instead of city water for ......

You Can Make A Difference

Install a rainwater tank. Rainwater tanks:
- Can be used to keep gardens green
- Are free of restrictions
- Reduce water bills

For more info visit
CERES.org.au

THIS PROJECT HAS BEEN MADE POSSIBLE WITH THE GENEROUS SUPPORT OF:

Office of
Living Victoria

WPI

R) The Lake from Lee St. Sign

THE LAKE FROM LEE STREET

Issues with Urban Runoff

Urban runoff is flowing stormwater that cannot not soak into the ground. Hard urban surfaces block stormwater from entering the soil and direct it into the waterways. A lot of this quickly flowing flow of water:

- Increases **erosion**
- **Isn't naturally filtrated**
- Increases **flooding**

Urban runoff management methods reduce the **problems** with urban runoff.

For more info visit
CERES.org.au

CERES Lee St. Dam Makes a Difference

CERES collects urban runoff from Lee St. in a dammed reservoir. This water is prevented from flowing into the Merri Creek. This reduces the **problems** with urban runoff around CERES.

You Can Make A Difference

Plant a raingarden including plants:
- With deep fibrous roots
- That are perennial
- That are native

THIS PROJECT HAS BEEN MADE POSSIBLE WITH THE GENEROUS SUPPORT OF:

Office of
Living Victoria

WPI

S) Blackwater is the New Green Sign

BLACKWATER IS THE NEW GREEN

What exactly is blackwater?

Blackwater is wastewater that is comes from the toilet and the kitchen sink. This water is often **contaminated** with:

- **Human Waste**
- **Rancid Food**
- **Grease and Oils**

Because blackwater contains harmful toxins, it is a threat to our waterways. Therefore, we should limit the amount of blackwater we create.

For more info visit
CERES.org.au

CERES takes blackwater seriously

At one time CERES had many composting toilets that used no water. These toilets ....

You Can Make A Difference

You can reduce the amount of blackwater you create by following this simple rule:

- If it's yellow, let it mellow
  If it's brown, flush it down

T) Water Reuse Webpage

For full webpage please visit: http://www.ceres.org.au/greentech/CERES-OLV-2

U) Rainwater Webpage

Rainwater Harvesting at CERES

Water Regulations

During times of very severe drought, the government may create laws and regulations related to the use of water for non-vital purposes such as watering gardens or washing cars. Depending on how long a drought lasts, these regulations can have a great impact on how people live their lives.

KNOW YOUR WATERING SCHEDULE

MONDAY
No watering with sprinklers or irrigation systems

TUESDAY & FRIDAY
Non-residential sites (apartments, businesses, parks, common areas)

WEDNESDAY & SATURDAY
Residential addresses ending in 0, 2, 4, 6, 8

THURSDAY & SUNDAY
Residential addresses ending in 1, 3, 5, 7, 9

Example of daily water restrictions during drought

While these regulations are certainly necessary to maintain a sustainable rate of water usage, they have been met with some criticism.

For full webpage please visit: http://www.ceres.org.au/greentech/CERES-OLV-3

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V) Stormwater Webpage

Stormwater at CERES

The Problems with Stormwater

Stormwater is rainwater that reaches the ground and is unable to seep into the soil because impervious surfaces block its path. 500 billion litres of stormwater is washed off the roofs, driveways, and roads of Melbourne each year. After a heavy rainstorm, a large amount of this potentially contaminated stormwater flows off impervious surfaces and enters local waterways very quickly and can damage the ecosystem and be harmful to humans.
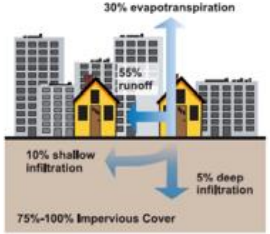
The combination of impervious surfaces and large amounts of rainfall can sometimes lead to flash flooding. Flooding occurs when the rate of rainfall is greater than what can be infiltrated into the ground or swept away, and can cause massive financial damage and even cause the death or injury.

Relationship between impervious surfaces and surface runoff

As stormwater washes through the city, it becomes runoff. When large amounts of runoff rush into the creeks

For full webpage please visit: http://www.ceres.org.au/greentech/CERES-OLV-1

Waste Water at CERES

The Problems with Blackwater and Greywater

Greywater and blackwater are the two types of waste water. Blackwater is sewage containing human waste and/or fats and oils from food and greywater is any other waste water, such as, the waste water from hand basins, washing machines, and showers.

Each type of waste water has harmful pathogens and pollutants that can be harmful to people and the environment if not treated properly. Although blackwater contains more harmful contaminants than greywater, both can be recycled and reused. It is widely unknown that blackwater can be reused and, therefore, an entire source of valuable water is being almost completely ignored.

For full webpage please visit: http://www.ceres.org.au/greentech/CERES-OLV-4