Case Study Analysis: Room for the River

Elizabeth Cobb

Department of Civil Engineering, Gonzaga University

CENG 440 Gonzaga-in-Delft: Sustainable Cities

Drs. Bri Dorie, Sue Niezgoda, Kyle Shimabuku, Rhonda Young

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Abstract

Sustainability is an important focus for cities throughout the world as climate change continues to challenge the function of existing societies. To maintain the natural resources and livelihoods of individuals, a refocused mindset on sustainability's' three pillars of people, planet, and profit is necessary. The Netherlands has taken steps to make its society as sustainable as possible and even developed core values through its Delta Program. This example serves as a good place for Spokane to start on its journey toward making the water resources, buildings and energy, waste management, and transportation and land use as environmentally friendly as possible. Specific to water resources, the Room for the River Strategy meets the three pillars of sustainability because of its protection of people, increasing biodiversity, and potential economic benefit. While challenges exist in finding land to conduct the Room for the River Program, the benefits for society and contributions to sustainable practices make this a necessary part of the Spokane Sustainability Action Plan moving forward.

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Chapter 1 - Introduction

The concept of sustainability is increasingly important as people throughout the world begin to consider the longevity of our planet. Some natural resources on earth are nonrenewable, thus, several areas of action for sustainability need to be addressed. The areas of action within Civil Engineering include, but are not limited to transportation and land use, water resources, buildings and energy, and waste management. As society advances into new generations, change is necessary to sustain the lifestyles and livelihoods of people throughout the world.

Sustainable cities attempt to balance the components of sustainability: people, planet, and profit. These three pillars connect and constrain one another. Each component must be present to have a healthy, sustainable city (Ayers 2017). While a specific definition exists with criteria for a 'sustainable' entity, the makeup of each pillar differs between sustainable cities. Cities have different economic backbones because of their main exports and available resources. Further, the people and planet pillars vary from city to city because of different ecological footprints and built infrastructure. The way people interact with the environment as well as with each other directly impacts how sustainable a city can be and dictates how people in that area function. Another factor that contributes to a city's ability to be sustainable is resilience. Resilience is the "capacity of an individual or a system to survive disturbances unchanged" (Ayers 2017). Resilience looks different from city to city and even from block to block. The disturbances that one city experiences are not necessarily an issue somewhere else. For example, tornadoes that cause damage in the area known as 'Tornado Alley' is not the same type of natural disaster individuals prepare for in the Pacific Northwest. Protecting cities in a sustainable way first requires an understanding of how the natural world interacts with current civilization and infrastructure.

Sustainable efforts start with one person, one business, and one city, eventually growing large enough to get the attention of the government or another organization in a position to make a change. This bottom-up approach is when sustainable changes can begin; however, the most difficult part of this process is altering the day to day lives of individuals. Commuting to work, taking a shower, turning on lights, and throwing away trash are things that people throughout the world do every day. Each provides an opportunity for significant sustainable change and

corresponds to an area of action. Certain cities in the United States, for example, do not have train systems in place as an option for daily commutes. Cars have become "the default way you get around" especially in areas where urban sprawl is prevalent (Johnson 2021). Water is a significant source for sustaining human lives and the quality of water resources must be protected to continue supporting society's functions. Not only does water help transport goods and people around the world, but it is also where cities draw water from to use every day. This water becomes what people drink, cook with in homes and restaurants, and even use to flush their toilets. Wastewater often goes back into the same water resources after going through a treatment facility. The sustainability of treatment is important especially because the returned water enters the ecosystem, and thus directly interacts with the other resources people use. The buildings and energy required for wastewater treatment is one example of an area of action for sustainably as well because the process requires a considerable number of steps to complete. As sustainable change is brought to these action items, the longevity of the planet will increase, and future generations will have systems in place to help them keep the livelihoods of society.

Reduce. Reuse. Recycle. These terms come up often when learning about where trash and recycling goes after disposal. It is easy to ignore this concept when thinking that a small action will not make a notable change; however, establishing sustainability plans all over the world begins with the intention for change. The world we live in now and alter every day is the same physical world in which future generations will live. Society needs to protect the valuable social infrastructures that have been created in a sustainable way. Within Engineering, it is crucial to have sustainability as the focus of projects especially moving into the future.

Civil Engineers within Spokane play a strong role in creating a more economically, socially, and environmentally sustainable urban environments through their design and redevelopment of the city's infrastructure. In particular, the water resources systems designed by a civil engineer can contribute to a city's functionality and maintaining the quality of these resources is an important focus for the future. The Sustainability Action Plan for Spokane outlines ways to work toward maintaining the quality of water resources for future generations but focuses on reacting to the effects of the city's previous interactions with the resources. Dutch civil engineers, on the other hand, have focused on sustainable prevention measures that have

kept the Netherlands safe and flourishing for thousands of years. The different approaches presented by the US and the Netherlands in maintaining water resources have differing effects on the people, planet, and profit of cities.

The following chapters of this report discuss the Water Resources Area of Action for Sustainability within the Spokane Sustainability Action Plan. Further, it articulates the Dutch approach to water resources and the potential for Spokane to adopt these strategies, specifically, the Room for the River Program. The concepts and strategies implemented by the Dutch into their cities have been successful and provide a good example for possible sustainable measures in Spokane.

Chapter 2 – Water Resources Area of Action for Sustainability

The area of action of water resources considers the impacts of both natural water systems as well as managed water systems within a city. Both systems contribute significantly to humans and other living things such as plants and animals which must be protected to maintain the livelihood and longevity of these cities. Water resources further connects to the components of sustainability: people, planet, and profit. People in cities require water to live in multiple ways such as for drinking, cooking, and cleaning. Maintaining the sustainability of water resources for people is important because of its direct ties to the health and well-being of individuals. Human interactions with water resources alter the planet or and the locations water is taken from for human use have direct consequences on the surrounding ecosystems. Goods and services depend on water either directly or indirectly which makes the component of profit, or the economy an important consideration in the sustainability of cities.

Sustainable cities have key areas specific to water resources that include water supply, flood management, and stormwater management. Spokane has two main water resources: the Spokane Valley-Rathdrum Prairie Aquifer or SVRPA and the Spokane River, including its tributaries. The SVRPA is supplied almost entirely by groundwater and is primarily used throughout the city for drinking water. While the Spokane River is not directly used for drinking water, it has several other functions for the city. The river's landscape includes wastewater

treatment plants, municipal stormwater drainage, dams, and new developments (Spokane River Forum, n.d.). Further, the Spokane River is a component of Spokane's heritage and remains an important aspect of the livelihoods of individuals living in Spokane as people go to it to hike, bike, boat, swim, and fish. Considering the water resources in Spokane, the Sustainability Action Plan, or SAP, is a major step in establishing and maintaining safe water sources for the city. The Spokane SAP "refers to the protection and management of the Spokane River aquatic system and the Spokane Valley-Rathdrum Prairie Aquifer to ensure a clean and sustainable water supply, and the management of the associated watershed land use and activities that impact water resources directly or indirectly" (Spokane Sustainability Action Subcommittee, 2021). As shown in Table 1, the goals for water resources include protecting ecosystems, sustaining water supply, educating about water resources, and involving regional businesses.

Table 1: Spokane SAP Water Resources Goals (Spokane Sustainability Action Subcommittee, 2021)

Water Resources	
GOAL 1. Protect the Spokane River and natural aquatic ecosystems (wetlands, shorelines, aquatic ecosystems biodiversity, streams, floodplains, aquifer recharge areas)	
WR 1	Protect water quality, fish, wildlife, ecosystem function, and no-impact recreational opportunities in the Spokane River through responsible, long-term watershed planning and management
WR 2	Build climate resilience in natural water systems through responsible watershed planning
WR 3	Actively manage pollution within Spokane River and SRVP Aquifer
WR 4	Support the protection, restoration, and reintroduction of native fish species and their habitats in the Spokane River Watershed
WR 5	Improve stormwater and wastewater management
GOAL 2. Ensure sustainable water supply	
WR 6	Work with regional partners to reduce pumping from the Spokane Valley Rathdrum Prairie (SVRP) Aquifer in the face of projected population growth and future climate
WR 7	Create clear process and policies for assessing and approving land use and development that will impact future aquifer pumping volumes
GOAL 3. Educate & engage community in water resources stewardship	
WR 8	Promote opportunities to engage the community
WR 9	Promote and fund City programs that align with the Water Conservation Master Plan
GOAL 4. Establish partnerships with regional organizations and agencies to leverage funding and invite community input	
WR 10	Partner with regional groups to provide City input for Spokane River Watershed/SVRP Aquifer management plans and projects
WR 11	Identify opportunities to acquire and restore critical areas, natural areas, and connect riparian corridors for protection and conservation

The goals discussed in the table address the three pillars of sustainability: people, planet, and profit. Spokane works toward protecting its water resources through direct interventions to increase pollutant removal from wastewater in addition to investing in the redirection of urban stormwater (Spokane Sustainability Action Subcommittee, 2021. As shown in Table 2, Strategy 4 addresses ways to protect, restore, and reintroduce native fish species and habitats to the Spokane River.

Table 2: Spokane SAP Water Resources Strategy 4 for Goal 1 (Spokane Sustainability Action Subcommittee, 2021)

Strategy 4. Support the protection, restoration, and reintroduction of native fish species and their habitats in the Spokane River Watershed	
Priority Actions	
WR 4.1	Support the development and operation of a Lead Entity for the Spokane River Watershed to guide restoration of native Redband Trout and anadromous fish habitats through a collaborative framework that functions in concert with local socio-economic and cultural needs
WR 4.2	Support a Lead Entity Coordinator in their development of a Technical Advisory Group and Citizens Committee, inclusive of tribes, county and city governments, state agencies, conservation districts, business and industry, non-government organizations and citizens
WR 4.3	Support a Lead Entity to identify native priority fish species based on their historical distribution, population status, and value to indigenous communities and culture
WR 4.4	Support the identification of habitat limiting factors that may be impacting native fish species
WR 4.5	Support the development and implementation of a habitat restoration strategy that identifies habitat improvement projects addressing previously identified limiting factors

Strategies to protect water resources have been outlined in Spokane's Sustainability Action Plan and for their first goal, includes protecting the ecosystems directly connected to the water supply, building resilience, managing pollution within the water supply, supporting wildlife, and improving stormwater and wastewater management (Spokane Sustainability Action Subcommittee, 2021). The strategies addressing the other goals in Spokane's Sustainability Action Plan follow a similar pattern and emphasize each component of sustainability as well as connecting to the Core Values of the Delta Program: sustainability, flexibility, and solidarity (Slob, M. & Bloemen, P., 2014). The listed strategies also delve into priority actions; however, many actions have yet to be started. The first step toward accomplishing their sustainability goals is creating awareness and support for changes. As an example of successful sustainability

measures, the Netherlands has developed and implemented their own set of goals, strategies, and actions related to water resources and water management as is discussed below.

Researching and observing water resources in the Netherlands, the country has had success in their goals which are driven by prevention instead of reaction to disasters. The Dutch implemented the Delta Program as a response to two large flood disasters in the early 1900's (Mao et al, 2020). Incorporating the core values of sustainability, flexibility, and solidarity into the Delta Program, the Dutch have prioritized a comprehensive approach in their response to the uncertainty of climate change. Regarding sustainability, the Delta Plan focuses on the future and ensures a way to "achieve long-term resilience against climate change" (Mao et al, 2020). Keeping future generations in mind, a sustainable focus on projects ensures balance between people, profit, and planet. Flexibility is also considered in the Delta Plan because it recognizes the uncertainty in climate change and is prepared to use short-term decisions to ensure that long-term plans remain relevant. This also displays the Netherlands' ability to prioritize the potential future of their land and water resources. The Delta Program, relating to the core value of solidarity, displays the effectiveness of having people come together to find a solution to managing water resources. After the flood disasters in 1916 and 1953, the Dutch were motivated to find a solution to prevent any flood from happening again especially because they wanted to protect lives and their built infrastructure (Mao et al, 2020). Solidarity is important with water resources because this core value ensures access to clean water and safety with water resources for all. The Delta Program has a strong focus on sustainability and as shown in Figure 1, their focus incorporates people, profit, and planet.

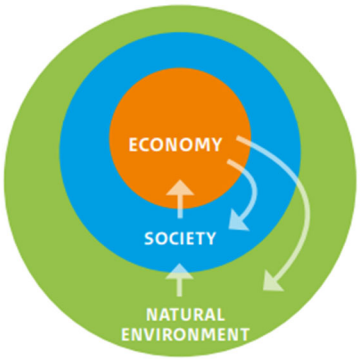

Figure 1: Core Value of Sustainability in the Delta Plan (Slob, M. & Bloemen, P., 2014)

Sustainability has a significant role in the Delta Plan and creates a balance check on people, profit, and planet within the Netherlands, especially when "the three Ps have been out of balance for too long" (Slob, M. & Bloemen, P., 2014). The First Delta Program aimed to prevent future flood disasters and implemented several hydraulic engineering projects, referred to as the Delta Works, focusing on flood risk management. Within the past twenty years, the Dutch have learned from their previous systems and developed solutions for flood risk management, freshwater supply, and spatial adaptation in the establishment of the Second Delta Program. This second program helps address areas of action in water resources specific to their region. Due to most of the land in the Netherlands being below sea level, flood prevention is a significant focus of the Delta Program. This aspect works to ensure the effectiveness of the current Delta Works and encourages plans to replace or update the systems, as necessary. The most recent Delta Program articulates the importance to be "resilient against freshwater shortages" and maps out steps to take to ensure their goals (National Delta Programme, 2021). Their consideration for the freshwater supply supports the sustainable aspects of the environment, society, and the economy. Expecting populations to grow, the Delta Program also looks at spatial adaptation to prepare for how growth will impact water resources and discusses ways to combat the risks. While the Delta Program was initially established in response to flood disasters, it has grown to consider much more than just preventing floods. The Netherlands has also prioritized ways to maintain the balance of ecological footprints within water systems. The building with nature perspective ensures that wildlife can move about in as natural of a way as possible, which maintains the sustainable component of the environment (Wiersma et al, 2014). The core value of sustainability is increasingly important, not only because of climate change but also because of nonrenewable resources.

Serving as an example to Spokane and other cities, the Netherlands has successfully implemented sustainable practices. The Dutch economy, natural environment, and the health and wellbeing of their region has experienced the impact of these changes. Economically, the Dutch have effectively been able to reduce the long-term costs because they have invested more upfront to ensure no large-scale flood disasters. Their natural environment has been directly impacted by

the expansion of cities, activating the systems of polders[1] for more space. The Dutch also encourage the health and wellbeing of their region through maintaining the cleanliness of their water sources for drinking and promoting travel via waterways.

Spokane's Sustainability Action Plan indicates the city's intention to implement multiple strategies to conserve and recharge the aquifer (Spokane Sustainability Action Subcommittee, 2021). This ensures that future generations will also be able to use the aquifer. Other steps have been taken to protect the Spokane River through increasing pollutant removal from wastewater and redirecting stormwater (Spokane Sustainability Action Subcommittee, 2021). Spokane is working toward sustainable water resources and has the potential to develop an effective system. There is potential for Spokane's water resources to reflect the core values of the Delta Program especially regarding the Room for the River Strategy.

Chapter 3 – Room for the River Sustainable Strategy

The Room for the River strategy implemented in the Netherlands is a sustainable solution to the water resources area of action because of its positive impacts on the pillars of sustainability. In the Netherlands, the Room for the River Program is currently being implemented and works "to reduce flood risk" and "increase the spatial quality by creating more space for the river" (Zevenbergen et al., 2013). As shown in Figure 2, the Program has multiple measures that can be applied during the process of adopting Room for the River to fit specific rivers throughout the world.

[1] A polder is a section of reclaimed land from the sea or rivers and is protected by surrounding dikes.

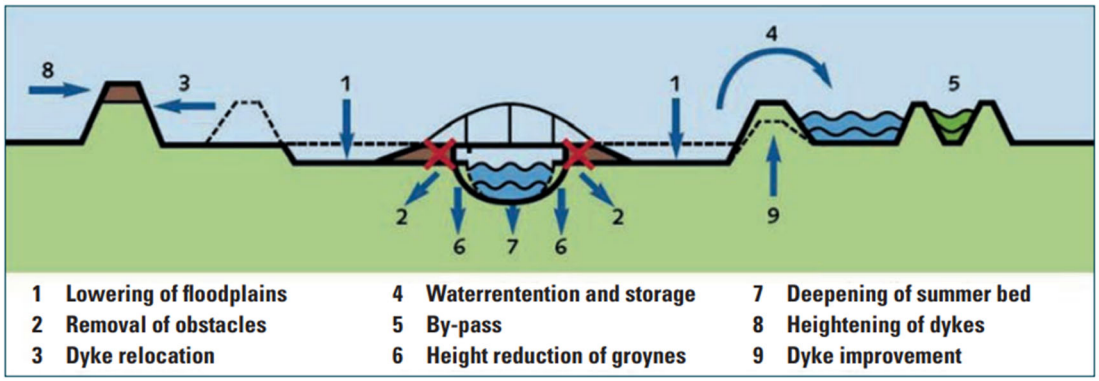

Figure 2: Measures Applied in the Room for the River Program (citation)

This program has key features that address balancing multiple objectives and is more widely applied as Integrated River Basin Management, or IRBM. The objectives of Room for the River include balancing "providing safety, transport capacity, opportunities for recreation, enabling nature, water supply, facilitating economics, safeguarding aesthetics and water quality" (Zevenbergen et al., 2013). The program is a sustainable solution for water resources because of its use of natural processes. It further protects people because it reduces the risk for major flooding thus preserving the lives of people and built infrastructure within cities. In addition, the program has positive impacts on the planet because it enhances the ecosystem through increasing biodiversity of fish and other naturally occurring things. Room for the River also provides the opportunity for economic benefits following enhanced ecosystems because of the improvements to natural resources. The changes to natural resources can alter the tourism industry in the area, provide new nutrients to fish populations, and protect cities downstream.

The Room for the River strategy would fit into the specific goals of the City of Spokane's Sustainability Action Plan because it addresses a way to protect the natural aquatic ecosystems, especially floodplains. Using natural processes, the room for the river program is feasible in the surrounding areas of Spokane that are not as densely populated, especially those upstream from city center. Implementing the Room for the River Program in Spokane would decrease the flow rate of water through the city because water would have more time to spread out upstream. It would also benefit the environment for fish populations with access to different nutrients in the floodplain. As displayed in Figure 3, the fish on the right are from the floodplain and the fish on

the left are not. This correlates to the increased biodiversity that comes with the room for the river program.

Figure 3: Comparative Growth rates of Chinook Salmon (Jeffres et al., 2008)

The Room for the River Strategy would work well in the surrounding area of the City of Spokane, especially considering connecting river such as Hangman's Creek to the Spokane River. Working to implement the program in this area would be beneficial as much of the area surrounding Hangman's Creek is filled with sediment from the nearby wheat fields. This would provide an opportunity for significant ecological enhancement and increased biodiversity. A challenge that may hinder the implementation of this program in the Spokane area includes the "fundamental changes in institutional arrangements at various levels" (Zevenbergen et al., 2013). It is extremely difficult to persuade landowners, typically farmers in this case, to allow their land to be used for something else. The benefits of the Room for the River Strategy can far exceed the cost of land when it comes to the value of human life, built infrastructure, and the future of the environment.

Chapter 4 – Conclusions and Recommendations

The three pillars of sustainability, people, profit, and planet are each considered in multiple areas within sustainable cities and create a baseline for civil engineering projects. The water resources area of action in Spokane and the Netherlands provides an opportunity for

growth in the pillars of sustainability. More specifically, the Netherlands' implementation of the Room for the River Strategy gives a steppingstone for Spokane to consider ways to protect people, profit, and planet moving toward the future. Most significantly, the Room for the River Strategy addresses the goals within the Spokane Sustainability Action Plan to protect the natural aquatic ecosystems in the surrounding areas and within Spokane. The program would further address the Spokane SAP's goal to "establish partnerships with regional organizations and agencies" through working with the individuals responsible for the land in which would be best for the Room for the River Program (Spokane Sustainability Action Subcommittee, 2021). Collaborating with individuals in the surrounding area will also be a significant challenge for helping the City of Spokane meet its intended outcomes, however, beginning the discussion now is essential for the possibility of change.

The unpredictability of climate change is a significant contributor to the need for sustainable practices. The City of Spokane should initiate a plan now to work with surrounding areas to develop Room for the River Programs to decrease the chance for flooding to protect the lives of people, reintroduce fish species to the floodplain to benefit biodiversity, and increase the economic potential of the river.

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