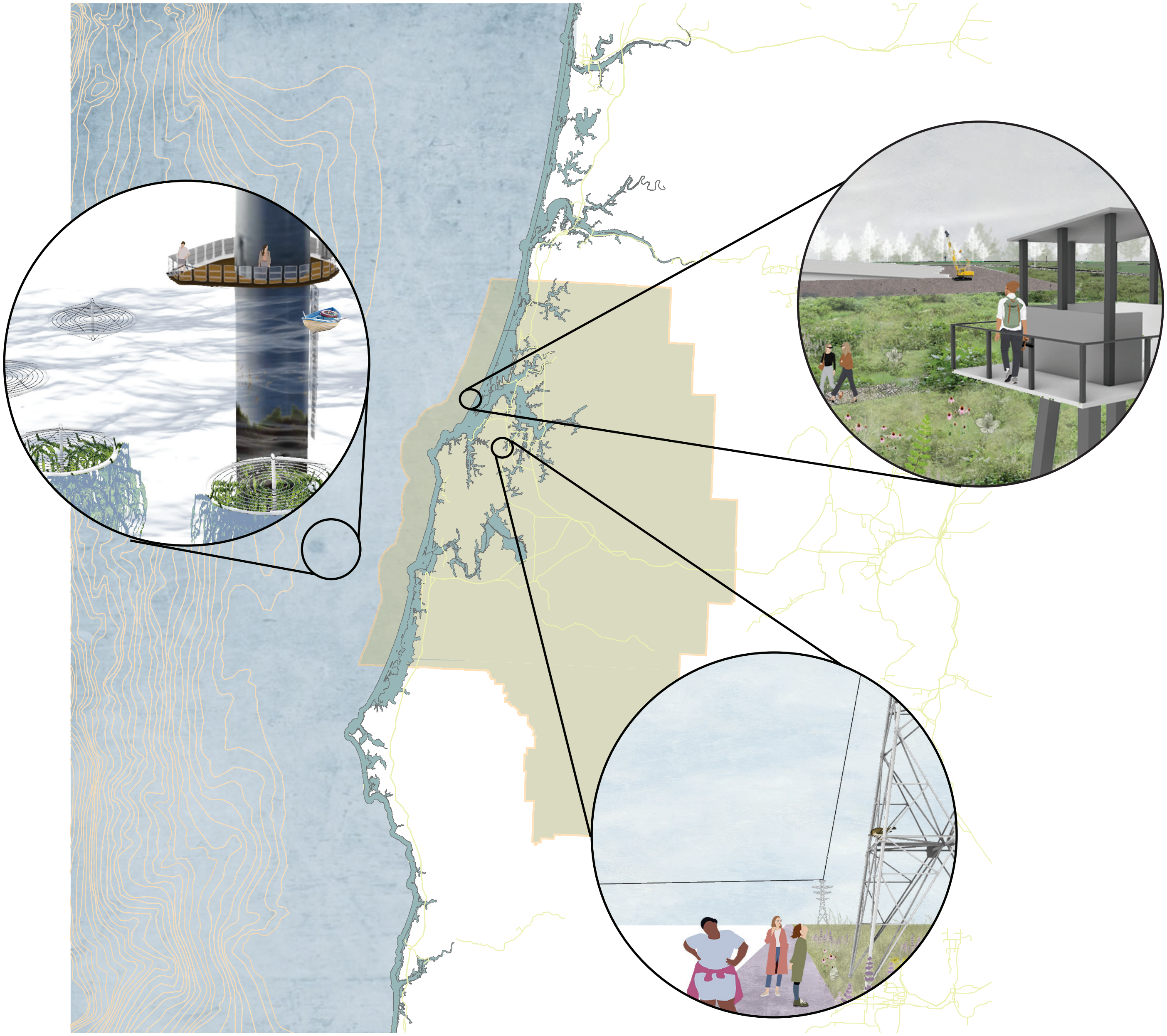

A Landscape Approach to Multifunctional Floating Offshore Wind Energy in Coos Bay, Oregon

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I want to thank my advisor, Yekang Ko, whose guidance and inspiration were so crucial to the making of this project, to all those who led their time and voice, and to my friends, family, professors, and cohort who supported me along the way.

Abstract

In an urgent call for climate actions and a Green New Deal, policy such as the "Ocean-Based Climate Solutions Act of 2020" looks to offshore renewable energy to aid in the goal of a clean electricity system while also looking to restoration and conservation of blue carbon habitats, prioritization of regenerative ocean farming, and protection of front-line communities. In recent years, off-shore wind has been pursued across the world as a promising way to mitigate climate change.

The history of green-on-green conflicts point to how poor planning of large-scale renewable energy infrastructure and lack of community engagement leads to compromise in protecting critical habitats and communities. To address this challenge, this project questions how landscape architecture can play a key role in serving the interests of public and local stakeholders while addressing the green-on green conflicts around renewable energy development.

I offer a landscape approach which combines multi stakeholder and multifunctional landscape techniques through a systems thinking approach. This project shows how this multi-functional landscape framework contributes to creating environmental, social, and economic synergies around off-shore wind farm development in the era of climate change.

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Chapter 1: ***Introduction***

1.1 Introduction

The ocean plays a fundamental role in our climate system, the time is now to look to it for solutions (Flemma et al., 2020). Representative Raul Grijalva, Arizona, Kathy Castor, Florida and 37 other colleagues sponsored the recently introduced "Ocean-Based Climate Solutions Act of 2020," shown in FIgure 1.1. This bill outlines the key ways in which the ocean can play a heroic role in reducing carbon emissions, protecting front line communities, restoring coastal and ocean ecosystems, and creating new "blue" jobs (Flemma et al, 2020). The current Biden administration has made ambitious commitments to confronting climate change, including limiting global warming to 2 degrees celcius. Congress needs to approve the Ocean-Based Climate Solutions Act and Biden needs to take inspiration from it and begin authorization of exectuive orders (Flemma et al, 2020). On May 11, 2021 Biden approved the first major commercial-scale wind farm off the coast of Massachusetts. The Vineyard Wind project has the potential to power 400,000 homes (Davenport and Friedman, 2021). This executive order is the first of many that will pave the way to a clean energy economy.

Figure 1.1
Rep. Raúl Grijalva's on ocean-based climate action
Source: https://aldianews.com/

Along with national efforts, the International Ocean panel, an international panel of 14 leaders, released a document titled "A Sustainable and Equitable Blue Recovery to the COVID-19 Crisis." They outline five priorities within a blue stimulus that could rebuild the economy,into a stronger and more resilient one. These include investing in coastal and marine restoration and protection, investing in sewage and wastewater infrastructure for coastal communities, investing in sustainable community-led non-fed marine aquaculture (mariculture), incentivising zero-emission marine transport, and incentivising sustainable ocean-based renewable energy (Northrop et al, 2020). In order to rebuild the community from the devastation of COVID-19, including these priorities in the design and planning of offshore wind development is essential.

As large scale renewable energy infrastructure projects begin to develop, it is important to consider the land-use conflicts that they are likely to create. We can refer to this idea as a "green on green" conflict. The land use controversies in the American Southwest from utility scale solar energy development offer history to this issue. Such projects faced social controversy over habitat and cultural resource threats. Many of the solar projects in California drew comments to the Department of the Interior and BLM citing a lack of consultation and participation opportunities (Mulvaney, 2017). The Defenders of Wildlife were particularly loud in this respect. In regards to offshore wind planning on the California coast, the Defenders of Wildlife were clear in their support of clean energy development, but only if done with adequate planning and stakeholder participation. In a letter, the defenders called for a "smart from the start" approach. This includes proper planning and management alongside stakeholders (Defenders of Wildlife, 2020). Pearce et al. (2016), identified similar solutions to green on green conflicts. By meeting with stakeholder groups individually to identify "least conflict solutions" the team could then form "combined rather than consensus" results.

Stakeholder engagement highlights the wide array of impacts that renewable energy infrastructure can have on society. Therefore, planning and development initiatives need to be approached through a multifunctional framework. Planning green infrastructure through multifunctional landscape features will increase the performance of the space (Lovell and Taylor, 2013). Pevzner rethinks "energy infrastructure as backbones of a synergistic and multifunctional network, with the potential to balance new public uses with new habitats, ecological restoration with economic development" (Pevzner, 2015). For example, MLA student Sarah Gaines proposed a "bundled Infrastructure corridor" where power lines are situated with an evacuation road and tourism trail," shown in FIgure 1.2.

Ko et al. (2011) refer to green on green conlfict when analyzing the green initiatives in Incheon, South Korea where plans for the largest tidal power plant and a master plan for a green city will destroy critical tidal flat wetlands. The authors refer to a solution in

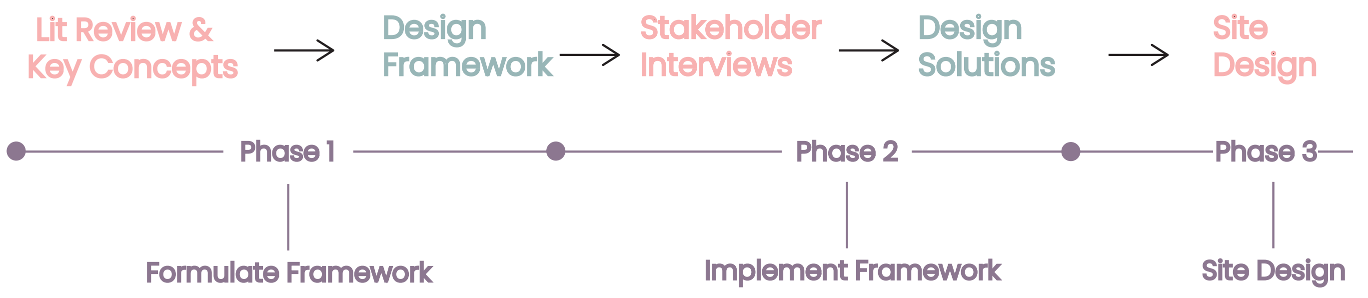
Figure 1.2
Sarah Gaines reconceptualization of power lines as a bundled corridor
Source: (Pevzner, 2020)

which a “systemic approach” is considered, instead of a “segemented” approach (Ko et al., 2011).

The large scale infrastructural changes that renewable offshore wind is calling for will undoubtedly have an impact on the landscape. Landscape architects have the means to ensure that these impacts serve the interests of the public and the local stakeholders (Pevzner, 2019). Therefore, this project proposes a landscape approach that incorporates multistakeholder engagement and multifunctional landscapes (Sayer et al.2013) through a systems thinking (Daniels and Walker, 2001) process.

1.2 Research Question

How can a systematic multifunctional landscape approach mitigate the “green-on-green” conflict associated with the development of floating offshore wind energy through multistakeholder engagement?



1.3 Methodology

To address my research question, I broke my project into three phases, shown in Figure 1.3. The first phase of the project draws from recent literature across several fields including conflict resolution, public particicipation, design thinking, resilience thinking, multiple stakeholder landscapes and multifunctional landscapes. This literature was synthesized to identify design processes as well as key principles in relation to the key concepts. They key concepts were used to formulate a design framework.

The second phase involved applying the framework to the context of Coos Bay to create a set of design typologies. Informal, informational interviews were conducted with various stakeholders in Coos Bay, OR to gain supplemental and first hand knowledge regarding their perspectives on offshore wind development. In addition, newspaper articles and publications were used to inform a greater understanding of these different perspectives. The results of this process were used to create a set of design solutions.

In the third and final stage I applied my findings to a site design in Coos Bay, OR.

Figure 1.3
Methodology diagram

1.4 Significance

The Oregon coast currently has no local generation systems. The state of oregon relies heavily on inported energy. Most of this energy is generated from hydroelectric energy and the remainder from carbon emitting sources. The Oregon coast offers some of the most powerful winds in the United States and therefore has the potential to play a major role in securing large scale localized renewable energy (Data for Progress, 2020).

This project focuses on offshore floating wind development in Coos Bay, Oregon. The absence of offshore wind energy development on the west coast of the United States currently brings major significance and importance to the need to set a successful precedent. Development is on the horizon as this year the Bureau of Energy Management (BOEM) begins the leasing process in Coos Bay. It is incredibly important that BOEM and the energy developers understand the concerns of local stakeholders as well as the opportunity that offshore wind development can have for the local community.

Potential conflict around co-management of the ocean among fishing groups, environmental groups, tribal groups, labor groups, and coastal residents calls for a plan that engages each of their needs. Fishing groups fear that critical fishing grounds will be taken from them, environmental groups fear that the infrastructure will damage critical ocean ecosystems, and the coastal community fears the uncertain future of their city.

Local efforts are already underway in Coos Bay, particularly by the organization OCEAN Winds (Offshore Coastal Energy Alliance Newtork). This project works to support their mission to “create community equity in the blue green energy discussion (OCEAN, 2020).”

Renewable energy infrastructure is likely to scale up significantly in the coming years. The framework introduced in this project is designed to be applied to different contexts to aid landscape designers in ensuring that community voices are heard in the process.

Figure 1.4
Lobsterman protest wind farm development in Maine
Source: https://bangordailynews.com/

Chapter 2 :
Key Concepts

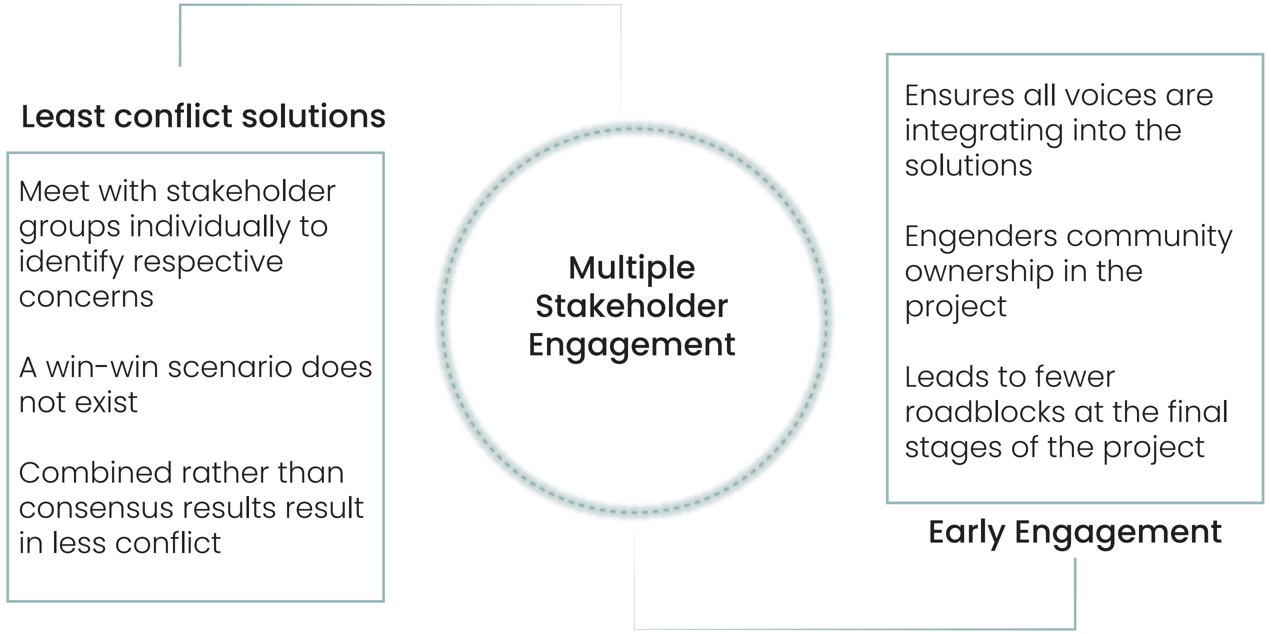
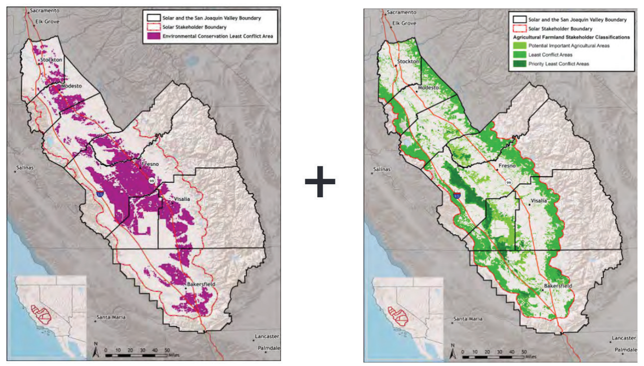


Figure 2.1
Multiple stakeholder egagement key principles

2.1 Multiple Stakeholder Engagement

Engagement with stakeholders is an essential component of a landscape approach and to the concept of resilience. The goal of this engagement is to define a "least- conflict" approach to offshore wind energy development in Coos Bay, OR. This was the goal of a research team seeking to find least-conflict solar PV development in California's San Joaquin Valley (Pearce et al, 2016). This research team met with stakeholder groups individually to identify their respective concerns and desires, seen in Figure 2.2. By acknowledging that a win-win scenario could not exist, the research group then came together to devise solutions that met in the middle. Therefore they formed "combined rather than consensus" results to best achieve a "least-conflict" solution, seen in FIgure 2.3 (Pearce et al, 2016).

Lack of early engagement with stakeholders is often a contributor to major roadblocks towards the time of implementation. Not only does it produce solutions that leave out critical users, but it inhibits the project from operating entirely. In a letter drafted from the Defenders of WIldlife regarding the development of offshore wind on the California coast, the defenders emphasized the need for a "smart from the start" planning approach (Defenders of Wildlife, 2020). They mentioned the need to set a intentional precedent and framework on the west coast of the U.S. How we plan for the initial instalment of OSW will set the precedent for the future (Defenders of Wildlife, 2020).



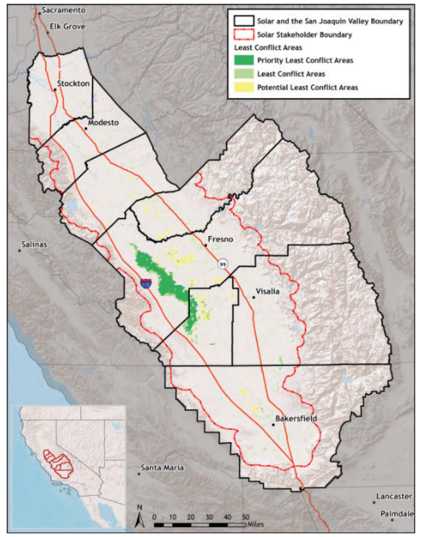


Figure 2.2
Development of least-conflict areas from (Pearce et al, 2016, pg 28)

Figure 2.3
Least conflict model from (Pearce et al, 2016, pg 29)

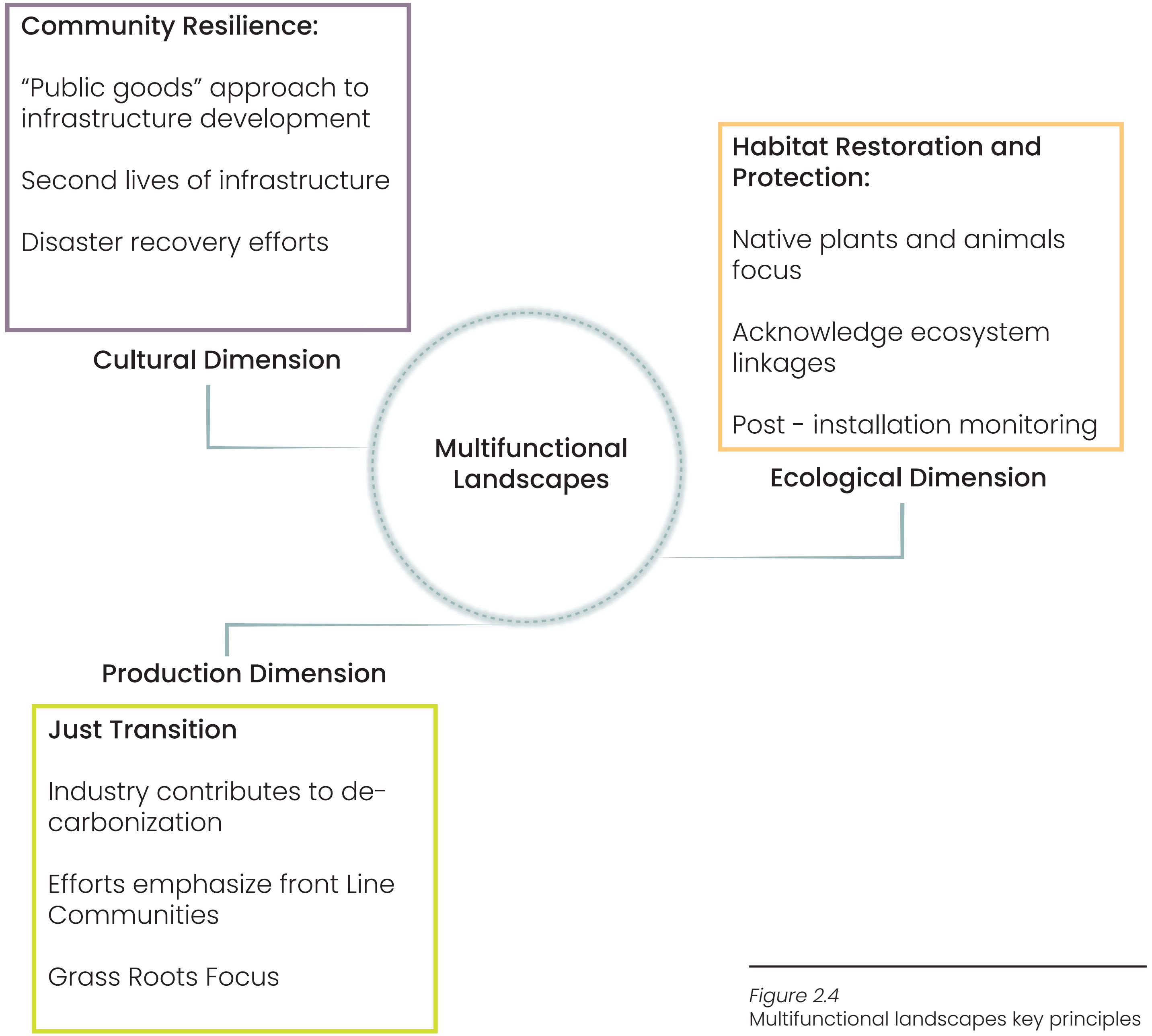


Figure 2.4
Multifunctional landscapes key principles

2.2 Multifunctional Lanscapes

Landscapes with multiple functions are, "landscapes that provide a range of beneficial functions across production, ecological, and cultural dimensions, considering the needs and preferences of the owners and users (Lovell et al. 2013)." Yang describes them as "multifunctional landscapes, by definition, are designed for multidimensional benefits. (Yang et al, 2013)." A multifunctional framework to landscape design is useful in its contribution to the co-transformation of the social and ecological values of a landscape system (Lovell et al, 2013). Multifunctionality is seen as a key element of sustainable energy landscapes (Selman, 2009).

Multifunctionality consists of three key dimensions that embody three key elements of sustainability. The cultural dimensions represent the social realm of sustainability, the ecological dimensions represent the environmental realm, and the production dimensions represent the economic realm of sustainability (Lovell et al, 2013). The performance of a landscpe increases as the different functions are stacked on one another through the introduction of various landscape features, shown in Figure 2. 5 (Lovell et al, 2013). The concept of multifunctional landscapes is particular in that its functions interact beyond their location, the interactions are synergistic and postive, the landscape provides services beyond cultural association, and rural and urban regions are considered a continuous matrix (Lovell et al, 2013). Most significantly, multifuncitonal landscapes highlight the land owner and its users as the primary stakeholders.

This project further defined the production, ecological, and cultural dimensions of multifunctional landscapes, which are described in the following section.

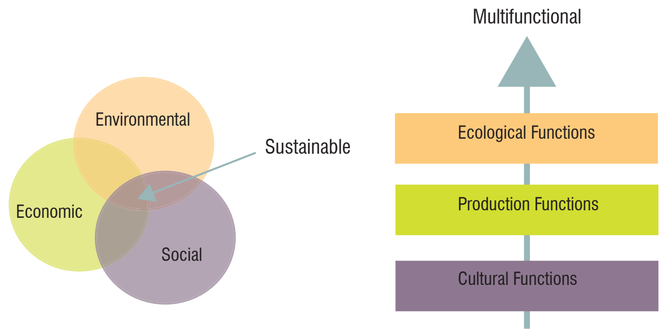
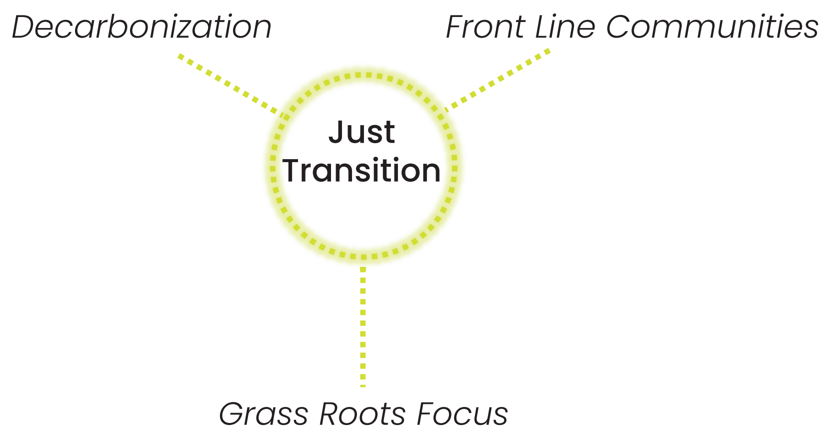


Figure 2.5
Comparison of the concepts of sustainable and multifunctional from (Lovell et al, 2013, pg 6)



Production

Production functions work to enforce a just energy transition. According to the Climate Justice Alliance (CJA), a "Just Transition is a vision-led, unifying and place-based set of principles, processes and practices that build economic and political power to shift from an extractive economy to a regenerative economy (CJA, 2019)." Just transition strategies were intially formed by labor unions and environemntal justice groups from low-income communities of color who needed to address the industries harming their workers and communities health. They formulated strategies that worked to both recover from harm as well as transition away from polluting industries (CJA, 2019).

The transition to production modes that center on decarbonization is a key element to a future under the Green New Deal. To effectively confront the climate crisis, we need to shift to more localized production systems that are not dependent on fossil fuels. The CJA group provides a framework through a series of principles required for a just transition. The framework is focused on creating deep democracy in which power and resources are shifted to the hands of the workers and communities. The principles include special attention to frontline communites, building grassroots power, indigenous consent based on The United Nations Declaration on the Rights of Indigenous Peoples (UNDRIP), renewable energy instead of "clean energy", and a transparent, inclusive, and democratic process (CJA, 2019).

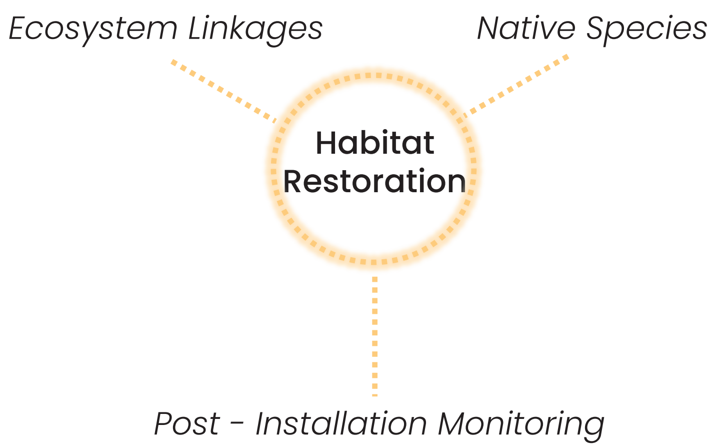
Special attention to frontline communities involves focusing on the workers in the energy sector and sectors alongside it such as construction, farming, transportation, water and ecosystem stewardship (CJA, 2019).

To build grassroots power, community led and operated production sites should be prioritized. Community -led strategies that work towards a regenerative economy include sustainable agriculture, energy democracy, land and water stewardship, affordable housing, and localized clean energy (CJA, 2019).

Most specifically, a just transition looks beyond the issue of carbon and recognizes that solutions only targeted toward reducing carbon will not solve the larger crisis (CJA, 2019).

Figure 2.6 (left, above)
Just transition key principles

Figure 2.7
Climate Justice Alliance
Source; https://climatejusticealliance.org/



Ecological

Renewable energy has the ability to mitigate the effects of climate change on the environment, drastically. However, the infrastructure needed to support this endeavor engenders fear in the environmental community that the ecological damage and displacement from the infrastructure will be too much. The risks from offshore wind development include birds and bat collision, disruption to marine mammal corridors, and scour and sediment resuspension around the foundations (Copping, 2020).

Copping et al (2020), outline a framework for protecting wildlife while enabling renewable energy. The framework adapted the existing ecosystem-based management (EMB) framework to apply to wind energy development. The researchers used case studies to test and then refine the framework (Copping, 2020). The framework offers a set of 11 goals that are accompanied by "wind farm objectives needed to meet risk-based management goals." The framework, shown in Table 2.1, was used to inform the set of key principles related to this project.

Figure 2.8
Habitat restoration key principles

Goal	Wind Farm Objectives Needed to Meet Risk-Based Management Goals
Sustainability	Native animals, plants, and the habitats and migratory corridors that support them must persist and take into account population-level effects
Ecological health	The health and resiliency of the overall ecosystem is maintained or enhanced through management acitons
Inclusion of humans in ecosystem	A range of ecosystem services are accomodated in the area of wind farm development
Complexity	Management decisions acknowledge linkages between ecosystem components
Temporal	Post-installation monitoring data collection and mitigation actions are applied seasonally as needed for key populations
Spatial	Baseline assessments and post-installaiton monitoring of key populations cover spatial scales
Economics	Operational constraints to protect wildlife and habitat allow sufficient power generation for wind farms
Stakeholders	Interested parties are consulted at the start of the development process
Science-based	Management criteria are science-based
Technological	Appropriate technologies and scientifically validated methods are used
Adaptive	Adaptive management principles and procedures are applied to allow changes in post- installation monitoring

Table 2.1 (Above)
Ecological risk - based management framework (Copping, 2020, pg 6)

Cultural

The cultural dimensions of multifunctional landscapes work to enhance community resilience. Energy democracy revolves around the idea that a "public goods" approach is necessary to the transition from fossil fuels. This means that the resources, capital, and infrastructure needs to shift from private hands to the public sector (Seeney et al, 2015). The Trade Unions for Energy Democracy used the strategy "Resist, Reclaim, Restructure (Sweeney, 2013)." This refers to resisting corporations' fossil fuel agenda, reclaiming the parts of the energy system that have been privatized or marketized, and restructuring the global energy system to support safe low-carbon renewable energy that is supported by sustainable job creation (Sweeney, 2013).

Knitting together infrastructure with public space is a key principle to energy democracy. Christopher Jones uses the term "landscapes of intensification" to describe the infrastructure networks created by energy transitions. Landscape changes reach far beyond the points of generation. We need to think about the vast networks of transmission corridors and substations (Jones, 2014) . The construction of new infrastructure will create various nodes, such as construction camps and service roads. We need to think about the second lives of these infrastructures; service roads can be transformed into public roads or construction camps into recreational facilities.

Community disaster resilience is strengthened by social infrastructure. This was found to be the case in communities affected by devastating hurricanes in Puerto Rico. Soler and Lloveras-Marxuach, 2019 looked at the use of community solar hubs in El Caño Martín Peña, Puerto Rico as a means of generating resilience and equity through community power and control, shown in FIgure 2.10. Four community centers were equipped with solar panels and battery storage. In the event of a disaster, the community center provided space and electricity for community gathering. In non-disaster times, the hubs continue to provide essential services while empowering the community through energy ownership and operation (Soler and Lloveras-Marxuach, 2019).

Figure 2.9 (left)
Community resilience key principles

Figure 2.10
Solar Hub in El Caño Martín Peña, Puerto Rico from (Soler and Lloveras-Marxuach, 2019)

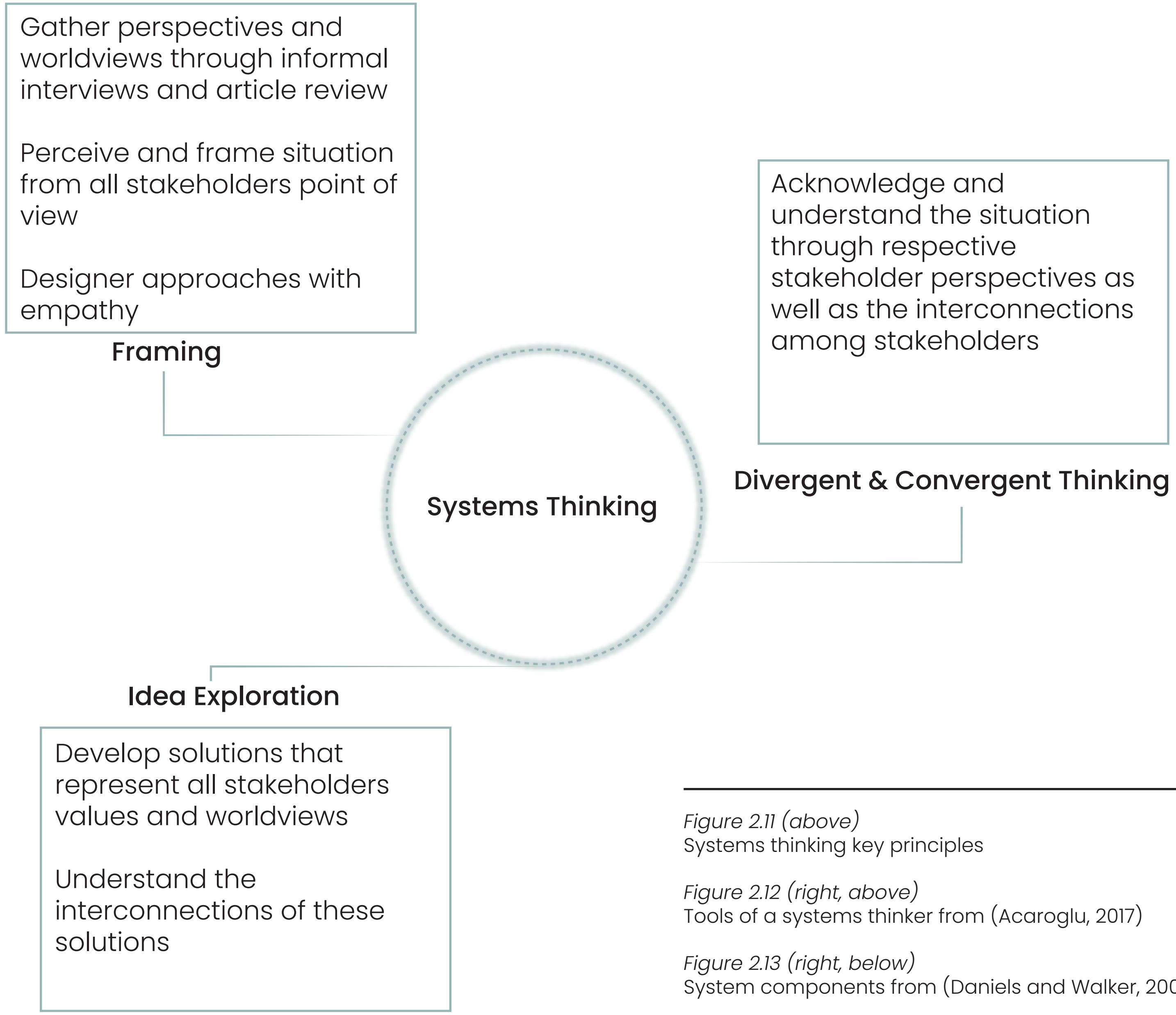


Figure 2.11 (above)
Systems thinking key principles

Figure 2.12 (right, above)
Tools of a systems thinker from (Acaroglu, 2017)

Figure 2.13 (right, below)
System components from (Daniels and Walker, 2001, Ch 6)

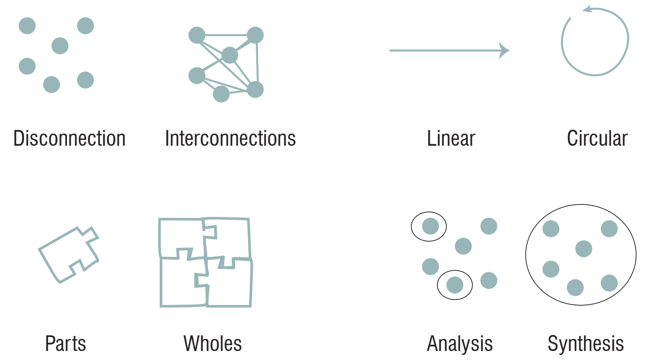
2.3 Systems Thinking

It is important to analyze the offshore wind conflict in Coos Bay in the context of systems thinking, as Senge described it, "seeing interrelationships rather than linear cause-effect chains, and processes of change rather than snapshots (Senge, 1990)."

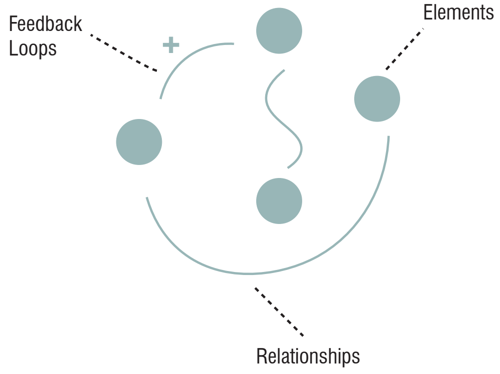
Systems thinking allows us to address complex problems while acknowledging that component parts act different than they do within a system (Daniels and Walker, 2001). In "A Case for Systemic Design," Allison Bouganim speaks to the importance of systems thinking; "The integration of Systems Thinking, into the Design Thinking process, gives context to the scope of design work and enables the creation of more meaningful and intentional solutions. It is a means of embracing the chaos and exploring the interconnected complexities of the system (Bouganim, 2020)."

Leyla Acaroglu, a designer and sociologist, offers key tools that are fundamental to systems thinking, they are illustrated in Figure 2.12 (Acaroglu, 2017). The basis of these thinking tools involves shifting the mindset from linear to circular. Interconnections involves understanding that everything is reliant on other things to survive. Synthesis, as opposed to analysis, approaches understanding the parts as well as the whole (Acaroglu, 2017).

Daniels and Walker, provide a diagram illustrating the different components that



make up a system (Daniels and Walker, 2001). These include; elements, relationships, and feedback loops. Elements represent the "things" of the system; the nouns. Relationships represent the connections between elements. Feedback loops describe how elements reinforce, positively or negatively, certain functions (Daniels and Walker, 2001). These system components, illustrated in Figure 2.13, are used to analyze a situation in which multiple objectives exist (Daniels and Walker, 2001).



Systems thinking involves the use of both divergent and convergent thinking. Divergent thinking processes use analogical thinking to create novel perspectives in the framing process. Convergent thinking uses synthetic and integrative thinking to recognize patterns (Donaldson and Smith, 2017).

Table 2.2 is a description derived from Donaldson and Smith (2001), of the design thinking characteristics that are integrated in the process of framing and idea exploration. The first step in the systems thinking process is framing. The designer situates themselves as a learner, and uses modes of inquiry and empathy to appreciate the perspectives of individual stakeholder groups (Donaldson and Smith, 2017). Modes of inquiry include semi-structured interviews and synthesis of related publications such as articles and maps (Daniels and Walker, 2001).

The second step of the process begins to identfiy solutions through idea exploration. The designer identifies solutions through abductive reasoning and pattern formation (Donaldson and Smith, 2017).

Table 2.2
Domains of Design Thinking for Engaged Learning from (Donaldson and Smith, 2017, pg 16)

Domain	Design Thinking Characteristics
Framing	Treat all problems as “wicked” problems
	Create “frames” - bovel perspective, standpoints, or positions
	Learn by modeling, pattern-formation, and synthesis
	Value practicality, ingenuity, empathy, and appropriateness
	Question all “facts,” and critically challenge “reality,” particularly social/cultural systems
	Deeply understand problems in context, particularly regarding human aspects of context
Idea Exploration	Use abductive reasoning in simultaneous creation of solution, process, and value
	Understand through exploring, connecting, and intersecting information
	Use both divergent and convergent thinking
	Use synthetic and integrative thinking

Chapter 3 :
Design Framework

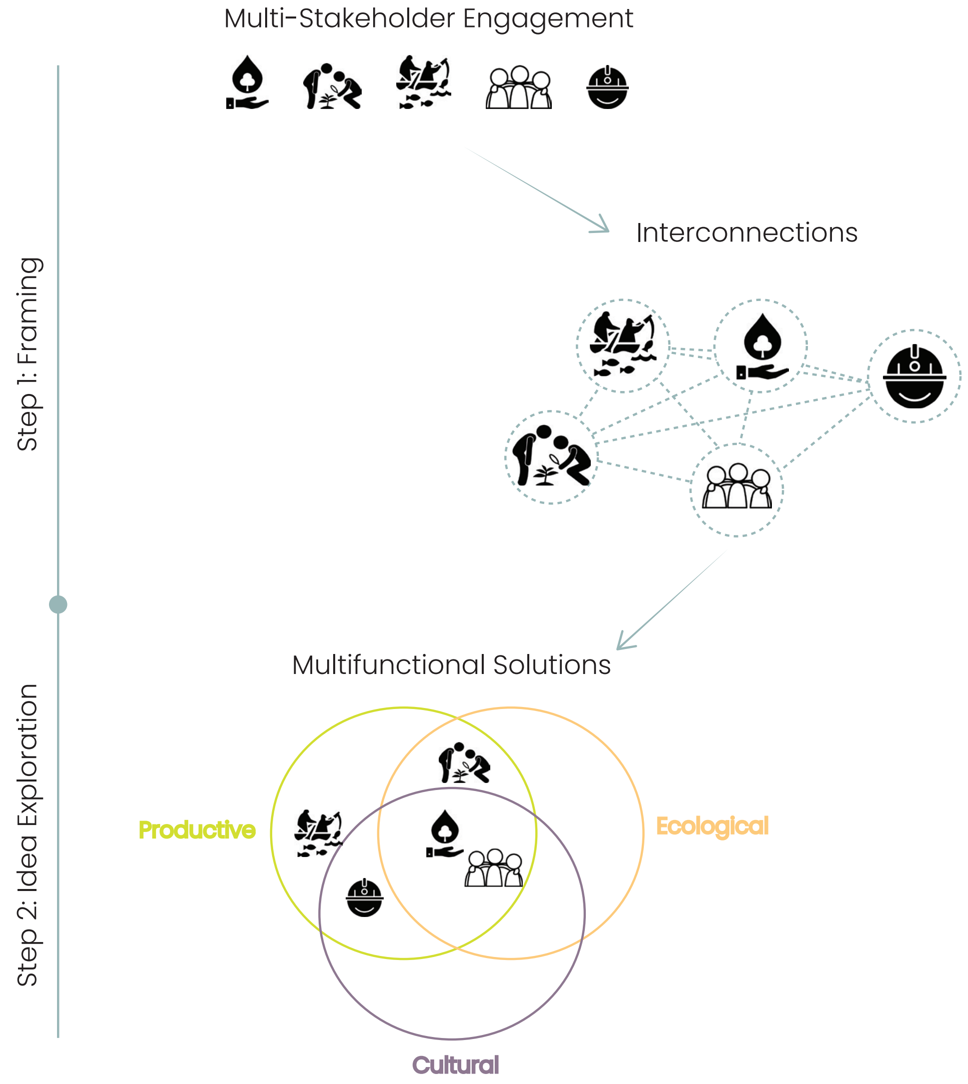


Figure 3.1
Design framework

3.1 Design Framework

The key concepts all informed the creation of a design framework, shown in Figure 3.1. The design framework uses the processes of systems thinking to synergize multi-stakeholder engagement and multifunctional landscapes. This synergy is crucial to formulating design solutions that represent and unite all of the stakeholder concerns.

Step 1 is framing where the perspectives and concerns of individual stakeholders through informal interviews and reviews of newspaper articles are obtained. First, the designer conducts multi-stakeholder engagement through divergent thinking processes to learn and reflect on the different stakeholder perspectives. It is important that the designer approaches each stakeholder engagement opportunity with empathy. The goal is to reflect on their persepective without preconceived judgements.

Following multi-stakeholder engagement, the designer uses convergent thinking to evaluate the interconnections between stakeholder perspectives. This is crucial to understanding the situation as a whole. No system operates without inputs and feedback loops, therefore this exercise identifies patterns of relationships and feedback loops.

Step 2 is idea exploration where the strategies of multifunctional landscapes are intersected to the results of Step 1 to formulate landscape solutions. These solutions acknowledge each stakeholder as well as unite them together through multifunctional interventions.

For this project, the design framework is applied to the Coos Bay community to aid in the planning of offshore wind infrastructure.

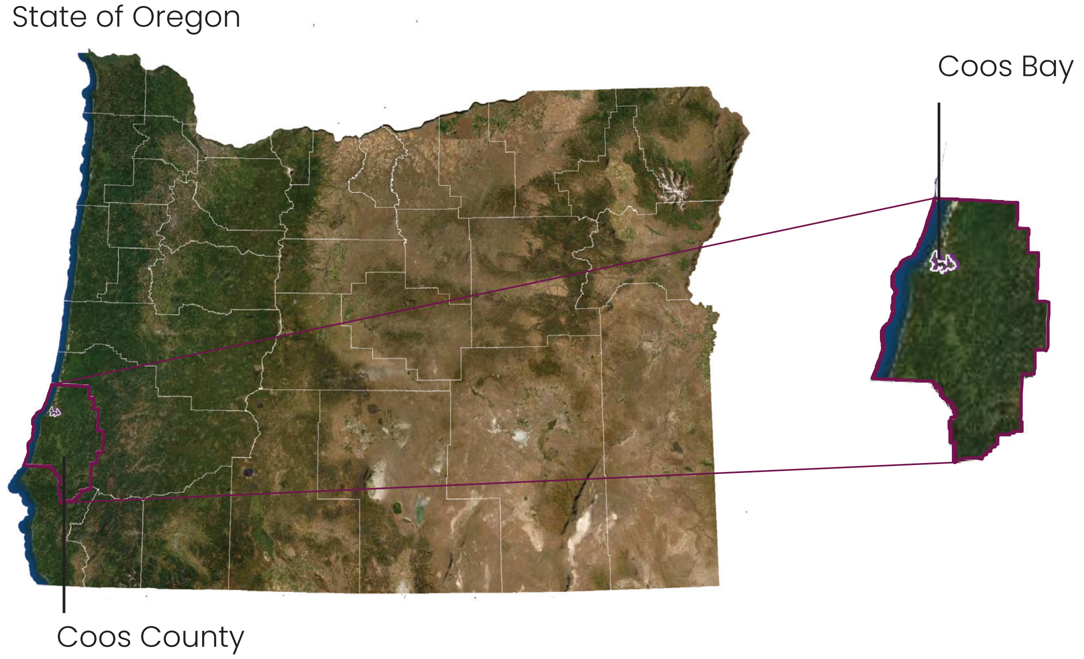


Figure 3.2
Coos Bay context

3.2 Site Analysis

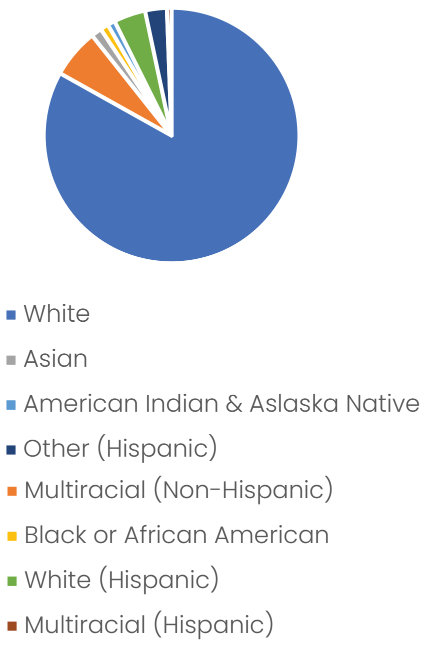
Coos Bay is located in Coos County, Oregon, shown in FIgure 3.2. Coos Bay is the largest city on the Oregon coast, with a population of 16,615, making it the regional hub for Oregon’s south coast. It is surrounded by the Coos Bay estuary, lush forests, and the pacific ocean.

Demographics

The population of Coos Bay is 16, 415 people (2018) out of the 64,487 that live in Coos County. Age 55-64 make up the majority of the population and age 18-24 make up the least. White is the dominant race (86.9%) and black, american indian and alaska natives, asian, native hawaiian and pacific islander all make up less than 1.3%, individually, Shown in FIgure 3.3. The median household income is $43, 779, which is less than the median american household income, which is $61, 937. The average male salary is $66,971 where the average female salary is $52,010. In 2019, 16.8% of the population had an income below the poverty level, which is lower than the rate of 11.4% across the country. The largest demographic living in poverty is females age 25-34 (datausa.io).

Industry Information

The most common occupations in Coos Bay are Office and Administrative Support, Food Preparation and Serving Related Ocupations, and Sales and Related Occupations, shown in FIgure 3.4. However, the occupations most specialized to Coos Bay, compared to the rest of the country, include farming, fishing, and forestry occupations, healthcare support occupations, and community and social service occupations, shown in Figure 3.5 (datausa.io).



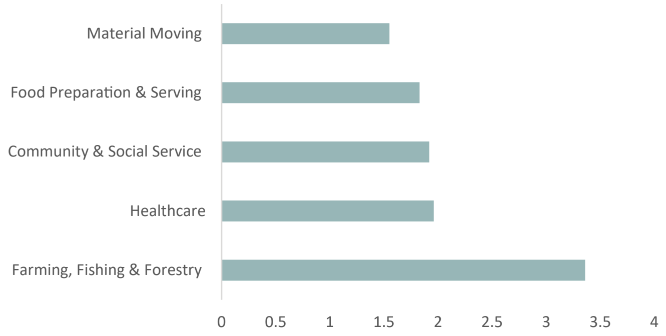


Figure 3.3 (left)
Coos Bay demographics

Figure 3.4 (right, above)
Coos Bay occupations

Figure 3.5 (right, below)
Coos Bay specialized occupations

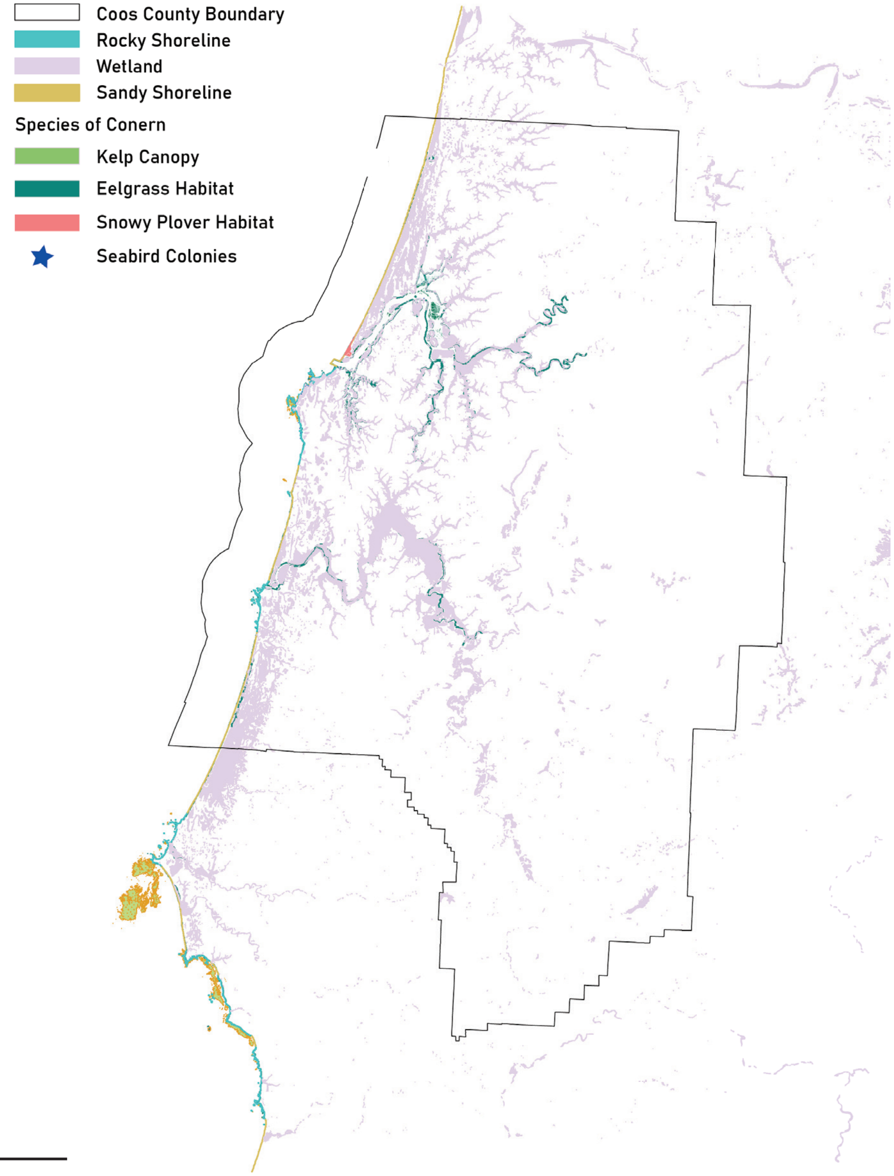


Figure 3.6
Coos Bay blue carbon habitat

Challenges and Opportunities

Blue Carbon Habitat Loss

Blue carbon refers to the carbon stored in marine and coastal ecosystems. Many of these habitats, such as tidal marshes and seagrass meadows, store more carbon per unit than terrestrial forests (NOAA,2021). Therefore, their contribution to climate solutions is critical.

Coos Bay is comprised of a significant number and area of blue carbon, shown in Figure 3.6. However, current challenges in Coos Bay involve critical blue carbon habitat loss, most specifically the decline of bull kelp. Kelp forests are an essential ecosystem for the health of marine life and productivity of commerical and recreational fisheries (Bailey, 2019). Kelp forests have largely turned

into wastelands due to the elimination of the sea otter, a keystone species, and the subsequent over abundance of purple sea urchins, shown in Figure 3.7. The complete loss of the kelp forests will have devestating impacts on the Coos Bay community.

Opportunity lies in the conservation of the diverse blue carbon habitats that do exist and in the current local efforts to restore them. The Elakha Alliance, an organization led by tribal, non-profit, and conservation leaders is spearheading efforts to restore the otter to the coast. Partnerships with organzations, such as the Elakha Alliance, will be essential to to the successful planning efforts of offshore wind infrastructure.

Figure 3.7 (left)
Kelp wasteland
Source: oregonlive.com

Figure 3.8 (right)
Elakha Alliance
Source: https://www.elakhaalliance.org/

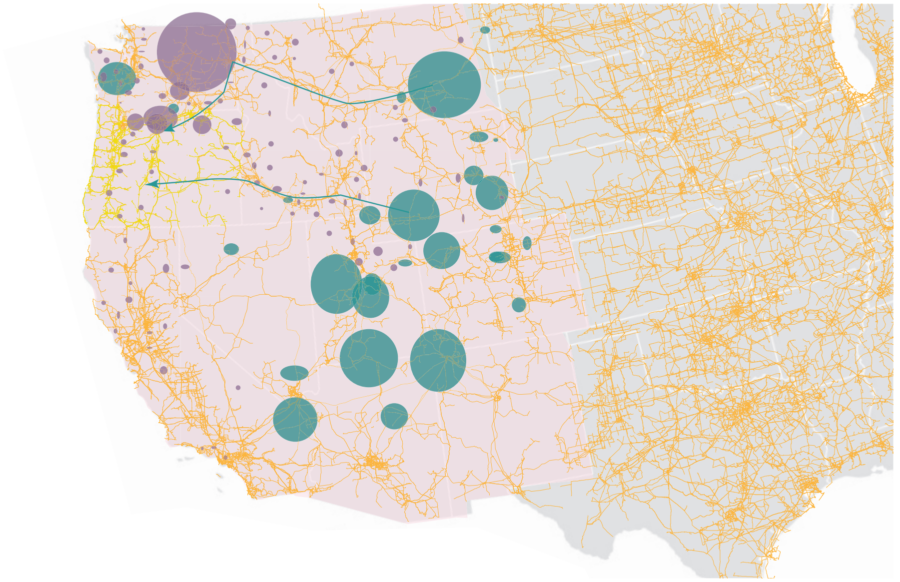
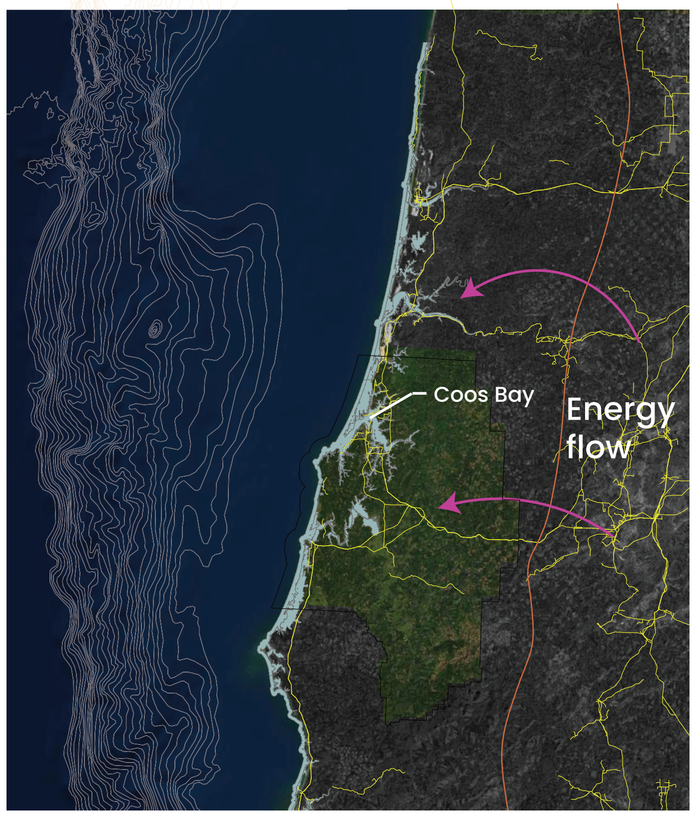


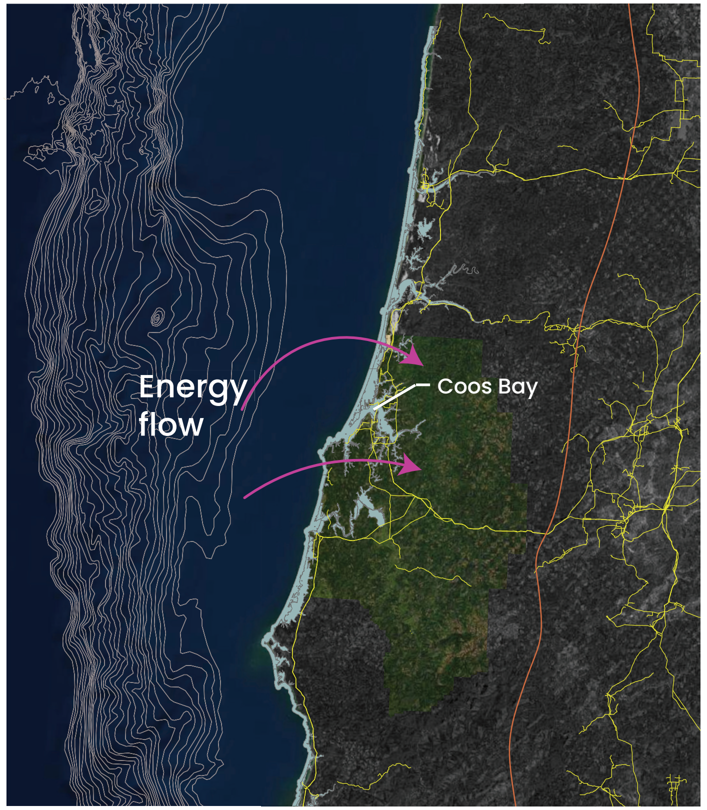
Figure 3.9
Coal and Hydro energy imports

Energy and Disaster Vulnerability

The State of Oregon's Renewable Energy Portfolio Standard currently requires that 50 percent of its electricity will be sourced from renewable resources by 2040 (oregon.gov). However, the "100% Clean Energy for All" or House Bill 2021-1 was introduced in March of 2021. If approved, utilities would be required to source 100% of Oregon's energy from emissions-free sources by 2040.

Currently, hydropower, a non-renewable resource, makes up the largest portion of Oregon's electricity, followed by coal and natural gas. Oregon is a significant energy importer, particularly from coal and hydropower. Oregon imports a large amount of coal produced energy from Montana, shown in Figure 3.9. The reliance on imported energy decreases the disaster resilience of the state. The Oregon coast offers some of the most powerful winds in the United States and therefore has the potential to play a major role in securing large scale localized renewable energy (Data for Progress, 2020).

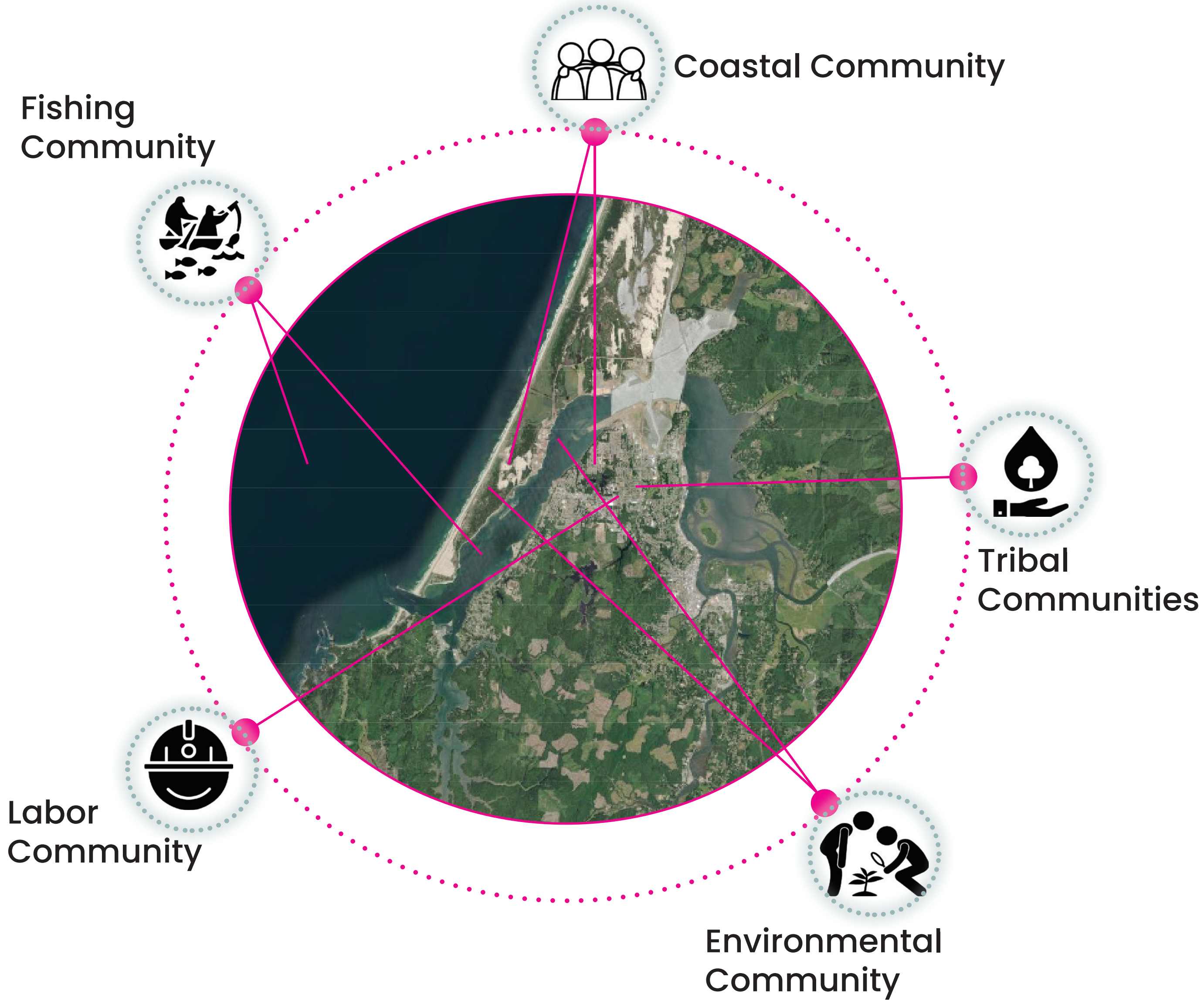




The Oregon coast is particularly vulnerable in the case of a disaster due to the relience of imported energy across from the I-5 corridor, shown in Figure 3.10. If a Cascadia earthquake were to happen, energy would be cut across the I-5 corridor, leaving the coast without energy for 3-6 months. Therefore, new sources of renewable, local energy are needed to meet the 2040 goal and increase the disaster resilience of Oregon coastal communities, shown in Figure 3.11.

Figure 3.10
Disaster vulnerability

Figure 3.11
Disaster resiliency



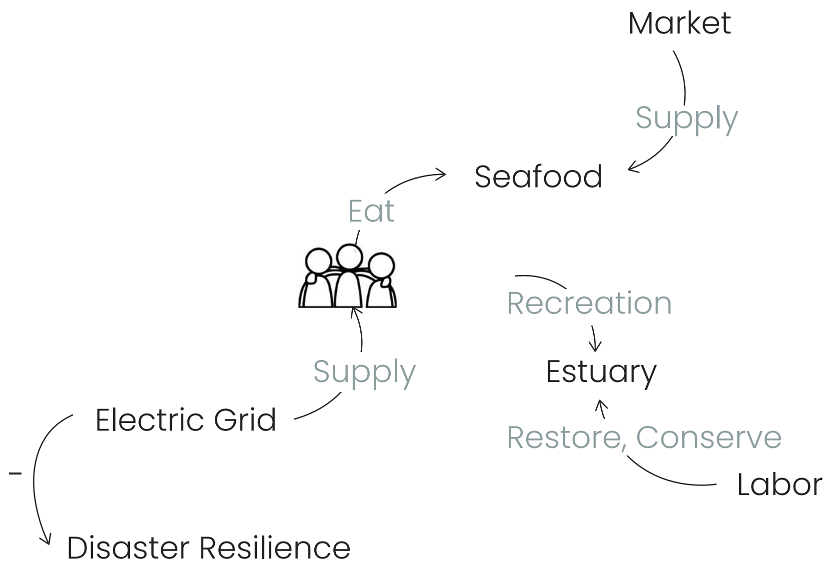
3.3 Multi- Stakeholder Engagement

This project looks at the following stakeholder groups for multi-stakeholder engagement; fishing community, coastal community, tribal communities, environmental community, and the labor community, shown in Figure 3.12. The first step of the framework, framing, involves stakeholder engagement in which informal interviews and article reviews are conducted to frame the perspectives and worldviews of each stakeholder group. The following information represents the key concerns and perspectives that were found in the stakeholder interviews.

Figure 3.12
Stakeholder groups in Coos Bay

Coastal Community

Notes from a Coastal Community Member



Key Concerns

Recreational access and enjoyment on a healthy coastline

Clean energy and energy **resilience**

Fresh and **local seafood** industry

More **job opportunities** that allow families to stay in Coos Bay year round

From conversations with a coastal community member, key concerns regarding offshore wind infrastructure included the maintenance of recreational access and enjoyment on a healthy coastline, clean energy and energy resilience, maintenance of a fresh and local seafood industry, and more job opportunities, all shown in Figure 3.14.

Coos Bay is known for its recreation opportunities along the Pacific Ocean, rivers, and estuaries. Activities include kayaking, hiking, biking, camping, fishing, and foraging (Coos P&R). The extensive mudflats along the estuary create numerous opportunities for clam, oyster, and crab harvesting. Figure 3.15 shows community members digging for Empire Clams in the South Slough of Coos Bay. Maintaining a healthy ecosystem that enables recreation opportunities is crucial to the planning of offshore wind infrastructure.

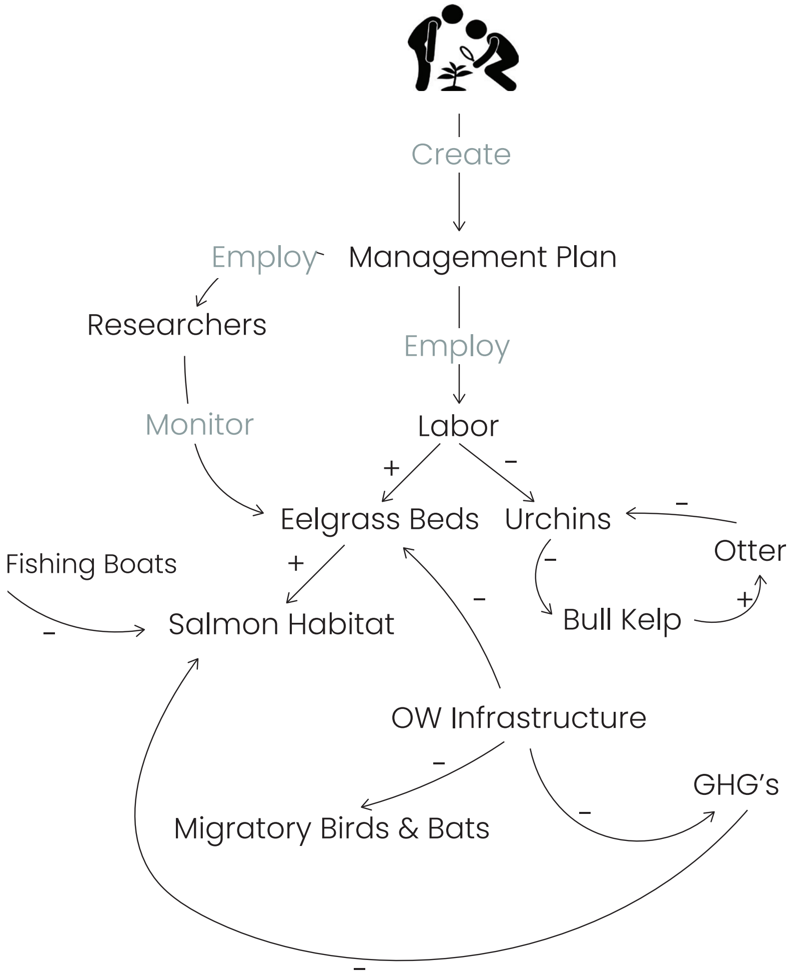
The threat of a Cascadia eathquake in the coming 50 years brings fear and insecurity to members of the Coos Bay community. The location of the coastline makes the danger of a tsunami immense. Therefore local energy generation and sovereignty would help increase the resiliency of the community in the event of a disaster.

Figure 3.13 (far left)
Coastal community system

Figure 3.14 (close left)
Coastal community key concerns

Figure 3.15
Coos Bay members dig Empire clams
Source: www.clamdigging.info

Environmental Community



Notes from OCEAN Environmental Commitee

Key Concerns

Habitat protection from infrastructure construction, partcularly **eelgrass, wetland, and benthic** habitats

Reduction in GHGs needs to occur for healthy ocean salinity levels

Attention to **keystone species** to maintain healthy habitats

Scientific monitoring to keep track of ecosystem health

Notes from a member of the environmental committee on the offshore coastal energy alliance network (OCEAN), mentioned a concern around habitat protection when infrastructure is developed and constructed, particularly key habitats such as eelgrass, wetland, and disturbed benthic communities. An overall need for a decrease in GHGs to create healthy salinity levels. Particular attention to keystone species that are critical to the unique Coos Bay ecosystems, and the need for scientific monitoring to track infrastructure impacts on ecosystem health.

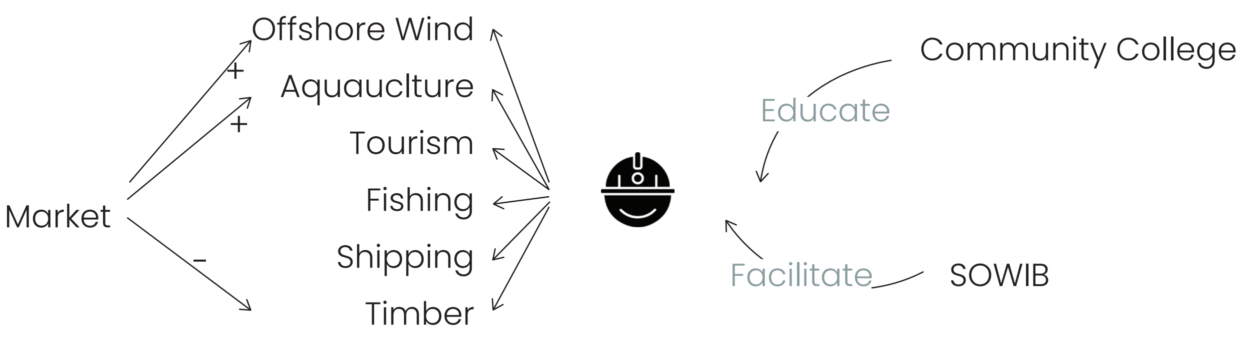
The recent proposal for the Jordan Cove Keystone XL liquified natural gas export project in Coos Bay sparked fear of extreme environmental harm from energy infrastructure, shown in FIgure 3.18. The proposal, which has now been rejected by the Biden-Harris administration, would have displaced critical blue carbon habitat. Offshore wind infrastructure is not immune to this fear and skeptisim from the Coos Bay environmental community. Therefore a proposal for offshore wind infrastructure would need to include substantial and comprehensive environemntal restoration and conservation opportunities.

Figure 3.16
Environmental Community System

Figure 3.17
Coastal Environemntal Community Key Concerns

Figure 3.18
Activists protest against the Keystone XL pipeline
Source: www.theguardian.com

Labor Community



Notes from Southern Oregon Workforce Investment Board

Key concerns

Job training programs, such as the Earn and Learn programs need to exist for industry jobs

A desire for **diverse employment opportunities** to give people the opportunity to diversify their employment portfolio

Connections to the community college to introduce training to students

In a meeting with a member of the Southern Oregon Workforce Investment Board (SOWIB), I learned of key elements that can increase labor employment opportunity. These include offering apprenticeship programs, such as the existing Earn and Learn programs, availability of diverse employment opportunities, allowing those in the workforce to diversify their employment portfolio, and connecting training to the local community college, so those graduating can come prepared to work in the industry.

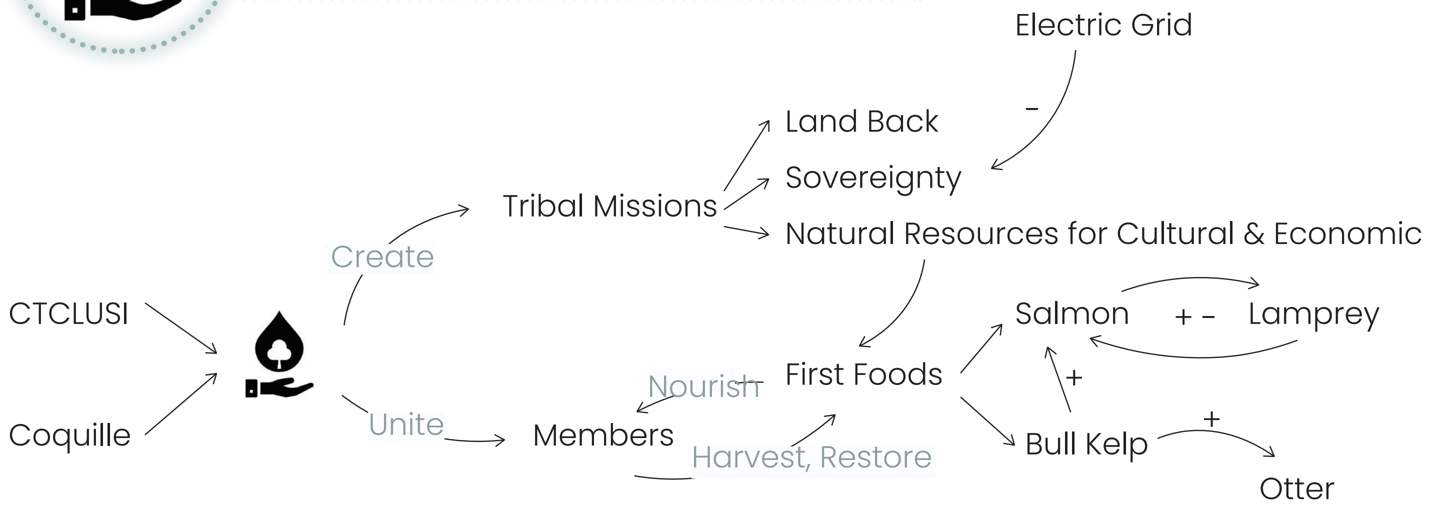
The Coos Bay community is in need of a catalyst for job creation and economic stimulus. The unemployment rate is one of the highest in the state of Oregon. The coronavirus pandemic hit coastal cities more than they did others. Most likely due to a decrease in tourism, which makes up a significant portion of the economy (Silva, 2020). Therefore, creativity and diversity in job opportunities will need to be thought about with the development of offshore wind energy. The marine economy is unique to the Coos bay area and offers great potential for secure, sustainable jobs.

Figure 3.19
Labor community system

Figure 3.20
Labor community key concerns

Figure 3.21
SOWIB training program
Source: www.sowib.org

Tribal Communities



Notes from CTCLUSI member

Key concerns

Energy sovereignty as acomponent of tribal soveriegnty is an ultimate goal

Care for the environment as a source of cultural, environmental and production values

The health of the **kelp forests** is a big concern, thinking about returning **sea otters**

Co-management with all communtiies in Coos Bay

The tribal communities in Coos Bay include the Confederated Tribes of Coos, Lower Umpqua, and Siuslaw Indians (CTCLUSI) as well as the Coquille Indian Tribe. Through conversations with a member of the CTCLUSI, I learned how offshore wind energy can both support and conflict with existing tribal missions. Alongside tribal sovereignty, the tribe has goals of energy sovereignty. The tribe approaches maintaining the environment holistically and therefore would like to see a systemic approach to planning. The health of the kelp forests along with the decline of sea otters is a big concern for the tribe, especially regarding how critical this habitat is to other keystone species, such as salmon and lamprey. And finally, co-management of the environment where priorities are shared among stakeholder groups.

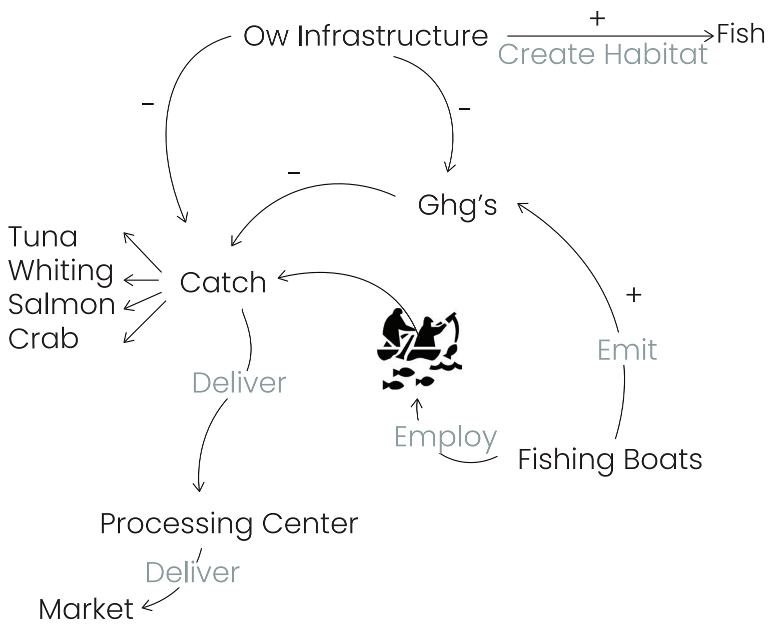
The climate crisis is a major concern to the Tribes, for the future generations of humans and for creatures. The forced removal from their ancestral lands has erased critical tribal practices that enable healthy co-existance between people and the land. Therefore, the return of tribal lands is essential to finding these practices again.

Figure 3.22
Tribal community system

Figure 3.23
Tribal community key concerns

Figure 3.24
Traditional salmon bake of the CTCLUSI
Source: Margaret Corvi via blog.national geographic.org/

Fishing Communities



Pacific Fisheries Management Council Member

Key concerns

Although no trawling can occur around turbines, **other techniques should be able to**

Introduce more **local processing and distribution** opportunities

Education around seaosnality of fishing industry

Climate ready and adaptive fisheries

Need **federal support** for sustainable intitiatives

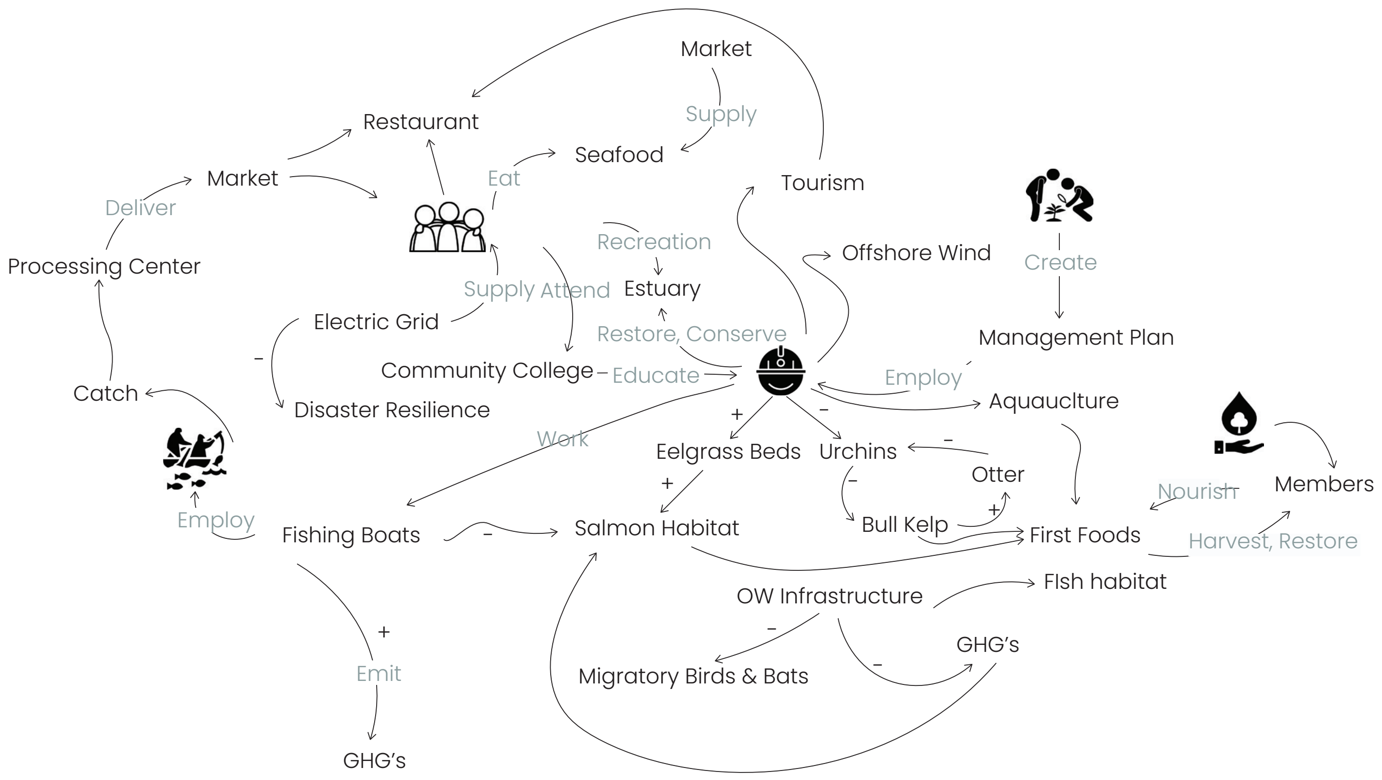
A member of the Pacific Fisheries Management Council offered me valuable insight into their perspectives. The biggest concern regarding the future of offshore wind is the ability for fishing activity to remain in the turbine areas. They acknowledge that trawling will not be able to occur around the turbines, however, alternative techniques should be integrated into the design. Therefore, the fishing community would like to see multi-use wind turbine arrays. Second, Coos Bay is in need of more local processing and distribution opportunities that support smaller scale initiatives. And with that, they would like to see community education around the seasonality of their practices and how their foods can be stored and cooked year-round. The fisheries are already seeing the effects of climate change on the health of the fish populations. Therefore, the fishing community would like federal support to become climate ready and adaptive.

The fishing industry's daily activities will be directly impacted by offshore wind infrastructure and they ask that the design and planning of offshore wind development includes their fishing activities, creating a "collectively conscious"design.

Figure 3.25
Fishing Community System

Figure 3.26
Fishing Community Key Concerns

Figure 3.27
Shrimping boat off Coos Bay
Source: PBase.com



Interconnections

The second step of the framework is to understand the interconnections of the individual stakeholder systems through convergent thinking mechanisms. I used abductive reasoning to examine the relationships and feedback loops between the elements of the system, show in Figure 3.28. This exercise visualized how the existence of each one of these stakeholder groups impacts the existence of the other and how the goals of individual stakeholder groups align with the goals of another group.

For example, the fishing community's success benefits from a healthy ocean ecosystem which the environmental groups and the tribal groups are working to maintain. The coastal community benefits from the abundance of local seafood which makes up a significant part of their coastal identity. The labor workforce is found at the center, where their contribution allows the system to operate.

Figure 3.28
System interconnections

3.4 Idea Exploration

Recognizing how interrelated the concerns and perspectives of each of these stakeholders are helped to inform a set solutions that address each of them individually and as a whole. To do this, the stakeholder engagement was intersected with the multifunctional landscape design strategies to create a set of landscape solutions, shown in the third column of Figure 3.29. These solutions include community cooking classes, local seafood market, local processing center, public access trails, energy storage, disaster recovery centers, keystone species restoration and conservation, industry training programs, hydrogen fuel for boats, regenerative aquaculture, federal support for marine initiatives, multi-use wind farm array, and scientific monitoring. These solutions unite the interests of its owners and users, contribute new functions to the system that will stimulate social, environmental, and economic growth, and enforce resilient adaptive strategies that address future climate disaster.

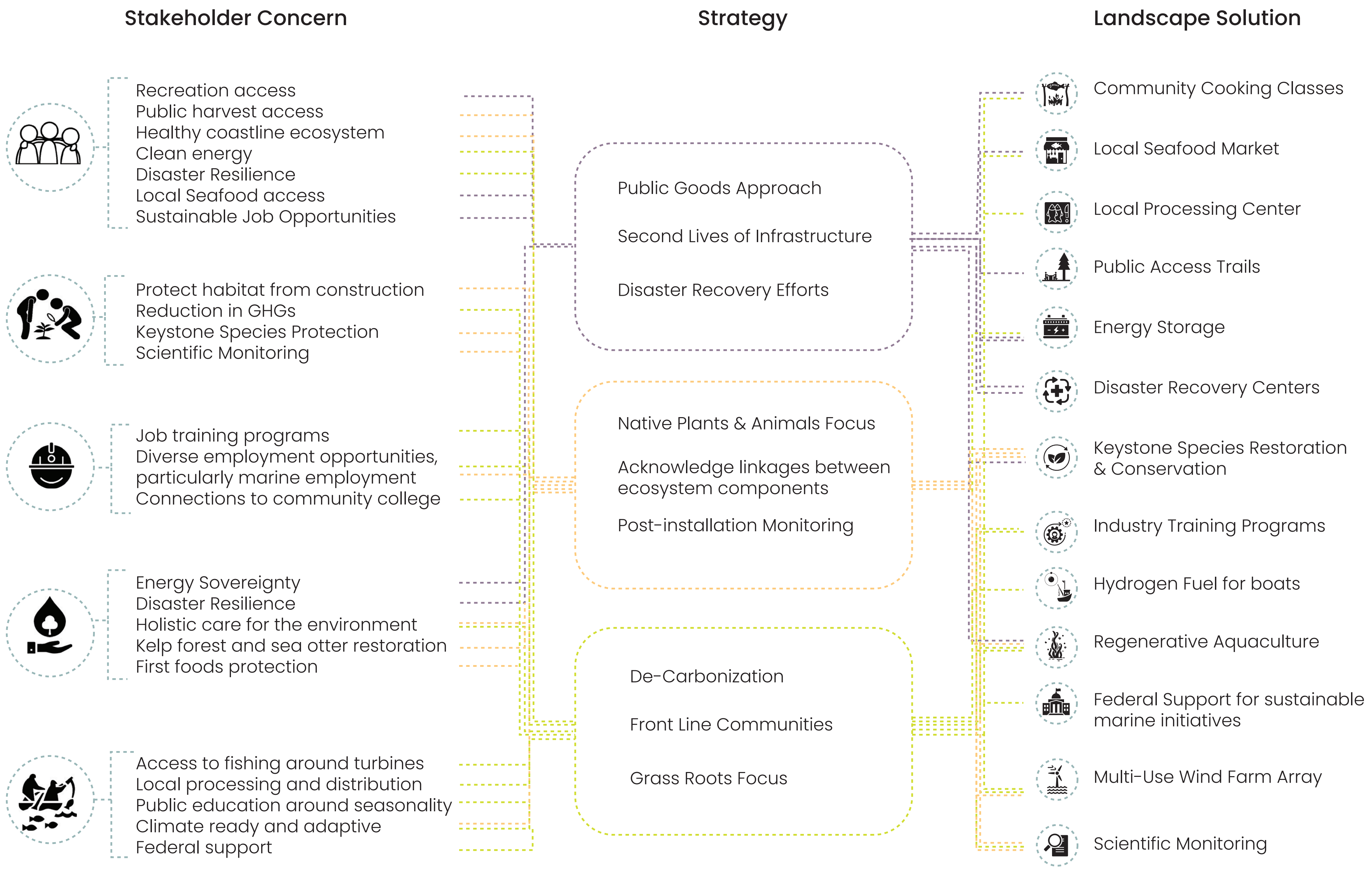
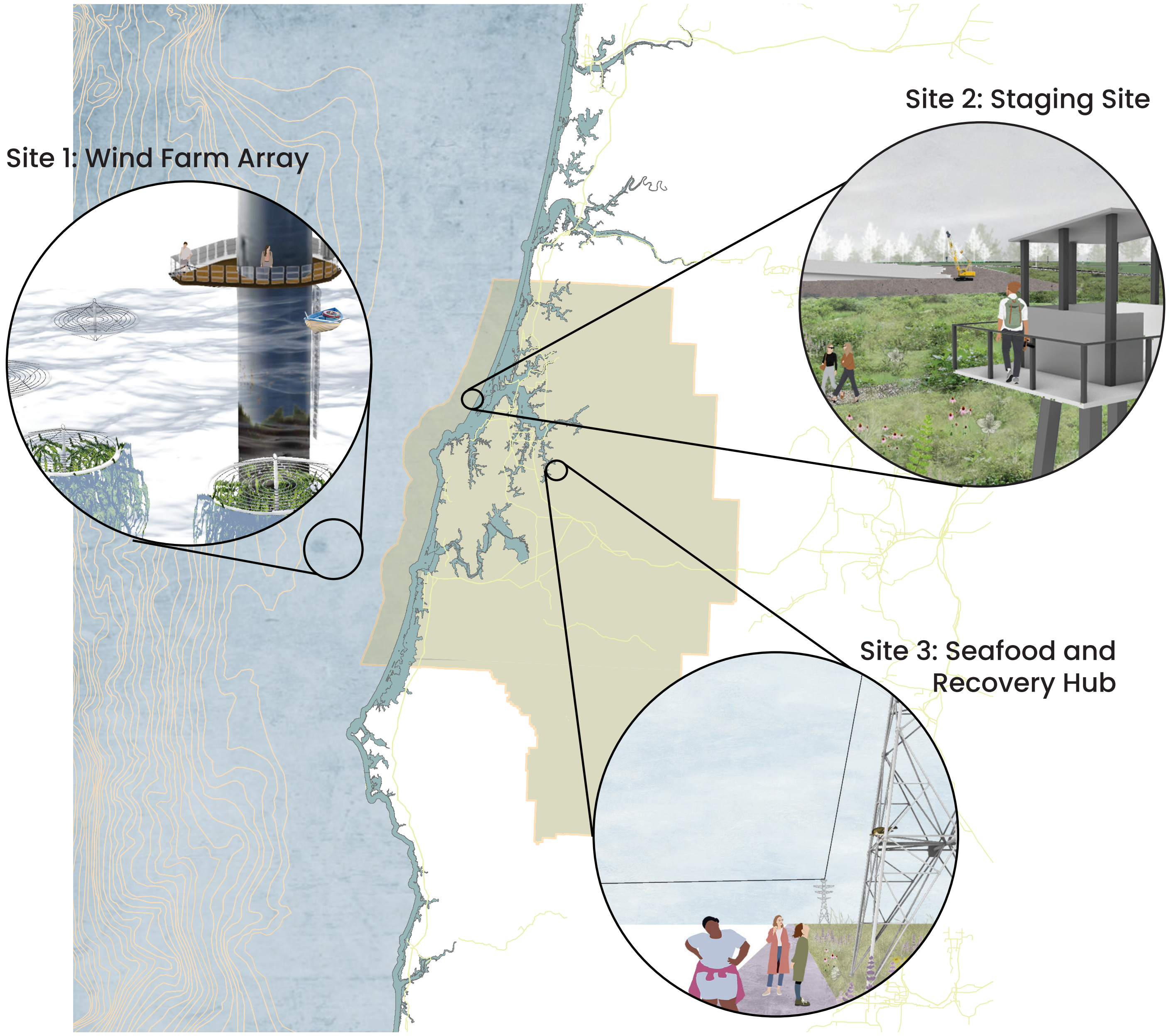


Figure 3.29
Identifying Solutions Diagram

Chapter 4 :
Site Design Proposal



4.1 Design Proposal Overview

I looked at 3 sites where offshore floating wind infrastructure will have an impact on the landscape. These impacts range on the 3 different sites and their effects on stakeholder concerns differ as well. Therefore, each design used the design solutions to accomodate different stakeholder needs.

The three sites are connected in their support of offshore wind energy. The first site, the Wind Farm Array, looks to the floating wind turbines 20 miles off the shoreline, shown in Figure 4.2. These turbines are constructed and assembled at site 2, the Staging Site, located on the North Spit of Coos Bay, shown in FIgure 4.3. The energy created from the wind turbines is connected to the grid where the energy flows along the transmission line network to connect to distribution substations. Site 3, the Seafood and Recovery Hub, looks at one of these substations , shown in Figure 4.4 to imagine how that footprint could be maximized for community benefit.

Figure 4.1
Design proposal overview

FIgure 4.2
Site 1 existing conditions

Figure 4.3
Site 2 existing conditions

Figure 4.4
Site 3 existing conditions

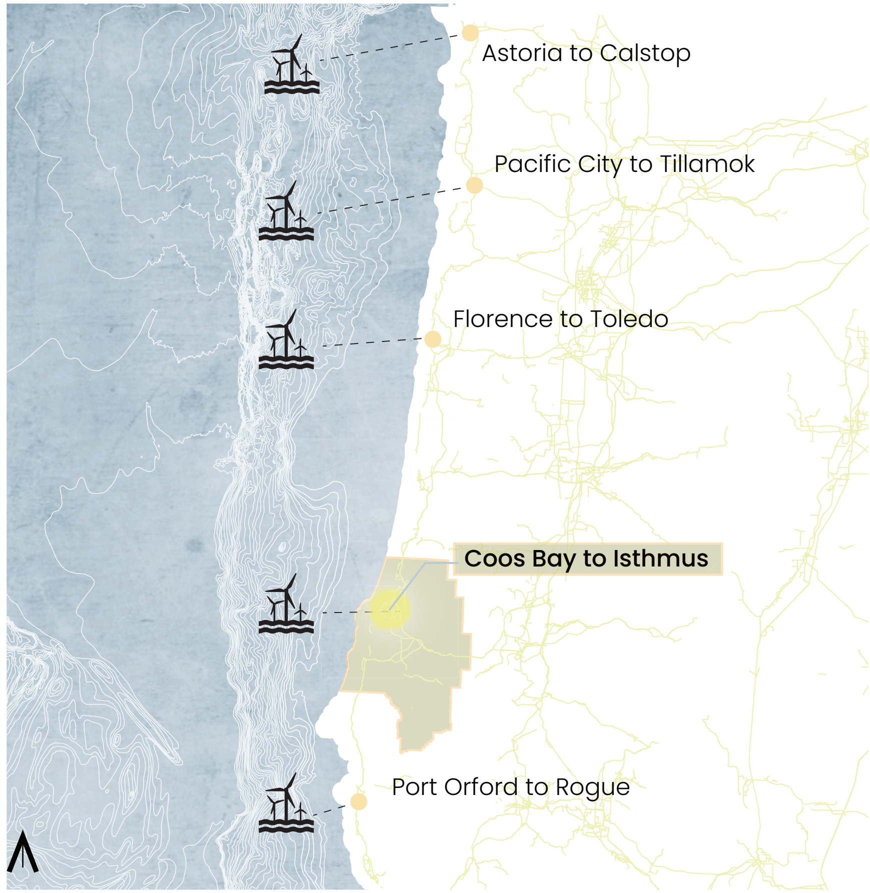
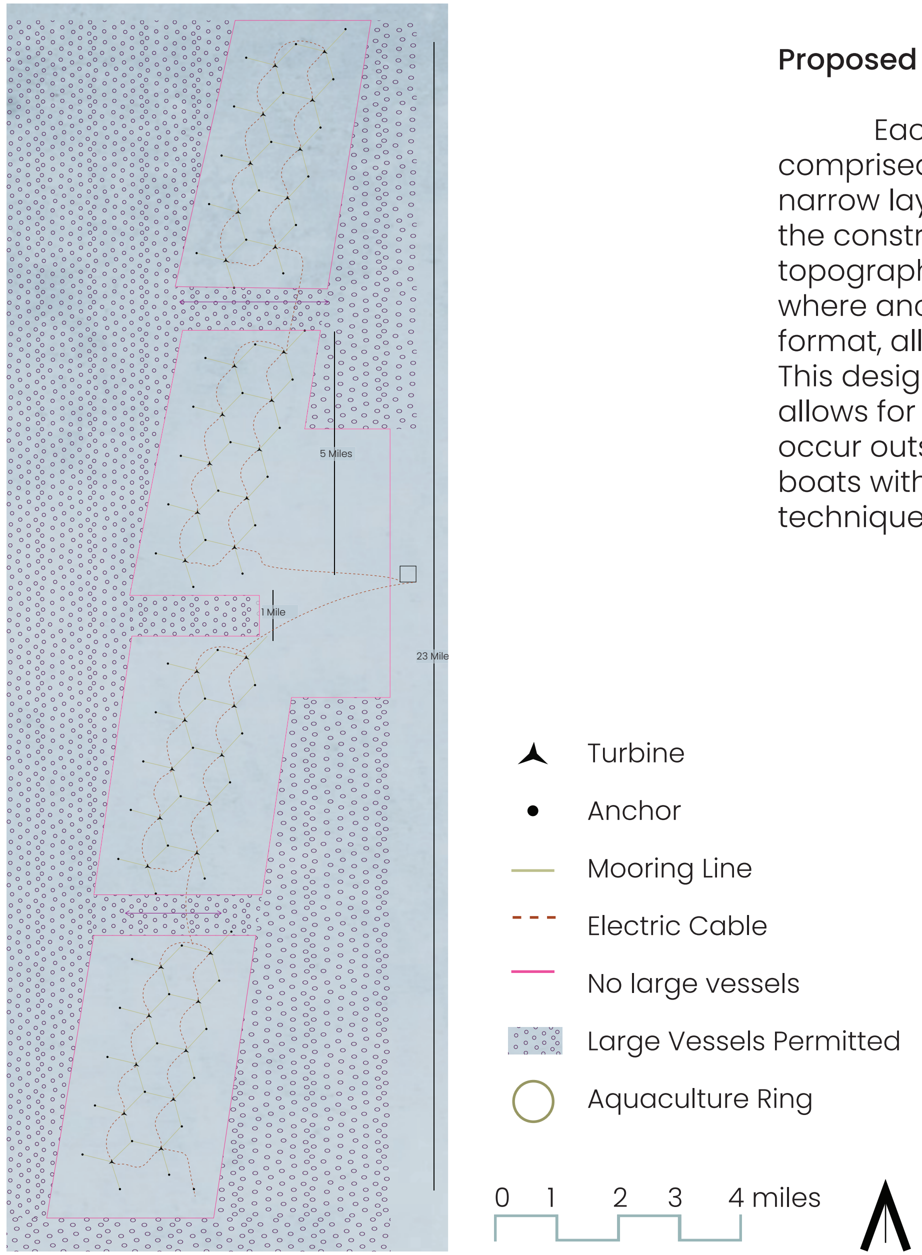


Figure 4.5
OR array distributions

4.2 Wind Farm Array

Context

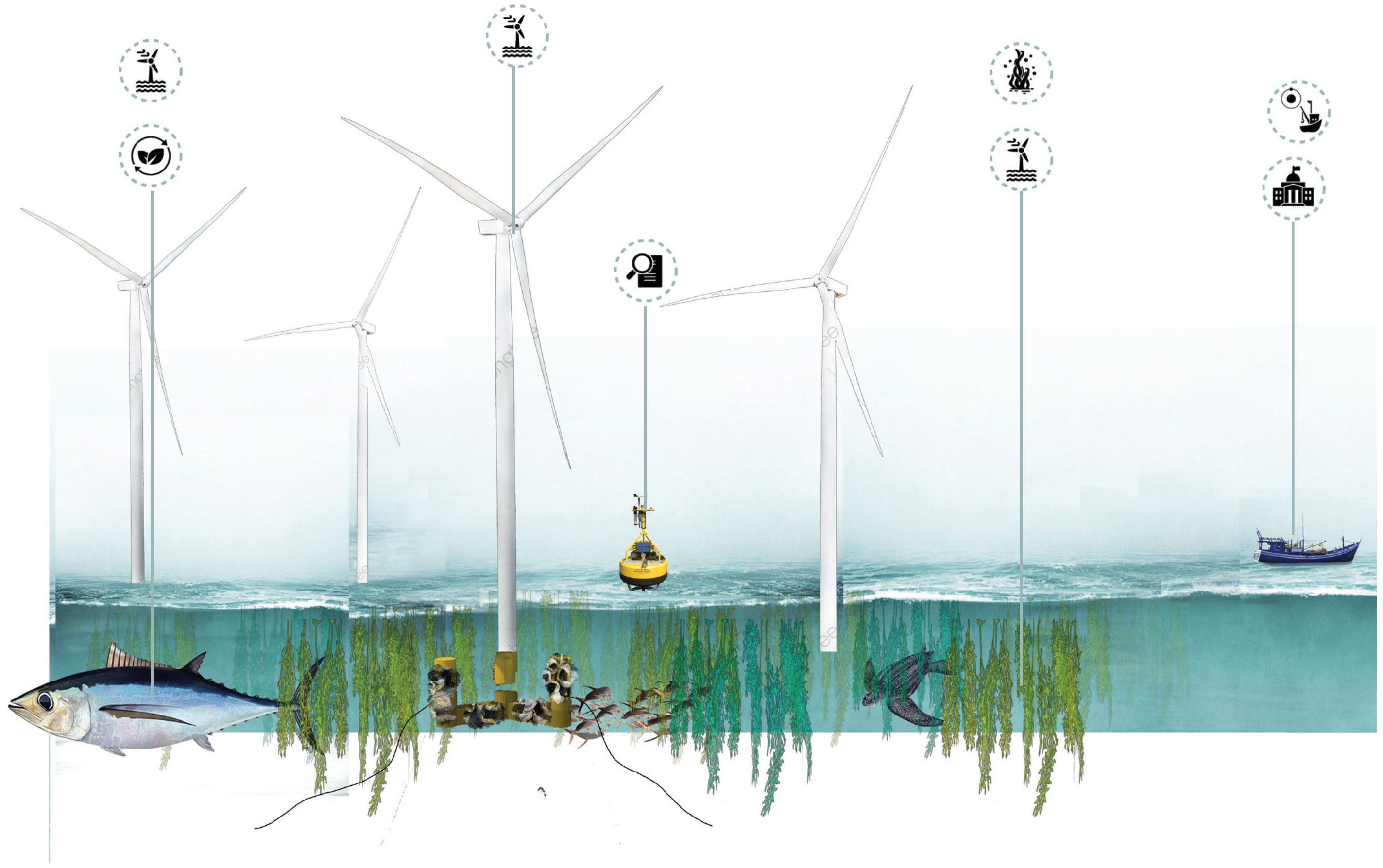
The first site looks to the location of the actual wind turbines, around 20 miles offshore. To reachOregon's 50% renewable energy goal, the Oregon coast will be lined with 5 sets of turbine arrays to generate 3GW of energy, each supplying electricity to a section of the coast. Figure 4.5 illustates the location of these arrays and the sections of the coast that they cover. For this project, we will zoom into the array that will supply Coos Bay.



Proposed Conditions

Each set of turbine arrays will be comprised of 40 turbines. The linear, narrow layout was determined based on the constraints of the continental shelf topography. The shared mooring system, where anchors are deisgned in a triangular format, allows for a more compact layout. This design and orientation of the turbines allows for large scale boats and fishing to occur outside of its boundaries and smaller boats with line fishing and less conflicting techniques to occur within the bounds.

Figure 4.6
Turbine layout



Regenerative Aquaculture

Keystone Species Restoration & Conservation

Scientific Monitoring

Multi-Use Wind Farm Array

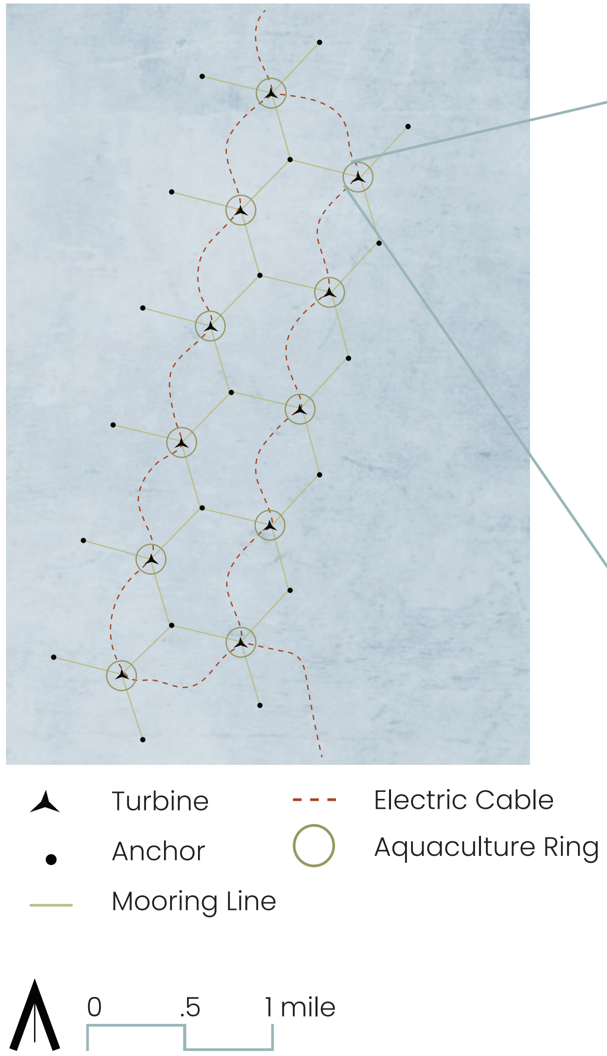
Federal Support for sustainable marine initiatives

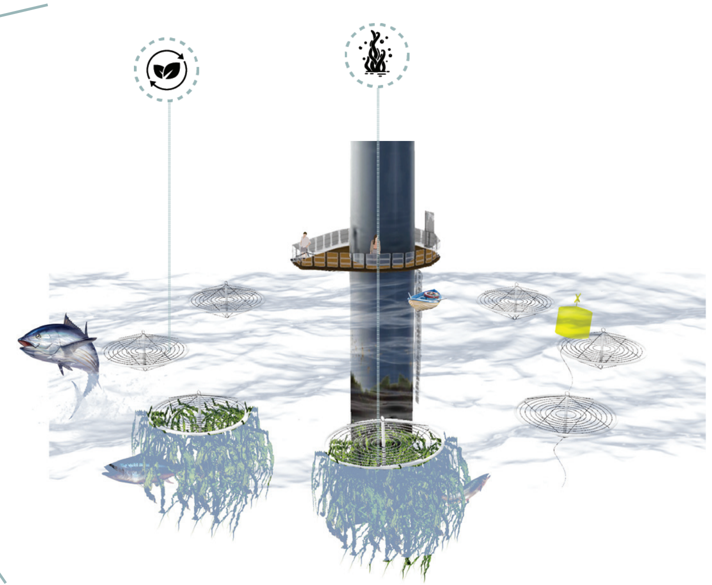
Hydrogen Fuel for boats

Multi-Use Wind Farm Array

The area around the turbines will exist as a multi -use areas for marine habitat, small scale fishing, regenerative aquaculture, and scientific monitoring. Species such as the Pacific bluefin tuna, a keystone species as well as a critical fishery resource, will find habitat here. A scientific monitoring buoy will be situated around the turbines to gather consistent data. Federal support will be given to fishing boats to allow them to transition to hydrogen fuel, in an effort to de-pollute the ocean. Support will also be given to fishing boats when fisheries, such as the tuna fishery, needs to regenerate for as season and be prohibted for fishing.

Figure 4.7
Multi-Use wind farm array





Regenerative Aquaculture

Keystone Species Restoration & Conservation

Multi-Use Wind Farm Array

Offshore Kelp Aquaculture

The lack of large scale fishing within close proximity of the turbines makes the space available for offshore kelp aquaculture. The aquaculture and wind turbine infrastructure also serve as habitat sanctuaries for marine life. Therefore, enhancing the health of the fish population which will ultimately benefit the fishing community.

Figure 4.8
10 turbines layout

FIgure 4.9
Kelp ring aquaculture

4.3 Staging Site

Context

The second site looks to the staging site of the offshore wind infrastructure. The staging site is situated on the north Spit of Coos Bay. The sectioned zoned for *Private/ Industrial* is the footprint of the proposed staging site. The North Spit is accessed via the Trans pacific Ln road, shown in FIgure 4.10.

Existing Conditions

The North Spit already has existing program elements that make it an enjoyable destination for residents and visitors. The area surrounding the *private/commercial* zoning lot is BLM land. It is accessible via the Trans Pacific Pkwy road that leads to a parking lot and boat ramp. The land consists of wetland, sand dune, and old growth forest habitat, shown in FIgure 11. Trails for ATV's, horse back riding, and hiking circulate throughout and, in some cases lead to the beachy shoreline. Along the inner estuary coastline, eelgrass habitat and mudflat habitat is situated on both sides of the shipping channel. A sea lion haul is located on the edge of eelgrass habitat here as well.

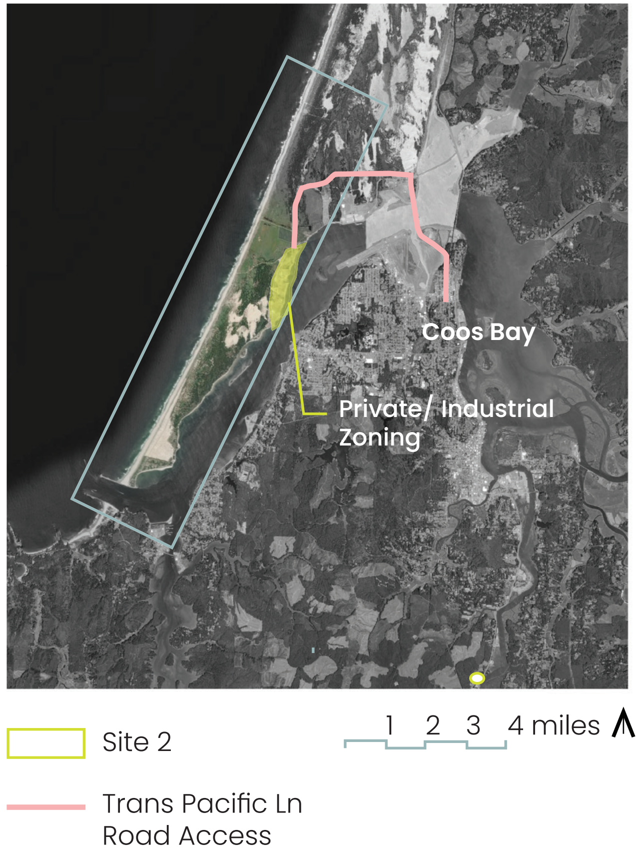
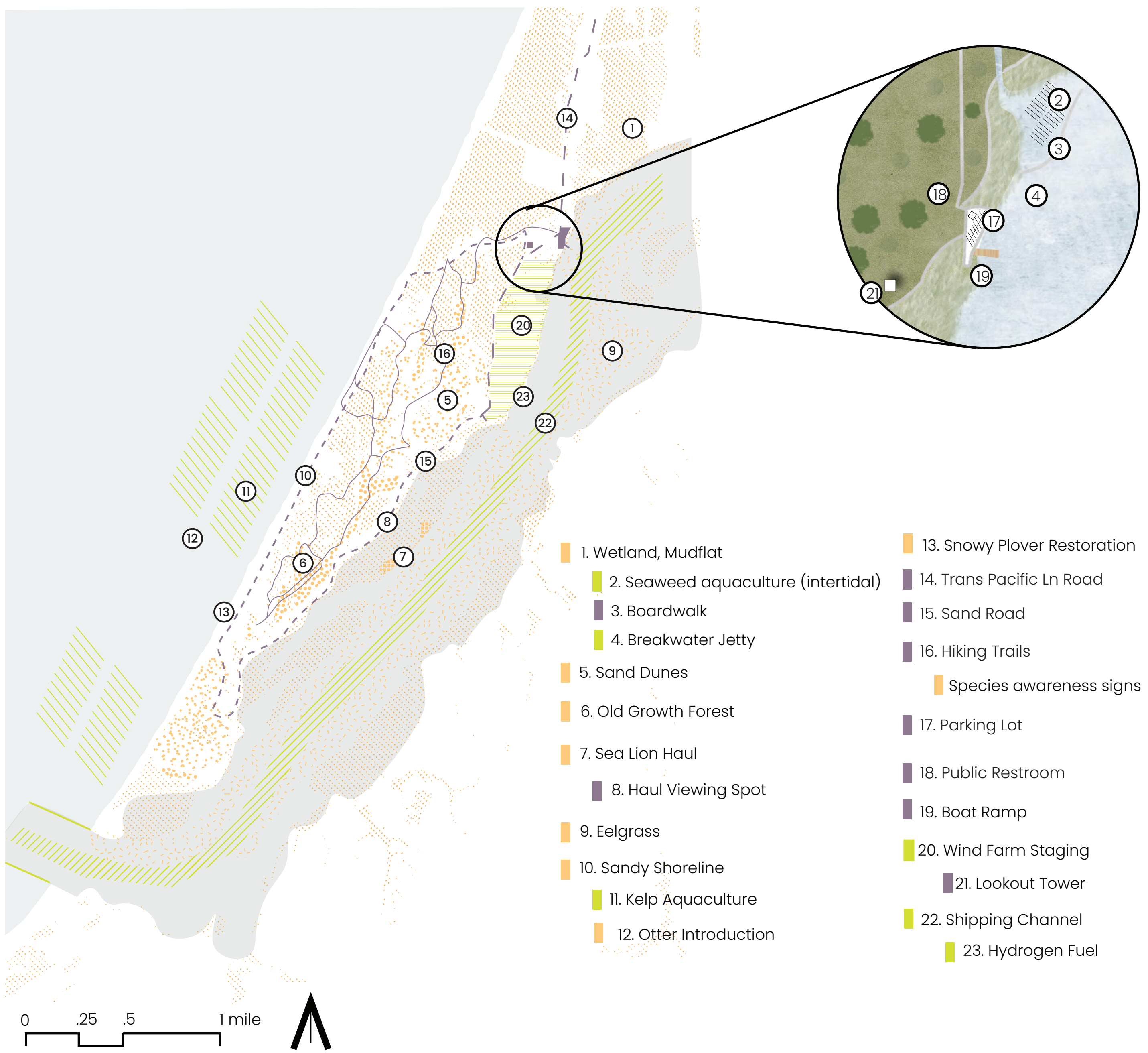


Figure 4.10
Staging site context map

Figure 4.11 (right)
Staging site existing conditions



Proposed Conditions

The proposed site design, shown in Figure 12, introduces some of the key design typologies to the existing uses of the site. For example, in the zoomed in plan, I introduce regenerative intertidal seaweed aquaculture with a boardwalk that welcomes public access, a tower lookout that offers views of the estuary, staging site, habitat, and the ocean. Off the coast, I introduce Bull Kelp aquaculture and restoration. Each of these interventions work to maximize the function of the existing space while aiding in the production of offshore wind energy.

Figure 4.12
Staging site proposed conditions

Local Seafood Market	Scientific Monitoring
Public Access Trails	Regenerative Aquaculture
Industry Training Programs	Keystone Species Restoration & Conservation

Intertidal Seaweed Aquaculture

The intertidal seaweed aquaculture, shown in Figure 4.13, is regenerative in the sense that it absorbs CO2 from the air, the species are native and support the habitat of critical species, such as salmon, and they do not require inputs of feed. Scientific monitoring occurs within the estuary to monitor the changes this infrastructure has on ecosystem health. The aquaculture operation adapts to those findings. Within the production dimension, regenerative aquaculture is contributing to de-carbonization as the seaweed is acting as a blue carbon habitat, absorbing CO2 from the atmosphere. Seaweed aquaculture offers alternative employment in the marine sector, and the small scale seaweed operations will be processed and sold locally, contributing to community supported marine agriculture. Along the cultural dimensions, the boardwalk offers public access and education to both the aquaculture system as well as the estuary itself. It also bridges connection to those growing the food they eat.

Figure 4.13
Intertidal seaweed aquaculture

Public Access Trails

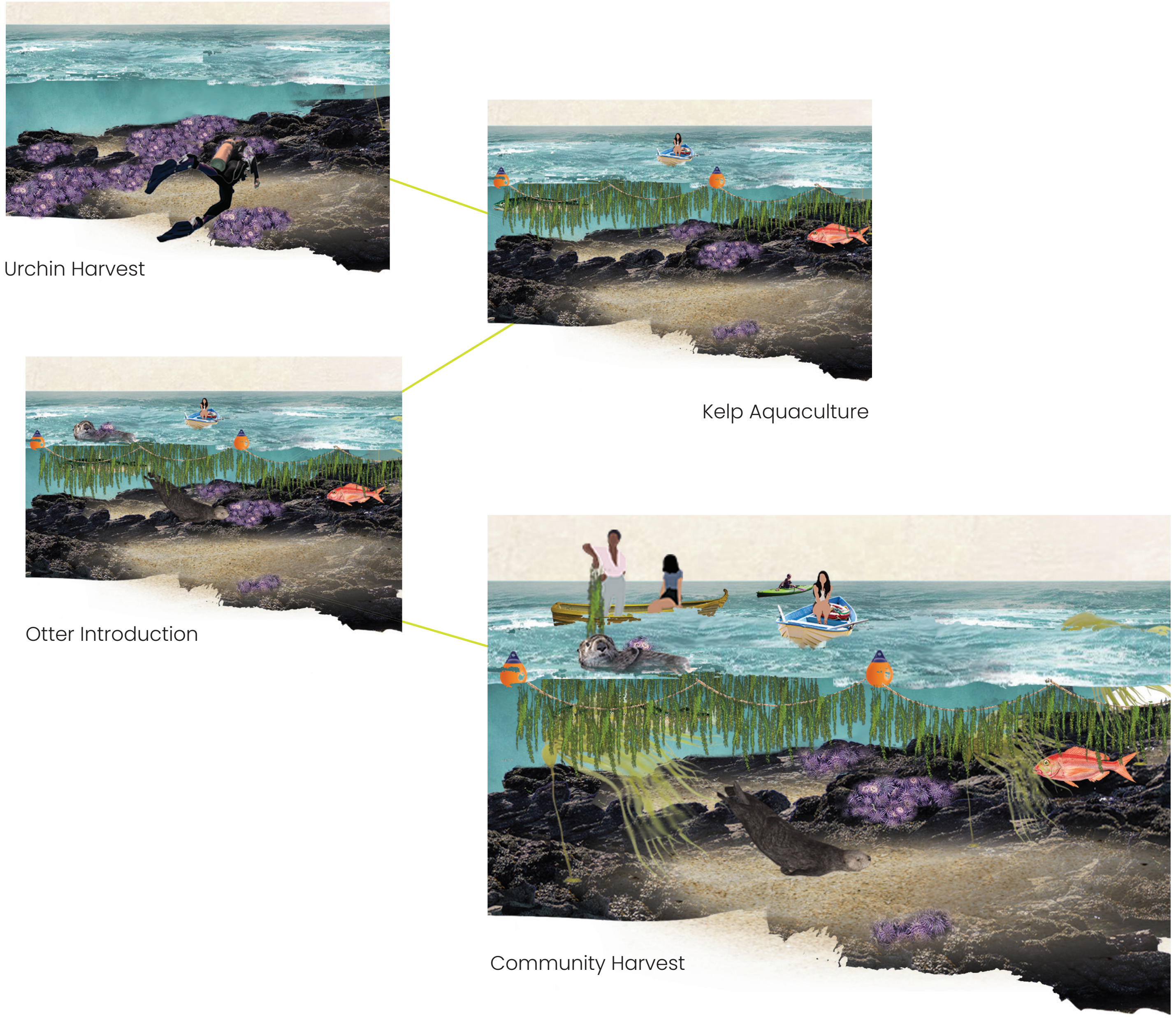
Industry Training Programs

Keystone Species Restoration & Conservation

Tower Lookout

The tower is situated close to the entrance, where visitors can access it from the parking lot. Views of the estuary, habitats, and staging site can all be seen from the tower. The existing service trail below, now has a pedestrian and horse back trail adjacent to it. The integration of the public trail into the private staging site allows users a view into the infrastructure development process. On the production side, this staging site situates coos bay as a supplier of offshore wind infrastructure, thereby supporting the growth of renewable energy on the west coast as well as supporting the coos bay economy and creating green energy jobs. The staging site needs to be maintained in such a way that it does not disrupt the critical habitats around it. Therefore, there needs to be an emphasis on conservation and restoration of the wetlands and old growth surrounding the staging site.

Figure 4.14
Tower lookout



Kelp Aquaculture and Restoration

Kelp Aquauclture and Restoration will occur along the coastline. Much of the kelp forest along the Northern California and Oregon coast have been turned into wastelands due to the over abundance of purple sea urchins. This coincides with the elimination of sea otters, which were wiped out by the fur trade. The sea otter acts as a keystone, or even ultra keystone species in the regulation of the kelp habitat. Organizations such as the Elakha alliance, led by tribal, non-profit, and conservation leaders, pursuing the restoration of sea otters to the OR Coast, is working to restore the sea otter. However, in order to do so, kelp forest habitat needs to already exist. Therefore, my proposal introduces kelp aquaculture which works to both restore the kelp forest and provide a source of food.

Kelp aquaculture and resotoration will be implemented in phases, as shown in Figure 4.15. To aid in the restoration process and provide a unique local seafood option, purple sea urchins will be harvested for production. Because there is no kelp for sea urchins to eat, they need to fattened up for 12 weeks before going to market. This will take place at the seafood hub, which will be illustated in the following section. Kelp aquaculture with them be implemented alongside urchin harvest for food production, habitat restoration, and de-carbonization efforts. Once kelp forests are established along the coast, otters will be re-introduced to regulate the system. Once the ecosystem is confirmed healthy and sustainable, community recreation areas will be designated to allow for community harvest opportunities, making humans a part of the ecosystem as well.

Figure 4.15
Kelp aquaculture and restoration phasing

Coos Bay UGB

Transmission Network

Substation

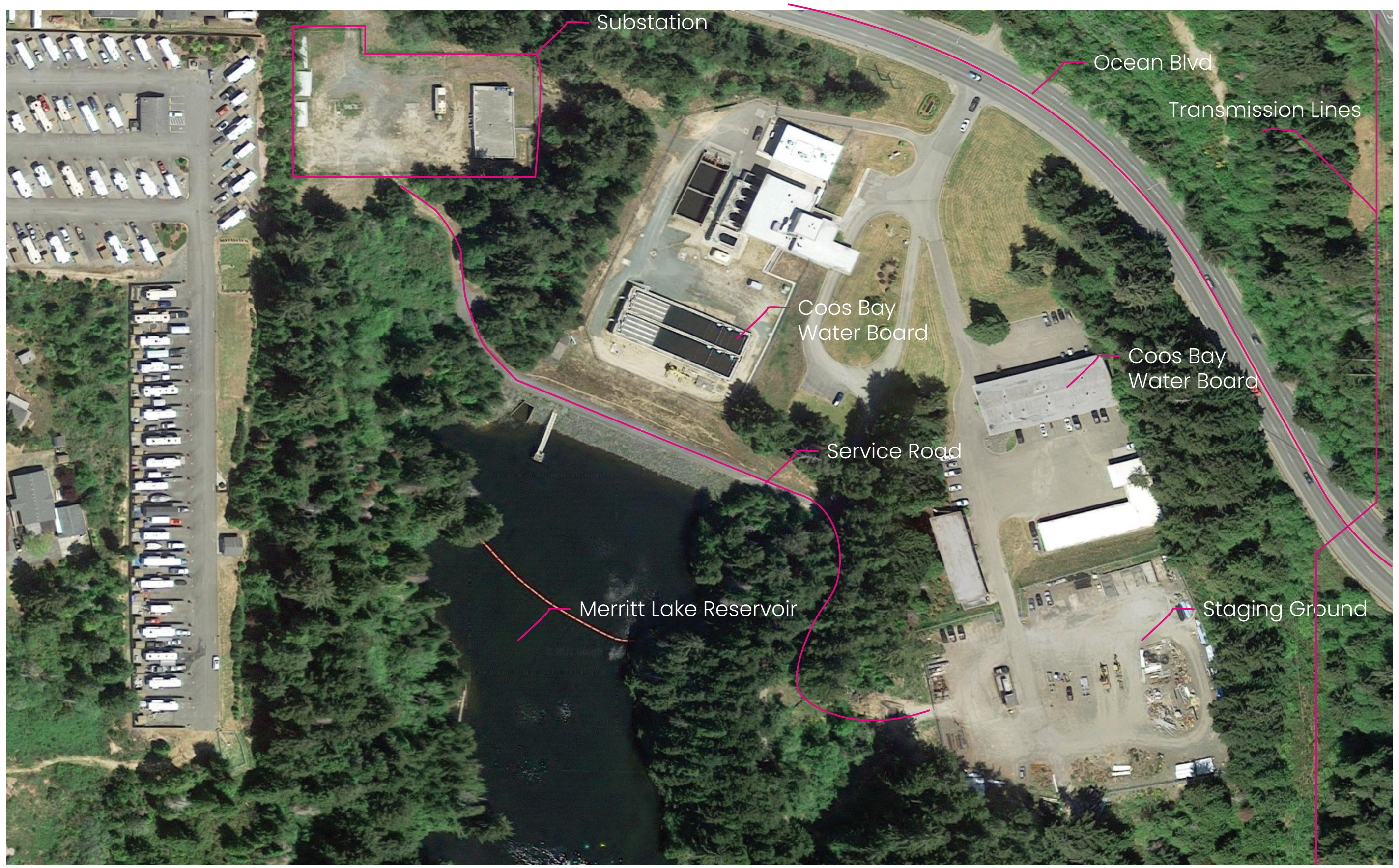
Tsunami Evacuation Zone

4.4 Seafood and Recovery Hub

Context

The third site is the proposed seafood and recovery hub. This proposal is located at the site of an existing substation, seen here in pink. This site is situated outside of the tsunami evacuation zone to allow for safety in the event of a tsunami. The site is located off of a main road, making it a short drive from either end of town.

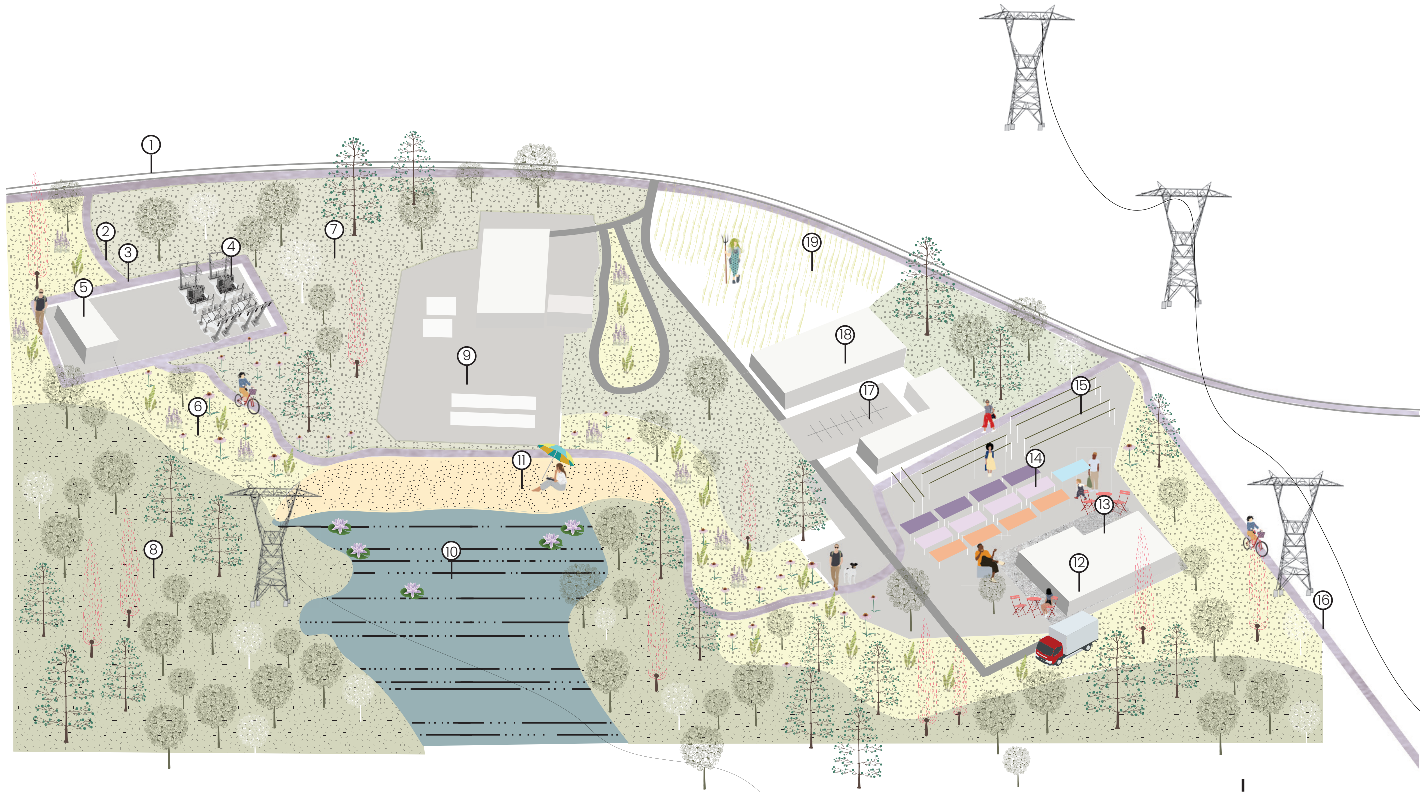
Figure 4.16
Site 3 context map



Existing Conditions

Figure 4.17 zooms into the existing conditions of the site. Here you can see the substation footprint, existing service road that meanders past the Coos Bay-North Bend Waterboard facilities, Lake Merritt reservoir, and leads to a former staging ground through dense forest habitat. Transmission lines extend beyond the staging ground and lead toward downtown Coos Bay.

Figure 4.17
Site 3 existing conditions



1. Ocean Blvd Rd
2. Service Road
3. Public trail System
4. Substation
5. Battery Storage
6. Meadow
7. Savanna
8. Dense Forest
9. Coos Bay North Bend Water Board
10. Lake Merritt Reservoir
11. Picnic Tables
12. Processing Center
13. Seafood Market
14. Urchin Aquaculture
15. Seaweed Drying Demonstration
16. Tranmission Line Trail
17. Parking
18. Water Board Buildings
19. Community Garden

10 30 60 Feet

Proposed Conditions

My proposal incorporates a public trail system along the existing service road, allowing the public to experience the infrastructure. The trail meanders through habitat of dense forest, savanna, and meadow to connect to a seafood and recovery hub that is situated on the former staging ground. Battery storage on the substation footprint links to the seafood hub to allow it to transform to a recovery hub in the event of a disaster. The trail then follows a multiuse transmission corridor that ends up in downtown Coos Bay.

Figure 4.18
Seafood and recovery hub proposed conditions

Seafood Hub

The seafood hub consists of a local processing center and seafood market. A consistent community supported marine agriculture program operates here year round. The urchin aquaculture program that exists to both introduce a local seafood species as well as restore the kelp forests operate in this public space for community education purposes.

Figure 4.19
Seafood hub

Recovery Hub

The seafood hub has the capability to act as a recovery hub for the community in the event of a disaster. The battery storage will supply electricity for means of refrigeration for food, heat, communication, and shelter. The public space setting offers multiple gathering spaces and community resource sharing.

Figure 4.20
Recovery hub

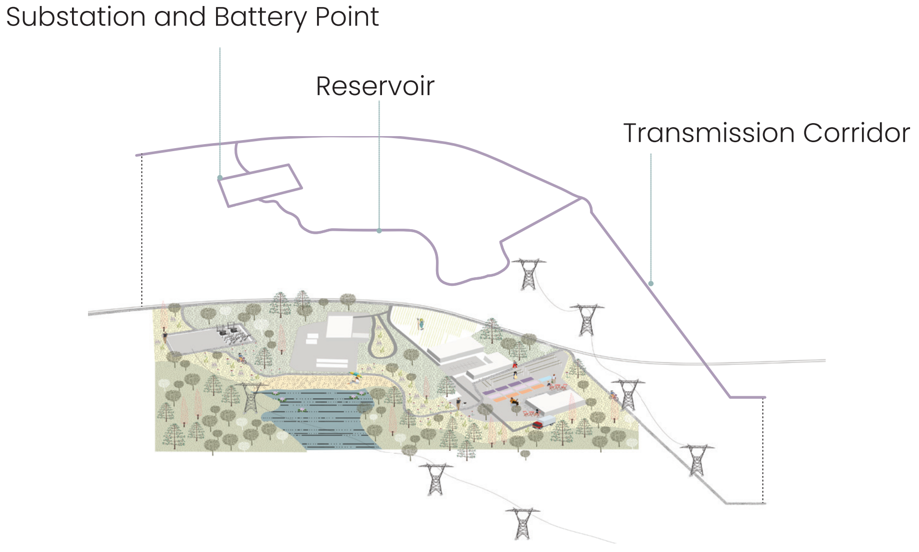


Figure 4.21 (left, above)
Infrastructure trail

Figure 4.22 (left, below)
Substation and battery Point

FIgure 4.23 (right, above)
Reservoir point

Figure 4.24 (right, below)
Transmission corridor

The public trail system that serves a second life as a pedestrian trail, connects users to their infrastructure by providing ownership and education. The significant stop on the trail includes the substation and battery footprint, shown in Figure 4.22. Grassland and wildflower habitat is maintaned adjacent to it to both support pollinator habitats as well as bring beauty to the area. The second stop along the trial is Lake Merritt Reservoir. Picnic tables are added to the gravel beach creating opportunity for users to enjoy the reservoir, shown in Figure 4.23. And finally the trail continues along the transmission corridor where a meadow ecosystem is maintained. The trail moves beyond the ite to follow this corridor to downtown Coos Bay, shown in FIgure 4.24.

Chapter 5: *Conclusion*

5.1 Discussion

In conclusion, this project shows how a multi-functional landscape approach contributes to creating environmental, social, and economic synergies around off-shore wind farm development in the era of climate change. My hope is that this framework can be applied to the many other communities that will be experiencing large scale infrastructure changes to ensure that those changes are designed with and for the communities they are existent in.

The framework provided in this project creates a process guideline for designers to follow, as well as key pinciples to guide design outcomes. The framework consists of three parts; multi-stakeholder engagement, multifunctional landscapes, and systems thinking. Systems thinking works to synergize multi-stakeholser engagement and multifunctional landscapes. This synergy is what makes this framework successful.

Coos Bay is just one example of a community with varying stakeholder needs that seem contentious on the surface. However, through stakeholder interviews and analysis, interconnections and shared goals became apparent. I beleive that lanscape architects can serve a community organizing role in the way we can act as an outside facilitator that works to find "least conflict" solutions.

5.2 Limitations

Due to the scope of this masters project, I was not able to conduct a thorough stakeholder analysis process. I was only able to interview one person from each staekholder group. For infrastructure planning processes, I reccomend designers and planners work with community engagement specialists to design community engagement processes. These processes should give more power to community members in decision making processes and should give them a seat at the table in the design room.

Therefore, the site design results of this project serve more as inspiration to the Coos Bay community as to what is possible when infrastructure is planned with multistakeholder engagement and multifunctional landscapes principles. They are not definitive design proposals.

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