

The impacts of sea level rise environmental sciences essay



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"Adaptation" refers to efforts by society or ecosystems to prepare for or adjust to future climate change. These adjustments can be protective (i. e., guarding against negative impacts of climate change), or opportunistic (i. e., taking advantage of any beneficial effects of climate change). Adapting Waikiki to the anticipated sea level rise and increased coastal storm activity Waikiki must stay in its current location and adapt to oncoming sea rise in order to ensure the resilience of the state and county. It is not economically feasible to relocate Hawaii's urban core. Climate change is impacting the state of Hawaii and efforts towards resilience can already be seen. Increases in air temperature, decreases in rainfall and rain intensity along with increased sea surface temperature are all signs of climate change on a local and global level. Waikiki is located on the South shore of the island of Oahu, bounded on the North and West by the Ala Wai canal from Kapahulu avenue to the ocean. The Hawaii Convention Center, Ala Moana Hotel, the shoreline adjacent to the Honolulu Zoo and Kapiolani Park are also included in the Waikiki zone. Waikiki is comprised of six hundred acres which is equivalent to approximately 1/100th (1%) of the state's land area. According to the Honolulu tide record at Sea Level Trends, over the last century sea levels in Hawaii have risen 0.6 inches or more per decade. A one foot rise in sea levels is expected for Hawaii by the year 2050 and a three foot rise is expected in the next century. Adapting to sea level rise in Hawaii rather than developing new infrastructure elsewhere encourages resilience. Adjustments which reduce vulnerability and increase resiliency to climate change effects on natural and human systems are adaptive solutions. Taking advantage of beneficial opportunities and the minimization of harm are involved in adaptation strategies. Adaptation seen from a law and policy perspective <https://assignbuster.com/the-impacts-of-sea-level-rise-environmental-sciences-essay/>

ensures that current policies and procedures account for climate trends, variability and uncertainty. Ultimately, adaptation seeks not only to create new policies, but to routinely consider how the future climate may affect the outcomes of decisions and applying that information to make more informed solutions (Codiga et al. 2011). If we had to relocate the people of Waikiki, where will they go? Most of Hawaii's economy lies on our coastlines. If sea-level rise was to affect Waikiki it will also affect most of Oahu and Hawaii's economy as most businesses lay near our coast lines. The tourism industry accounts for 26% of the state's economy and in 2006, tourism brought more than seven million visitors and generated more than \$12. 4 billion for the state. More than 11% of the state's civilian jobs are provided within Waikiki alone and 12% of state and local tax revenues. Roughly 46% of statewide tourism revenues are generated in Waikiki. \$2 billion would be forfeited annually in overall visitor expenditures due to the loss of Waikiki beaches and 6, 352 hotel jobs. Waikiki is obviously an economic asset in the State. The tourism industry supports roughly 8% of the gross state product and even more when the re-spending of the visitor dollar by Waikiki employees of tourism-related firms (Lim 2012). On an average day Waikiki hosts 72, 000 visitors, 32, 000 employees and 19, 700 residents. Policy

RecommendationsThe impacts of sea-level rise could be mitigated by forwardlooking state or local land-use policies. The City/County shall develop a comprehensive shoreline stabilization strategy to address protection of the built environment where it has been determined to be feasible and in the best interest of the City/County to protect economic investment and public and private infrastructure. Hard-engineered structures can protect coastal development from flooding and erosion. Hard armoring can be built onshore

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or offshore and includes bulkheads, seawalls, revetments, dikes, tide gates, storm surge barriers, and groins. In deciding when to armor, decision makers will need to balance many trade-offs, such as the degree of threat to people and property, cost to build, value of the threatened property or infrastructure, long-term costs to maintain, environmental impacts, the physical conditions of the property (such as geology and elevation), aesthetics, and impacts to public access. If regulators decide to permit hard armoring, they should account for future sea level rise when reviewing the design and construction of protective structures. Currently most regulators require that armoring be designed to withstand at a minimum, a 100-year flood event. (" Synthesis of Adaptation Options for Coastal Areas" 2009) The Florida Action Team articulated a goal to " reduce and discourage future reliance on bulkheading/hardening to stabilize estuarine and beach shorelines. Hard armoring is often favored because it has been the traditional method for protecting existing development. Armoring may be appropriate in some areas where expensive critical infrastructure or intensely developed areas are at risk. (" Synthesis of Adaptation Options for Coastal Areas" 2009)The City/County shall require adequate mitigation for shoreline stabilization through the construction of living shorelines in front of hard shoreline stabilization structures where it is feasible do so. Many jurisdictions have begun encouraging use of soft armoring techniques. Soft armoring creates man made barriers that replenish or mimic natural buffers or elevate land so that structures are less vulnerable to flooding, storm surge, and erosion. Examples of soft armoring include beach re-nourishment, dune creation, re-vegetation, wetlands restoration and living shorelines.

They will need to be designed to withstand sea level rise impacts. In order to <https://assignbuster.com/the-impacts-of-sea-level-rise-environmental-sciences-essay/>

ensure that soft armoring is sustainable given different SLR scenarios, local governments must consider how SLR, increased flooding, and erosion will affect the shoreline. Construction of soft armoring may not be feasible in all areas; it requires consideration of geological conditions, flood dynamics, and risks to property from coastal flooding. Soft armoring also requires consistent maintenance to sustain its flood control benefits. The Virginia Governor's Commission recommends that the Virginia Marine Resource Commission "adopt shoreline protection policies that emphasize the use of living shorelines and seek to avoid shoreline hardening where feasible" in order to "allow for the potential migration of tidal wetlands and increase coastal resiliency." Soft armoring can be less expensive than hard armoring but requires regular maintenance and monitoring. Beaches need a constant source of sediment and, therefore, may require expensive renourishment. Wetlands restoration projects can be expensive, and designing restoration projects to withstand sea level rise impacts may add to the expense of restoration and maintenance. Soft armoring preserves beaches and wetlands that provide habitat and important natural flood control processes. Beach renourishment, however, can have negative environmental impacts and harm habitats as sea floors must be dredged to provide sand. ("Synthesis of Adaptation Options for Coastal Areas" 2009)The City/County shall develop design guidelines that promote compact development and redevelopment that maximizes the use of floodways and flood storage within the zone of accommodation. Setbacks are building restrictions that establish a distance from a boundary line where landowners are prohibited from building structures. Local government can create buffer zones along Hawaii's coastal areas to ensure that vulnerable beaches have room to migrate inland as sea

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levels rise. More extensive buffers could be required in areas with sufficient buildable space or in areas that have important natural resources. The Environmental Protection Agency also recommends use of setbacks as a soft adaptation option (" Synthesis of Adaptation Options for Coastal Areas" 2009). Setbacks and buffers can extend the life of the structure, provide natural protection, and offer a less expensive alternative to hard- and soft-armored solutions. Where there is enough room for inland migration, buffers and setbacks can be used to effectively preserve ecosystems, habitat, and water quality (FEMA 55). The City & County shall require all new construction within the Accommodation Zone to adhere to performance standards designed to enable development to accommodate increasing sea levels and the additional flooding that will result by adapting the built environment and enhancing the resiliency of the natural environment where it is economically and ecologically practicable to do so. Governments can limit when and how structures are rebuilt by requiring that structures be rebuilt using resilient design techniques. After a local government has downzoned a vulnerable area, existing structures can remain, but they become " nonconforming," meaning that if a building is destroyed or damaged, reconstruction has to conform to the current zoning and building requirements for new construction. This deferred approach allows property owners to continue to use their property with no immediate restrictions. Rebuilding restrictions phase out high-risk uses over time and provide long-term costs savings. This measure could be used to ensure that structures are removed as they begin to encroach on beaches, and to create space to allow for the upland migration of beaches. Governments could also couple rebuilding restrictions with financial incentives to cushion the economic hardship on landowners

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who have to relocate. (" Sea Level Rise & Global Climate Change" 2000) Many states require their local governments to prepare Capital Improvement Programs (CIPs). For proposed investments in public improvements (such as roads and sewers, for example), CIPs budget for, and site, future public improvements based upon projections of the community's growth. (Prather) Accessed March 16, 2013. [http://apavirginia.org/documents/legislation/Growth Tools Revised 10-09_final. pdf](http://apavirginia.org/documents/legislation/Growth%20Tools%20Revised%2010-09_final.pdf). The Maryland Working Group recommends that " planning efforts for new or modified capital projects, such as transportation planning, stormwater management, and infrastructure siting... assess sea level rise and storm surge vulnerability." Maryland further recommends that the " design of future public projects, including roads, bridges, tunnels, landfills, water, and wastewater treatment plants, etc., should consider the effects of climate change and sea level rise. In addition, standards should be developed for the modification of existing facilities in response to sea level rise." By requiring consideration of sea level rise (SLR) in CIPs, governments could ensure that scarce public funds are not wasted developing infrastructure that will be at risk of damage from flooding and erosion in the near future. Using CIPs, local governments can plan for and budget for the significant additional investment that may be required to relocate or retrofit existing infrastructure. However, by discouraging development in coastal areas, governments may sacrifice some additional tax revenues. Case Study: Portsmouth, England The revenue made in Waikiki can be used to build resilience through the choice of " defending" and " attacking" our coastlines. Businesses and hotels closest to the shoreline edge can choose to invest to adapt to rising sea level through a defense sea wall that will be economically

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and commercially viable to the state. Implementation of a seawall in Waikiki will be at the southeast end of the Duke Kahanamoku Lagoon to Kapahulu Avenue. A similar example is the City of Portsmouth in England. Royal Institute of British Architects' (RIBA), experts from Building Futures and the Institution of Civil Engineers (ICE) proposed to build a 'living wall' that had commercial, residential, and recreational development purposes amongst the entire coastline. The wall extended seawards to create new space for development that would help compensate the cost of the project. Privately and publically funded maintenance programs were placed for a 200 year liability to protect the properties. In addition to the 'living wall', the City of Portsmouth, constructed a two tiered pier that that was developed for residential, commercial, and recreational purposes and interconnected to existing infrastructure. Waikiki is short of developable space, however there is potential to extend seawards that could accommodate more residential and commercial development and our future rail system. Floating communities can emerge around the two tiered piers and this type of hard engineering solution can act as groin to help Waikiki maintain its beaches. (Hamer et al. 2010). Cleveley, a town on the north-west coast of England, is another example of a city with a successful commercial development out onto the water. As a leisure and shopping destination, the town is a critical element in sustaining its social and economic welfare. Cleveley's defense scheme benefits the community by protecting it from tidal flooding and increasing the amenity of the beach. The defense scheme comprises of stairs that act as a flood stop by breaking the wave swell and pushing water back to the sea. The stairs may also be a place where people can sit and engage in the activities of the beach. To protect the defense structure from any

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damage and the erosion of materials over time, the construction materials consist of steel-sheet piles, soil, and precast concrete lengths of stairs ("Cleveys: Taking steps against flooding" 2012). Alternatives Although funding for the structural improvements for Waikiki to remain in place is a large concern, there have been great examples of public/private partnerships in previous improvements of Waikiki Beach. The Department of Land and Natural Resources (DLNR) Office of Conservation and Coastal Lands (OCCL) is currently developing a comprehensive beach management plan that will look 50 to 100 years into the future. The plan identifies the state's most threatened beaches and provides a range of tools designed to ensure the survival of the beaches for future generations. Beach restoration in Waikiki is included in this initiative, without mention of retreating Waikiki businesses or activities at this time. In 2012, the DLNR, with the cooperation and support of the Hawaii Tourism Authority and Kyo-ya Hotels and Resorts, restored a valuable and heavily utilized portion of Waikiki Beach by recovering and recycling sand that was eroded from the shoreline over time ("Waikiki Beach Maintenance Project" 2012). This partnership helped revive valuable environmental resources as well as an iconic local amenity. Investments already made in Waikiki are immense and continue to grow. The majority of the hotels in Waikiki were built in the 1960s and 1970s, with the last one built more than 30 years ago. Hotel owners have invested millions of dollars in recent years to improve existing hotels. Kyo-ya Hotel and Resorts has already completed renovations for the landmark Royal Hawaiian, the historic Moana Surfrider, and the Sheraton Waikiki. Upon completion of the final phase of the company's portfolio of Waikiki hotels, it will have re-invested \$1 billion into Hawaii's economy ("Renewing Waikiki" 2013). The \$350 million <https://assignbuster.com/the-impacts-of-sea-level-rise-environmental-sciences-essay/>

Hawaii Convention Center was opened just 14 years ago to attract business meetings and add revenue to the state. Also, new businesses, like H&M which plans to open a 31, 000 square-foot store on Kalakaua Avenue in 2014 (" Retailer H&M to Open First Store in Hawaii" 2013), will continue to invest in Waikiki as long as tourists continue to spend. The bottom line -- Waikiki businesses want to be in Waikiki, even if it means financing structural changes to adapt to environmental change. Several pilot sites of retreat have been created have showed positive results, but these sites were not considered economic or population hot-spots like Waikiki. Charles Lester, executive director of the California Coastal Commission, said planned retreat is an attractive option in theory, but it is hard to execute in densely populated coastlines where there may not be room to move back (Chiu 2012). Retreating Waikiki means removing any current coastal defenses and allowing the previously protected structures and infrastructures to be reclaimed by the sea. It is not financially wise for businesses to allow their current structures to be destroyed and spend even more money on rebuilding at another location. Tourism is the state's leading economic resource, and in 2008, Waikiki supported about half of all tourism-related jobs. " Waikiki is the anchor for the State's visitor industry, which is in turn the major driving force in Hawaii's economy," (" Economic Contribution of Waikiki" 2003). Losing Waikiki Beach would devastate Hawaii's tourism industry and leave thousands of residents unemployed. Although employment is possible if Waikiki businesses relocate, the new locations would be sprawled outward and there would be no central tourist destination. Without a central and walkable destination, it would be difficult to attract the same amount of tourists each year. Therefore, tourism-related

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businesses that have moved inland would struggle to stay afloat. Many of the hard engineered defenses of the 20th century have been criticized as being unsustainable, reducing access to water, damaging to coastal habitats, and costly to maintain and improve. However, they have provided protection and reduced risk from flooding, allowing activities to go on uninterrupted in the built environment. Chip Fletcher, from the University of Hawaii's School of Ocean and Earth Science and Technology, is one of the state's leading voices on erosion and climate change. He explained that seawalls are a major factor in coastal erosion of certain areas, but that the "fateful decision" to first build seawalls in Waikiki was made more than a century ago and likely can't be reversed now (Levine 2011). Therefore seawalls should be viewed as part of Waikiki and the plan for dealing with sea level rise. It is important that Waikiki remain and adapt to climate change in order to preserve the investments already made in the area, continue to generate revenue, and to evolve into a resilient economic asset for the state.