

Out of Harm's Way: Strategies for Managed Retreat from Climate Change in the United States

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Within the next 30 years, the United States can expect to see a one-foot rise in sea levels even if CO₂ emissions went to zero overnight¹. This is because more than 93% of the heat humans have already generated is trapped in the oceans where it will linger for centuries². Over the next seventy to eighty years, sea levels may go up to 7 feet based on how quickly the Antarctic ice sheets melt, rates of land loss, and ocean circulation changes³. For every foot of rise, roughly 100 feet of shoreline will be flooded⁴. The consequences will be catastrophic for nearly 130 million people who live in a coastline community – more than 40% of the U.S. population⁵. They should expect more than ten disruptive flooding events per year by 2050⁶.

A similar fate is in store for communities living in the American West, where almost 60 million homes are within less than a mile of a wildfire-prone area⁷. Those numbers will continue to grow as the increased intensity and duration of heatwaves and drought conditions create a risk of bigger, more frequent blazes.

These communities can respond in one of three ways: they can resist, accommodate, or retreat. Resist options include hard infrastructure like seawalls, levees, and dikes. Accommodate options include elevating homes, building reinforcements, or early warning systems. Retreat entails physically moving people away from the coastlines and further inland to a more elevated surface. While the three options can be complementary, there is little time to act and limited resources.

This paper looks more deeply at retreat – specifically “managed retreat” – the purposeful and coordinated movement of people and assets out of harm’s way. I set out to answer the question: what are the most efficient and cost-effective methods to encourage state and local governments as well as at-risk households to proactively retreat? I begin by characterizing the most common environmental threats posed by climate change that communities will be retreating from and what the barriers are to successful managed retreat. Then I will conduct four case studies of cities or counties implementing managed retreat programs against sea-level rise, coastal erosion, and flooding: (1) King County, Washington, (2) Charlotte-Mecklenburg County, North Carolina, (3) Austin, Texas, and (4) Queens, New York. A comparative analysis will be done on these case studies to assess their outcomes, cost-effectiveness, and policy tradeoffs. Finally, I conclude with recommendations and next steps for policymakers who are looking at implementing managed retreat policies.

Ultimately, certain areas will be under water or smoldering in ashes no matter what we do. People in those areas are already, and will inevitably, retreat. Whether or not it is done in a managed and coordinated way is a different question. Despite the name, “managed retreat” should not be thought of as accepting defeat. Rather it is a chance to live to fight another day. In the words of Marine Corp General Oliver Smith, “Retreat, hell! We’re not retreating, we’re just advancing in a different direction.”⁸

Drivers of Retreat: Environmental Catastrophes in a Warming World

In the summer of 2021, one in three Americans experienced a climate disaster - whether from a heatwave, flash flood, wildfire, or drought⁹. The number of people living in a designated disaster area in the U.S. has increased by 84% since 2018, encompassing more than 100 million people¹⁰. Globally, more than 85% of the world’s population and four-fifths of the world’s landmass has suffered from extreme weather events linked to human-induced warming¹¹.

Despite bold commitments by nations to decarbonize their economies, the world is on a path for some inevitable warming to continue. In 2021, the United Nations Intergovernmental Panel on Climate Change (IPCC) assessed that it is “very likely” that the planet will warm by 1.0°C to 1.8°C above pre-industrial levels even under their very low greenhouse gas (GHG) emissions scenario. It will warm by 2.1°C to 3.5°C in the intermediate scenario, and by 3.3°C to 5.7°C under the very high GHG emissions scenario¹². The last time temperatures sustained at or above 2.5°C was more than 3 million years ago¹³.

Figure 1 – Changes in global surface temperature until 2100¹⁴

Scenario	Near Term, 2021 – 2040		Mid-term, 2041 – 2060		Long-term, 2081-2100	
	Best Estimate (°C)	Very Likely Range (°C)	Best Estimate (°C)	Very Likely Range (°C)	Best Estimate (°C)	Very Likely Range (°C)
Low GHG (SSP1-1.9)	1.5	1.2 to 1.7	1.6	1.2 to 2.0	1.4	1.0 to 1.8
Intermediate GHG (SSP2-4.5)	1.5	1.2 to 1.8	2.0	1.6 to 2.5	2.7	2.1 to 3.5
High GHG (SSP5-8.5)	1.6	1.3 to 1.9	2.4	1.9 to 3.0	4.4	3.3 to 5.7

Even if transformative emission cuts are made globally, the planet is still headed to at least a 1.5°C increase over the next 20 years up to 2°C in 40 years. Many leading climate scientists believe a rise of at least 2.3°C is inevitable given how many greenhouse gases have already been emitted¹⁵. Each of these scenarios carry associated environmental effects, with every additional 0.5°C of warming amplifying these effects in intensity and frequency. The most common environmental extremes will be seen in heatwaves, droughts, heavy precipitation, and sea level rise.

- **Heatwaves:** At 1.5°C, extreme heatwaves will become widespread affecting about 14% of Earth's population at least once every five years. At 2°C, that number jumps to 37% with extreme heatwaves occurring annually¹⁶. The areas most affected will be in Central and Eastern North America, Central and Southern Europe, the Mediterranean, Western and Central Asia, and Southern Africa¹⁷.
- **Droughts:** At 1.5°C, roughly 130 million people globally will be exposed to severe drought. At 2°C, that goes to nearly 200 million¹⁸. Accordingly, 271 million people will experience water scarcity at 1.5°C, going up to 388 million at 2°C. The areas most affected will be the Mediterranean, Southern Africa, South America, and Australia¹⁹.
- **Heavy Precipitation:** At 1.5°C, the frequency of extreme rainfall globally will increase by 17%. At 2°C that number more than doubles to 36%. These events are projected to intensify by about 7% for each 1°C of warming.²⁰ Relatedly, Category 4 and 5 cyclones are expected to increase 1.5-2 times at 1.5°C due to warmer ocean waters, compounding extreme precipitation. The areas most affected by precipitation will be in Eastern North America, Northern Europe, Northern Africa, and Southeast Asia²¹.
- **Sea Level Rise:** At 1.5°C, global sea levels will rise by 10cm feet affecting 510 million people²². At 2°C this goes to 20cm, causing more than 70% of Earth's coastlines to see increased coastal flooding, beach erosion, and water salinization²³. These risks will be felt globally but are projected to be the highest in South and Southeast Asia²⁴.

The United States is already experiencing all four of these extreme weather events and communities have already started retreating. For those who are thinking of retreating themselves or want to facilitate the retreat of others, there are a number of barriers to accomplishing it.

Barriers for Managed Retreat: Psychological, Institutional, and Practical

As stated earlier, managed retreat is the purposeful and coordinated movement of people and assets out of harms way. It is considered the strategy that most effectively eliminates climate risk²⁵

compared to resisting or accommodating to climate change. Resist options like seawalls and levees have been known to fail in places like New Orleans while accommodate options like building reinforcements or elevating homes may not be enough to eliminate the threat. Moreso, resist and accommodate options can provide a false sense of security which continues to encourage risky development along the coast, flood plains, or fire prone areas. Managed retreat physically removes people away from the source of the risk. Though it sounds like an elegant solution, there are three principal barriers to accomplishing managed retreat in the U.S. – psychological, institutional, and practical.

Psychological barriers largely relate to a resident's fear of moving, an attachment to where they live, and being optimistic that they will be able to survive future environmental disasters. Unsurprisingly, most people who live in coastal communities don't want to leave²⁶ - they enjoy the aesthetic beauty, recreation, and even historical ties to the area. Many also rely on coastal proximity for their livelihoods and maintaining their location becomes central to their personal identities²⁷. Moving can be scary and full of uncertainties, including losing a sense of community and leaving behind sentimental memories.

Repeated disasters in an area can motivate some to leave, but studies have shown that a strong attachment to a place can even overcome personal experience with flooding or wildfires²⁸. This can be coupled with what's known as an optimism bias – recognizing that retreat will be required somewhere in some place, but not accepting that their home is one of those places. This is either due to downplaying the risks and believing that environmental disasters won't happen or won't be that severe. Or they may believe that whenever the situation gets really bad there will be some technological solution or government intervention which will save them. Regardless of their reasons, the coming changes are inevitable whether they proactively prepare or not. More than 40,000 households have overcome these barriers and have relocated through managed retreat programs²⁹, though that represents less than .0003% of the 130 million Americans who live in shoreline counties. There are likely a large number of people who recognize the impending catastrophe and want to relocate to a different area, but they are not able to do so without financial and logistical support to do so. These individuals are trapped, and the onus is on public and private organizations to identify them and facilitate their retreat to safer grounds.

Institutional barriers stymie federal, state, and local governments from effectively using policy and regulations to incentivize and implement managed retreat. At the core of why governments struggle here is twofold: policies that subsidize risk, and a mismatch of authority that creates disincentives to relocate communities. There are two major policies that drive the federal government's approach to

climate adaptation – the National Flood Insurance Program (NFIP) and federal disaster assistance administered through the Federal Emergency Management Agency (FEMA) and the Department of Housing and Urban Development (HUD).

Federal disaster relief was originally designed in the Cold War to help communities in the event of nuclear war³⁰, but its payout structure presented a moral hazard by incentivizing people to live in flood prone areas because the government promised to step in and help repair the damages. As a result, the NFIP was created to impose costs on coastal residents by having them pay insurance to cover the flood risks. Unfortunately, the program has been fundamentally broken for decades: not enough property owners pay into the program to sufficiently spread the risk, and those who do pay have highly discounted premiums, so they are not paying the true cost of living in these risky areas³¹. When combined with uncertainty or misinformation about the threats of climate change, low flood insurance premiums have reinforced a belief that living in a coastal area is less risky than it actually is – in effect, subsidizing them to stay³². This dynamic has played out across the nation – one house in Mississippi has been rebuilt 34 times in 32 years at a taxpayer cost of \$663,000 for a house worth less than \$70,000³³. North Carolina, New Jersey, and Florida have let more than 9,000 new homes be built in flood zones since 2010³⁴. The U.S. Congress has reauthorized the NFIP nearly a dozen times since 2017 alone and has yet to make any structural changes to its design that could effectively disincentivize continued shoreline development³⁵.

The second institutional barrier at play is a mismatch of authority. State and local governments have the most power to engage and promote managed retreat through land use and zoning policies which can determine where housing development happens. However, they are the least incentivized to take action because they rely on property taxes, development fees, and economic activity from the residents in these areas to sustain their public expenditures. On some occasions, residents who have asked their local government to support a managed retreat have been denied. After Hurricane Sandy, residents of Oakwood Beach in Staten Island requested a buyout to relocate, but New York City refused³⁶ – even though the threat of flooding had already made itself apparent. The federal government and taxpayers, who have the most to gain from managed retreat, have little to no authority in regulating land use and have only a broken NFIP to discourage development in areas that they know will be under water. Making matters worse, FEMA’s Hazard Mitigation Grant Program and HUD’s Community Development Block Grant-Disaster Recovery program – the federal government’s primary vehicles for managed retreat – makes funding for disaster recovery available primarily after an extreme

weather event has already occurred, not before. The result of this mismatch of authority is a stagnant institutional process to get Americans out of harm's way before it is too late.

Lastly, practical issues abound with making managed retreat happen. Moving is hard, period. But picking up your life and moving to an entirely new area to escape an environmental catastrophe which hasn't happened yet presents different challenges altogether. For example, where do people go? One study of residents in Staten Island who retreated found that 20% relocated to a floodplain with equal or greater risk of flooding, and 98% moved to an area with a higher poverty rate³⁷. Without specific support for individuals to relocate to safer areas, there is no guarantee they will be knowledgeable enough to know where to move. Similarly, who gets prioritized for financial support to relocate? Some studies have found that managed retreat has disproportionately benefitted white communities and enabled white flight in some areas³⁸, while others have found programs disproportionately uproot low-income and minority communities³⁹.

An important part of that equation is how the evacuated land is used after retreat. Ideally, homes are demolished, and the land is rehabilitated into open spaces like parks and gardens or environmentally restored to absorb floodwaters, improve air quality, and provide a buffer against environmental changes. This has predominantly occurred in white, affluent areas that have retreated⁴⁰, while abandoned homes in low-income minority neighborhoods have been left dilapidated – acting as eyesores which tarnish community cohesiveness and do nothing to help prepare for more climate disasters⁴¹. The nation's coastlines are both a playground for the wealthy and where some of the most historically disadvantaged and marginalized communities live. How to make managed retreat fair is an open question given the limited scale of retreat that has happened so far.

There are no easy answers for overcoming these psychological, institutional, and practical barriers to managed retreat, but there are a number of tools for public and private organizations to use. The Georgetown Climate Center compiled a list of acquisition and regulatory tools that can be deployed to incentivize and facilitate managed retreat⁴². The acquisition tools include voluntary buyouts, open space acquisitions, land swaps, leasebacks, conservation land trusts, and life estates and future interests. The regulatory tools include living shorelines, setbacks and buffers, development permit conditions, and zoning and overlay zones.

This paper will take a closer look at four specific property acquisition tools that cities and counties are using for retreat: voluntary buyouts (Austin, Texas), open space acquisitions (King County,

Washington), land swaps (Queens, New York), and leasebacks (Charlotte-Mecklenburg County). The goal is to analyze these four mechanisms, assess their ability to overcome the psychological, institutional, and practical barriers to managed retreat, consider the policy tradeoffs for each program, and the degree of cost-effectiveness.

Case Study #1: City of Austin, TX - Voluntary Buyout Program

Voluntary buyouts are the most common form of managed retreat, primarily through FEMA and HUD grants for state, local, and tribal governments to purchase properties from homeowners, typically at the pre-disaster value of their home. After the purchase, ideally local authorities demolish existing structures on the property, prohibit future development through deed restrictions or a conservation easement and allows the property to revert to open space naturally or in a planned way (e.g. creating parks, gardens, greenways, etc.). Voluntary buyout driven at the federal level have their own challenges – they take a long time (up to a year) and purchase prices are both too low to enable homeowners to effectively relocate and too high to scale up nationally to meet future demand for retreat⁴³. For this reason, the city of Austin, Texas instituted their own Flood Buyout Program⁴⁴.

Roughly 10% of Austin’s land area is in a floodplain with several major creeks succumbing to flash flooding. Since the 1980s, the city has implemented buyout projects to relocate vulnerable communities from these areas, particularly Onion Creek and Williamson Creek. Austin’s Watershed Protection Department (WPD) guides buyout projects through the development of a Watershed Protection Master Plan which assesses and prioritizes areas of erosion, flood, and water quality problems. Following the 2015 Halloween Flood which saw water levels rise to nearly 40 feet⁴⁵, the city expanded its buyout program to expedite retreat. Austin’s voluntary buyout model is unique in its funding structure and providing relocation assistance.

The majority of the program is funded through a drainage fee leveed on each property in Austin based on the amount of impervious surface area on a property, e.g., roofs, driveways, and patios, which prevent rainwater from soaking into the ground. This funding is supplemented with municipal bonds, bond elections, and FEMA grants. This structure enabled Austin to proactively secure funding for retreat without exclusively relying on federal assistance which usually comes after a disaster strikes.

The more noteworthy aspect of Austin’s buyout program is their relocation assistance. In addition to purchasing the home, Austin will cover moving and closing costs and a replacement housing payment if the newer home, which has to be located outside the city’s flood plain, is more than the

original home. Most other municipalities provide no relocation assistance or set a cap on the assistance available. Rental assistance can also be available for renters as well as business reestablishment assistance for landlords. Austin’s flood buyout program lasts approximately nine months per home and has five key elements:

1. **Appraisal and Inspection Costs:** The city will conduct an independent appraisal to determine the original home’s fair market value as well inspection costs for a replacement home
2. **Original Home Purchase Offer:** The city will extend a purchase offer to the homeowner based on the original home’s fair market value
3. **Moving and Closing Costs:** The city provides both financial and administrative staff support for the displaced owner to buy and move into a new home
4. **Replacement Housing Payment:** If the new house is more expensive, the city will cover the difference if it considers it to be a “comparable home” — a home that is functionally equivalent to the original home but is not located in the 100-year floodplain. WPD only looks at the price of comparable homes within 50 miles of the original home and within the city limits.
5. **Demolition and Restoration:** The original home is demolished, and the land is maintained as open space or other floodplain-compatible uses desired by the surrounding neighborhood.

This program is considered a model approach for other jurisdictions due to its interdisciplinary nature cross cutting different sectors (floodplain and emergency management and housing and community development)⁴⁶. Below I summarize how the Austin model for voluntary buyouts can help overcome barriers to managed retreat, what the policy tradeoffs are, and a simple cost analysis for the program. The cost estimates are derived from a report by the Office of the City Auditor for Austin for 2017.

Voluntary Buyouts: Austin, Texas Program Analysis	
Ability to Overcome Barriers to Managed Retreat	
Psychological	<u>Fear of moving:</u> Providing financial administrative support to help homeowners find a new house can reduce the uncertainty and fear of where they will go once leaving their home.

Institutional	<u>Authority mismatch</u> : State and local governments are incentivized to participate because homeowners are relocated within Austin city limits in order to receive replacement home cost difference payments, thus existing tax bases are maintained despite retreat.
Practical	<u>Logistical execution</u> : The city facilitates the relocation pre-disaster and does not rely on post-disaster federal funding to do so.
Policy Trade Offs	
Administrative	<u>Staff burden</u> : Because of city involvement outside of just appraisal and purchase, there's a long-term commitment and diversified support staff that's needed which can contribute across grants management, real estate, environmental restoration, etc.
Economic	<u>High relocation costs</u> : An audit of the program found that the decision to provide full replacement housing assistance resulted in significant costs for the city, which was exacerbated by the increasingly expensive housing market in Austin.
Environmental	<u>Creating open spaces</u> : The restoration, protection, and management of bought-out properties to become open spaces requires additional funding that exceeds the price-tag of just purchasing the property and demolishing.
Social/Equity	<u>Equitable transition</u> : Providing relocation support and a replacement housing payment helps close the gap for historically marginalized and lower-income groups to be able to afford to retreat.
Cost/Benefit Analysis – 2017⁴⁷	
Homes bought	435
Cost	\$113.5 million
Cost per household	\$260,919

Case Study #2: King County, WA – Open Space Acquisition through Transfer of Development Rights

Unlikely voluntary buyouts, open space acquisition programs don't aim to buy homes and relocate individuals but to acquire privately held land for the purpose of open space conservation either by leaving it in its natural state, making it into recreational use (parks and trails), or working use like agriculture. This enables communities to protect priority migration corridors for people and species to

migrate to safer areas or further inland to higher ground when faced with sea level rise, flooding, or wildfires. King County in Washington state, home to the greater Seattle area, pioneered an innovative program known as the Transfer of Development Rights (TDR) to both preserve land for open space and ecological preservation through conservation easements, as well as create new, and more resilient housing development in areas that are less vulnerable to climate disasters⁴⁸.

The TDR program works by designating “sending areas” (farmland, wetlands, forest, or open space which the government wants to protect), and “receiving areas” (urban locations in environmentally safer areas that can accommodate future population growth). Landowners in sending areas can separate some or all of their unused property into tradeable development rights. Development rights can be bought and sold to developers in receiving sites who can then use those rights to increase the size or density of a housing development project above the base zoning standards. In return, the parcels of land from the sending area are preserved through a conservation easement and are eligible for lower property taxes.

King County cooperates with participating municipalities who come together to determine what areas can be designated sending and receiving areas as well as facilitating revenue sharing agreements with the county as receiving areas will need increased infrastructure services as they make room for more people who are retreating from flooding and sea level rise in the Seattle area. Qualifying landowners in a sending area must have land that provides one of the following public benefits: agricultural use, forestry use, critical wildlife habitat, open space, or regional trail connector or urban separator. The number of development rights given for each parcel of land that provides one or more of these benefits is determined through a qualification process that looks at the size and location of the parcel and any human development impacts already imposed on it or to be retained.

There are two models for receiving areas to acquire those development rights. In the first model, King County itself pays landowners with open space for a conservation easement through a TDR Bank. The TDR Bank then sells those development rights to residential housing developers. In the second model, landowners voluntarily put a conservation easement on their land and are given development rights by the county that they can sell themselves in an open market to housing developers. The advantage of the second model for the county is that there are fewer upfront costs involved since they don't have to get into the business of mediating the transactions between open space landowners and home builders. However, the TDR Bank does provide a stable market for development rights and credits and eliminates the need for housing developers to find new credits and removes administrative barriers

that can slow the implementation of a project. Ultimately, under both models the property owners are compensated for their development rights and developers receive credits to build more apartment units, townhomes, houses, etc.

From 1998 to 2019, over 144,500 acres (225+ square miles) have been protected from development through the TDR program with 2,800 new residential units added to environmentally safer urban areas⁴⁹. The main source of funding for the program has not been through federal grants but a local property tax known as the Conservation Futures Tax (CFT). King County’s TDR Program provides a model for jurisdictions who want to use a market-based retreat approach that both encourages preservation of sensitive ecosystems while reducing development in at-risk areas and increasing development in safer areas.

Below I summarize how the King County model for open space acquisition can help overcome barriers to managed retreat, what the policy tradeoffs are, and a simple cost analysis for the program. The cost estimates are derived from the TDR Bank’s public website detailing the number of TDRs purchased for acreage of open space in 2016, and the corresponding number of TDRs sold to housing developers in the same year. The cost benefit analysis transposing square feet of development capacity acquired by housing developers into number of equivalent housing units was determined by the Seattle-area average apartment size of 711 sq feet⁵⁰.

Open Space Acquisition: King County, WA Program Analysis	
Ability to Overcome Barriers to Managed Retreat	
Psychological	<u>Place attachment</u> : Receiving areas can be in nearby localities, thus diminishing the loss of a sense of place or community, especially as multiple households can move in a coordinated way to a receiving area.
Institutional	<u>Authority mismatch</u> : Local municipalities don’t have to lose their tax bases because receiving areas can be established within existing municipalities that are not environmentally threatened, thus they’re incentivized to participate.
Practical	<u>Increased development areas</u> : King County is proactively establishing more housing in urban areas with infrastructure and services to accommodate more people, thus removing ambiguity about where residents know they can move.

Policy Trade Offs	
Administrative	<u>New zoning regulations</u> : Local governments will have to amend land-use and zoning maps and regulations to designate sending and receiving areas and provide for a program's rules of operation
Economic	<u>Increased infrastructure investment</u> : TDR programs can generate and sustain an independent source of revenue but receiving areas with significant increases in density will likely need additional funding for investments in new supporting infrastructure and services.
Environmental	<u>Open space conservation</u> : TDR programs can protect open spaces from future development and remove existing development in vulnerable coastal areas that are being impacted by sea-level rise, flooding, and land loss.
Social/Equity	<u>Changing demographics</u> : Current residents in receiving areas may be concerned about how their communities may change in response to increasing density and population (community cohesion, the capacity of infrastructure, and schools).
Cost/Benefit Analysis – 2016^{51, 52}	
Acres protected	270.44
Cost	\$5,439,653
Additional Development Capacity acquired (Sq Ft):	325,469 square feet
Average apartment size in Seattle	711 square feet
Additional housing units built	458
Cost per housing unit	\$11,883

Case Study #3: Charlotte-Mecklenburg County, NC – Leasebacks

Leasebacks are a modified form of voluntary buyouts where a government purchases a property and then rents it back to the original owner. In exchange for rent, the lessee can use their property, but

they no longer own it. Certain trigger events, such as the death of the homeowner or a major flooding or wildfire event can end the lease and the homeowner must relocate.

The primary rationale of leasebacks is that it offers flexibility for homeowners, like the elderly who may want to remain where they are until they pass away, or others who need more time to find another home at a price that is affordable for them. Moreover, when a major environmental event happens it is easier for a resident to break a lease than it is to try and sell a house that has been severely damaged. Typically, with leaseback agreements the lease is not transferrable, and the lessee is not allowed to make substantial improvements to the property or accept federal funds to make repairs against future flood damages. Leasebacks tend to be short-term so that floodplain management objectives can be met in a timely way and people are not kept in vulnerable situations for too long. The goal for governments in using leasebacks is that it maximizes the scale of area-wide buyouts by getting holdout homeowners that are reluctant to leave into a flexible agreement whereby they can stay temporarily and can leave more easily on a timeline that works better for them.

Mecklenburg County in North Carolina, which includes the city of Charlotte, has more than 5,000 properties that are located within the county's regulated floodplain. In 1999, the county launched a Floodplain Buyout Program in order to prevent repetitive housing damage and to restore natural floodplain functionalities in the area after two major flooding events in 1995 and 1997. Charlotte-Mecklenburg Storm Water Services (CMSS) has been administering the program which has several unique features, including a local funding source through a storm water fee, pre-disaster buyouts, and post-acquisition leasebacks.

Like other buyout programs once properties are acquired, they are demolished and converted into open space that can serve as flood retention or community amenities. So far, the county has gained an additional 185 acres of open space while safely relocating more than 700 families and businesses – the county estimates that this has avoided \$25 million in property damage and prevented \$300 million in future losses. In 2016, FEMA recognized Charlotte as one of the top cities in the nation for flood mitigation⁵³. Leasebacks have been an integral part of CMSS's success, leveraging two types of them on a case-by-case basis: triple net leasebacks, and orphan parcel leasebacks.

Triple net leasebacks are a type of lease agreement where the tenant agrees to pay property expenses that the owner would normally pay like real estate taxes, building insurance, and maintenance. In return, the tenant pays a lower rent. This arrangement helps offset the costs of a

buyout for the government while allowing the homeowner to stay in their home for longer. Orphan parcel leasebacks are an additional cost-offsetting mechanism for the government by requiring tenants to provide in-kind services of property maintenance in exchange for reduced or no monetary rent costs. CMSS conducts periodic inspections of these orphan parcels to ensure these properties are being maintained in a way that enables seamless conversion to green spaces or flood retention capabilities.

Leasebacks can be a valuable tool to encourage participation in a buyout program by offering an additional, limited amount of time for residents in a vulnerable area to transition somewhere else. They may not be feasible in all situations, for example if there is imminent damage to a property expected or if someone’s home is a significant part of their net worth, retirement planning, inheritance etc., in which case they are less likely to part ways with it.

Below I summarize how the Charlotte-Mecklenburg County model for leasebacks can help overcome barriers to managed retreat, what the policy tradeoffs are, and a cost analysis for the program. The cost estimates are derived from the CMSS Floodplain Buyout Acquisition Program’s website⁵⁴.

Leasebacks: Charlotte-Mecklenburg County, NC Program Analysis	
Ability to Overcome Barriers to Managed Retreat	
Psychological	<u>Flexible timeline</u> : Residents who are hesitant or fearful of moving can leverage a leaseback arrangement to stay in their house for longer giving them more time to find another home and not have to leave abruptly.
Institutional	<u>Cost recovery</u> : Leasebacks enable governments to recoup some of the costs of the buyout since the tenant is now paying rent to the government in most instances, thus there is a reduced financial burden on local governments.
Practical	<u>No immediate logistics</u> : Homeowners doing leasebacks don’t have to figure out the logistics of their move off the bat, the extra time from the lease period allows for more logistical and practical planning of how and where they will relocate.
Policy Trade Offs	
Administrative	<u>New administrative burden</u> : Leasebacks are a flexible option that’s more attractive than a buyout for some homeowners, but it requires an administrative burden for the government to assume the role of a landlord, which it typically has not done before.

Economic	<u>Cost savings:</u> Renting properties back to the owners incurs savings for the government to offset cost of buyouts and also generating revenue. But governments still need to source funding as some federal hazard mitigation funding restricts use of leasebacks and triple net or orphan parcel leasebacks reduce overall rent revenues.
Environmental	<u>Timeliness of leases:</u> Governments have the ability to acquire more land and covert to open spaces, but that is contingent on securing short-term leases so there's enough time to achieve floodplain management objectives.
Social/Equity	<u>Flexibility in relocation:</u> Leasebacks provides additional time for people to plan their transition to new homes but may still face resistance and not be an appropriate tool for financial, cultural, historical, or sentimental reasons.
Cost/Benefit Analysis – 1999 - 2020	
Homes bought	400
Cost	\$67 million
Cost per home	\$167,500

Case Study #4: Queens, NY – Land Swap

A land swap is the exchange of title to land between two property owners – in this case the government and a homeowner or business. In a retreat context, land swaps can be used to facilitate relocation from an area that is vulnerable to environmental disasters to an area that is on higher or safer ground. In essence, the government owns public land, vacant lots, public housing, etc which it can exchange with a homeowner who they want to relocate for the purpose of managed retreat. This was experimented with in Queens, New York following Hurricane Sandy⁵⁵.

Edgemere is a waterfront community in the Queens borough of New York City located along the Rockaway Peninsula Barrier Island. Following significant damages it incurred after Hurricane Sandy, the New York City Department of Housing Preservation and Development launched the Resilient Edgemere Community Planning Initiative in 2015⁵⁶. This program was brought underneath the umbrella of the Built It Back housing recovery program funded by HUD's Community Development Block Grant Disaster Recovery (CDBG-DR) grant⁵⁷. One of the projects of this initiative was land swap pilot known as the Edgemere Rebuild– Relocation program, targeted towards houses within a “Hazard Mitigation Zone” (HMZ), the areas most vulnerable to future destructive wave action and storm surges.

The land swap pilot enabled Edgemere residents in the HMZ to relocate to a newly built, elevated house on higher/safer ground – in return they would transfer the title of their original home to New York City. These homes would then be demolished and reverted to open space that could be used for flood resilience. The title that homeowners would receive would be for a comparable replacement home on city-owned land that existed outside the HMZ. Sometimes the transfer was just a title to an empty lot that the city would construct a new home on. No money is exchanged in the process, the homeowner simply exchanges the title to their property for a new property owned by the city in a safer location. The Resilient Edgemere land swap pilot programs provides a model for how state and local governments can help facilitate managed retreat in a quick way that also helps maintain community ties and local tax bases since the new home is owned by the city already.

There were several challenges with the pilot however that are important considerations for future program design, including a construction backlog for unbuilt houses on vacant lots and a shortage of houses that the city owned to transfer the title to. As a result, the relocation did not occur as quickly as they hoped. Legal and financial complications also ensued in order to transfer property titles and mortgages that were free from any liens or encumbrances. As a result of these barriers, ultimately only three homeowners were able to participate in the land swap pilot project, though 800 properties in total were acquired⁵⁸. This highlights how land swaps can be challenging when there are existing mortgages and debts on homes that the government wants to acquire, requiring coordination with mortgage lenders and financial counseling with the homeowner the government wants to relocate.

Below I summarize how the Queens, NY land swap model can help overcome barriers to managed retreat, what the policy tradeoffs are, and a cost analysis for the program. The cost estimates are derived from the city’s HUD CDBG-DR grant award for post-Sandy recovery⁵⁹, however the funding amounts are not broken out by specific program so there was no way to identify how much of the award was spent on the three land swaps in the Edgemere Rebuild– Relocation program.

Land Swap: Queens, NY Program Analysis	
Ability to Overcome Barriers to Managed Retreat	
Psychological	<u>Future location</u> : Residents who may be unsure of where they will relocate to now have certainty over their next destination since the city is providing them the title to a future house in a safer area.

Institutional	<u>Authority mismatch</u> : Land swaps encourage state and local governments to participate in managed retreat because the title they are swapping is for another home within the existing city/locality, thus preserving tax revenue.
Practical	<u>Pre-Built or provided house</u> : Relocations can much more practically occur because the city has carved out specific lots or houses that residents are able to relocate to so there are not substantial logistical challenges in identifying a new place.
Policy Trade Offs	
Administrative	<u>Lack of land</u> : Governments may have insufficient land to facilitate swaps and can also be politically controversial as residents may be concerned about the transfer and conversion of public to private land.
Economic	<u>Tax base retention</u> : Land swaps can help governments avoid spending money to buy out property owners in flood-prone areas and can also help ensure residents relocate within their existing communities, preserving local tax bases.
Environmental	<u>Open space creation</u> : Land swaps can remove existing development to facilitate the inland migration of coastal wetlands and forests that are unable to keep pace with sea-level rise.
Social/Equity	<u>Community-scale relocation</u> : Larger-scale land swaps may help communities stay together and preserve social cohesion, compared to having people move individually through standalone buyouts.
Cost/Benefit Analysis – 2015⁶⁰	
Houses acquired	3
Cost	\$4,213,876,000 (total HUD CDBG-DR grant for Post-Sandy recovery)
Cost per home	Unknown (no public data on what portion of HUD grant was given to Edgemere Rebuild-Relocation project).

Conclusions and Key Recommendations

The four managed retreat mechanisms analyzed in this paper have their advantages and disadvantages. All of them have successfully relocated people out of harms way, albeit at different price points and different degrees of success in overcoming the psychological, institutional, and practical barriers to retreat. Below I have constructed a simple table comparing each managed retreat mechanism's total cost, how many homes they acquired, what the cost per home came out to be, and a

rough estimate of the avoided damages from these investments – these figures are sourced directly from the individual table analyses in each case study.

Managed Retreat Mechanism	Total Cost	Homes Acquired	Cost per Home or Housing unit	Avoided Damages
Voluntary Buyout (Austin, TX)	\$113.5 Million	435	\$260,919	\$454 million (hypothesized)
Open Space Acquisition (King County, WA)	\$5.43 Million	458	\$11,883	\$21.72 million (hypothesized)
Leaseback (Charlotte-Mecklenburg County, NC)	\$67 Million	400	\$167,500	\$325 million (provided by county) ⁶¹
Land Swap (Queens, NY)	\$4.2 Billion	3	Unknown	\$16.7 billion (hypothesized)

Based on this rough analysis, King County’s open space acquisition program using transfer of development rights netted the lowest cost per housing unit acquired (\$11,833), followed by leasebacks from Charlotte-Mecklenburg County (\$167,500), and then the expanded voluntary buyout program from Austin, Texas (\$260,919). Queen’s land swap pilot project was not able to quantitatively evaluated from a cost per house standpoint because there was no publicly available information on how the funding from HUD’s CDBG-DR was broken down across all post-Sandy recovery activities, which included building retrofits, sea walls, and home elevations. Isolating the program budget for just home acquisitions and/or the land swap pilot through the Edgemere Rebuild– Relocation program was not possible. From a cost standpoint, this suggests that market-based solutions like open space acquisitions through transfer of development rights and leasebacks, which are a hybrid market approach, yield some of the most cost-effective results.

In terms of avoided damages, only Charlotte-Mecklenburg County, NC provided a quantifiable analysis of the avoided damages cost from their managed retreat efforts. The remaining avoided damage figures are derived from an analysis in the Journal of Sustainability which conducted a landscape analysis of funding mechanisms for floodplain buyouts and found that on average, for every \$1 spent on hazard mitigation planning and projects, \$4 in future damages are avoided⁶². Thus, it may be difficult to do an apples-to-apples comparison across the mechanisms, because the cities or counties

that spent the most money will automatically incur the most avoided damages even if these projects were not the most effective on the ground. For example, Queens, NY had by and large the highest damages avoided at over \$16 billion, but it's not clear how effective the land swap portion of their initial funding was since they were only able to get three residents to partake in the program. Austin, Texas came in second at \$454 million in avoided damages, Mecklenburg County in third at \$325 million and King County in fourth at around \$21 million. Ironically, despite King County accomplishing the lowest cost per house acquired and acquiring more housing units than all other jurisdictions, they have the lowest avoided damage. This highlights the need for more accurate data to properly evaluate the risk-cost benefit analysis of these different managed retreat strategies.

Importantly, this analysis did not consider the avoided damages that would result from increasing disincentives like raising flood insurance costs. It is entirely possible that disincentives may create better outcomes in terms of avoided damages. However, increasing flood insurance premiums is problematic for its own reasons as many of the most vulnerable communities in small towns and low-income areas are unlikely to be able to pay higher premium costs. As a result, those residents will likely remain there but without insurance protection at all. With this in mind, the focus of this analysis was on purely voluntary measures to facilitate retreat for policymakers to target towards individuals who want to retreat but may not have the resources to do so. In that vein, the managed retreat mechanisms analyzed in this paper offer some lessons learned for other governments considering similar programs in order to overcome the barriers to retreat in their communities.

Recommendation #1: Voluntary buyout programs should expand beyond purchasing a home at its fair market value to include relocation assistance.

The vast majority of voluntary buyout programs are designed solely to cover the purchase price of the home. After that, the tenant is usually left to their own devices to determine where they should relocate. By incorporating relocation assistance, both logistical and financial, into the process, voluntary buyout programs can better incentivize all stakeholders to advance managed retreat. Homeowners have less fear and uncertainty about where they will go once leaving their home since someone will be guiding them through the process and financially supporting them. State and local governments are more incentivized to participate because their relocation assistance programs can help guide homeowners to move somewhere within their existing jurisdiction, as long as it is outside of a 100- or 500-year flood plain, thus enabling them to avoid loss of tax revenue from households retreating.

This option will require more funding, of course, to cover the relocation costs – especially if relocating within a city that has an expensive housing market, as was the case for Austin, Texas. The upside is that the program will likely be more successful and more equitable as lower-income groups will be better equipped to retreat. Localities can look to the Uniform Relocation Assistance and Real Property Acquisition Act of 1970 (URA) to provide baselines of how much relocation expense to cover⁶³. The URA was originally devised to provide a framework for how to treat people displaced through public works and transportation projects but can be adapted to a coastal, flood, or wildfire context.

Recommendation #2: Open space acquisition programs that employ transfer of development rights should proactively invest in infrastructure and services in receiving areas that will see increased population density.

In TDR programs, the housing density is increased in areas that are better protected against climate impacts (receiving areas) in exchange for preserving open spaces that can serve as flood retention barriers or for conservation purposes (sending areas). Thus, the municipalities in the receiving areas will need longer term planning and investment in a range of infrastructure and public services that can accommodate an increase in population. Policymakers considering this managed retreat policy should begin proactively planning for those expenditures while also engaging local communities through town halls and public comment periods so that receiving areas are able to maintain their community cohesion and community services like schools, hospitals, and childcare are able to keep pace. In King County, Washington’s TDR program, the sale of TDR credits to housing developers did not account for the costs of increasing infrastructure services in receiving areas, thus making it a lesson learned for other localities considering a similar program to find alternate ways to raise revenue to ensure receiving areas receive proper support to take on more people.

Recommendation #3: Leaseback programs will require government agencies to learn how to become landlords.

Policymakers considering leasebacks will need to become familiar with the administrative, financial, and legal responsibilities that go into taking on the function of a landlord. Private property that becomes acquired by the government has a host of regulations that go into leasing that property out, requiring new administrative burden on staff and a specialized skillset. Charlotte-Mecklenburg County in North Carolina needed this type of skill in order to define the type of lease it wanted to pursue: a triple net leaseback, orphan parcel leaseback, or traditional leaseback. A key part of building these leases will

be ensuring that they are on a short timeline so that houses can be cleared and demolished in time to achieve the government's floodplain management objectives. This constrained timeline of course runs up against residents who want a flexible timeline for being able to move out and relocate to a different area.

Recommendation #4: Land swap programs require financial counseling for landowners and advance preparation from governments to have sufficient public land available to make available into housing.

Pursuing land swap programs can be a simple and straightforward way to move a household from an area at risk to a safer area that is still within city limits and retains the local tax base for the state/local government. Queens, NY ran into trouble both due to not having enough comparable housing available with construction backlogs as well as financial and legal complications over acquiring mortgages and titles that had tax liens or other barriers to acquisition. Thus, future program design for this program would require advance planning on which vacant lots or public lands can be quickly converted into comparable housing as well as facilitating financial counseling with those homeowners to resolve any outstanding financial or legal roadblocks to acquiring the title to their home.

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