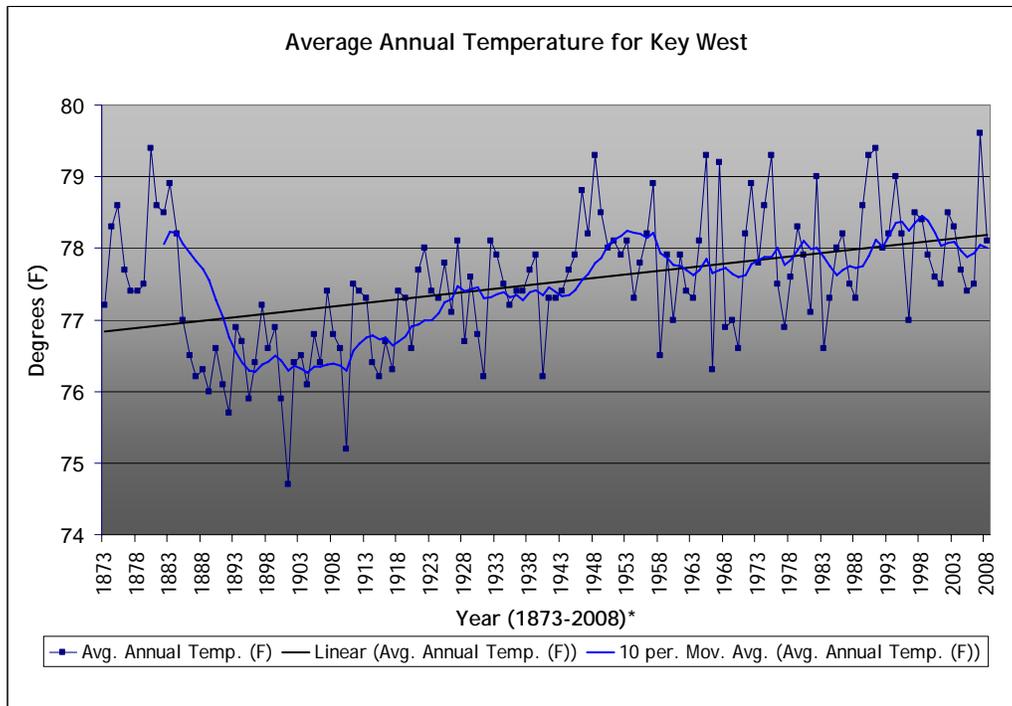


8.0 ADAPTATION

Climate Action is not just about mitigating current carbon use, but also about adapting to, or coping with, the consequences of climate change. Plans are needed for Key West to cope with the ever-rising water level and increasing temperature regardless if the rise remains at the rate it has been (8.76 inches in 100 years in Key West and 1.5 degrees Fahrenheit), or at the high end of the ICCP projection for the southeastern United States of 23 inches in water level and 4-6 degrees Fahrenheit increase in temperature. This almost 9-inch rise is the cause of frequent flooding on Front and Duval Streets which were designed 100 years ago when this rise was not anticipated. The photo to the right is the zero block of Duval Street at an extreme high tide in September, 2009. Imagine what will happen if high tide becomes another 9 inches higher; that will put high tide over the sidewalks and into the stores and restaurants. We must adapt now to be ready for this inevitable event.



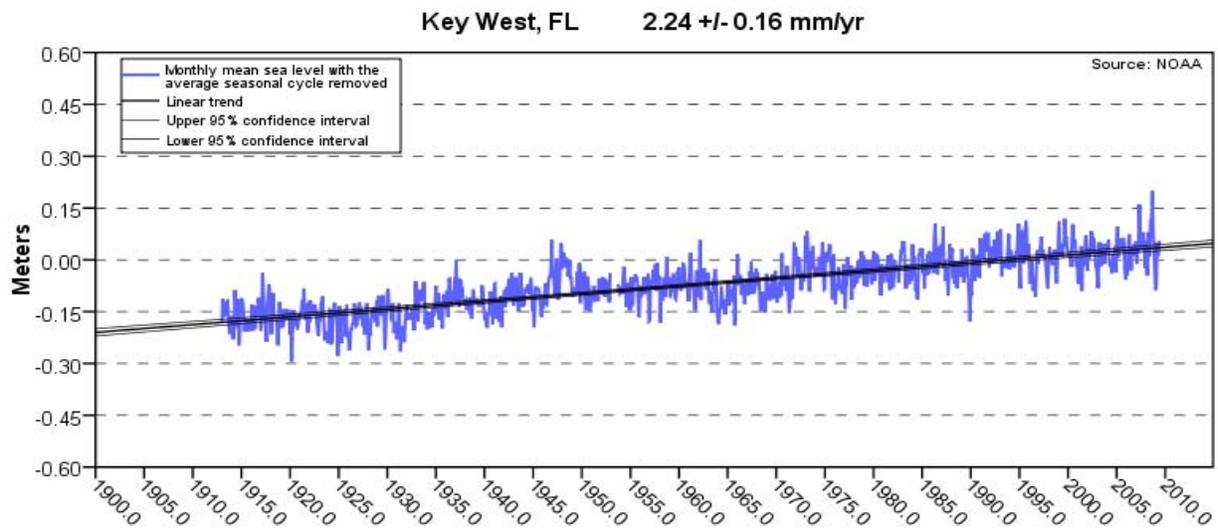
Courtesy of NOAA National Weather Service, Key West

Figure 4 – Average Annual Temperature for Key West 1873-2008

Humans have in the past had global emergencies that were successfully mitigated through infrastructure investments, technological advancements, and behavior change. For example, in the case of Ozone layer depletion; not only did behavior change (reduction in the use of aerosol spray), but the implementation of new refrigeration chemicals reduced the scope of the problem from imminent danger to a manageable life style change (i.e. the use of more sunscreen and spending less time in the sun.) Likewise, greenhouse gasses are causing changes that create a significantly warmer climate increasing risk of drought, flooding, fires, disease and sea level rise, so we must react through behavior change and new technologies.

Policy makers and emergency management staff have an opportunity to prepare today for the impacts of climate change. The topic has been discussed for over 30-years, the science of projecting impacts has been determined to be sound. Impacts are being observed and it is time to act on an adaptation strategy. We now know that some impacts are inevitable, probably at a minimum, a 9-inch rise in tide by 2100. We must help prepare the City of Key West and the citizens to adapt to climate change so we can manage the economic and ecological consequences. The actions we take will have significant impact for generations to come.

Mean Sea Level Trend 8724580 Key West, Florida



The mean sea level trend is 2.24 millimeters/year with a 95% confidence interval of +/- 0.16 mm/yr based on monthly mean sea level data from 1913 to 2006 which is equivalent to a change of 0.73 feet (8.76 inches) in 100years.

NOAA, National Weather Service Forecast Office Key West, FL September, 2009

Figure 5 – Mean Sea level Trend Key West Florida 1913-2006

8.1

Resiliency

Many of the essential services our government provides needs to be responsive to climate changes today. We must excel at adaptation and mitigation because Key West and our water supply is “ground zero” for sea level rise, ocean warming and ocean acidification with all their consequences. This provides Key West an opportunity to transform the island’s buildings into more sustainable structures and grow its economy through sustainable economic development. Even if greenhouse gasses are reduced significantly, climate change is going to continue long after; it takes tens of thousands of years for some greenhouse gas molecules to be broken down. It is inevitable that climate change will bring about negative economic consequences. With planning we may be able to create alternative economic opportunities that may benefit our city today and in the future.

Preparing for climate change should be recognized as is a key element of the City’s mission and strategic plan priorities which specify protecting the city, its quality of life and environment. We will need to anticipate the coming changes and become climate resilient. We will do so by gathering and analyzing information to inform policy and projects through creation of a resiliency plan. Collective planning in all areas will be less costly as we may be able to anticipate impacts and seek funding years in advance of climate impact. No one knows more about Key West than the people who live here, and their ability to lead state, federal and county governments in the right direction early enough will ensure less desirable changes are not imposed upon us.

Making America the greenest country is not a selfless act of charity...it is now a core national security and economic interest.
-Thomas L. Freidman

8.2

Getting Ahead of the Curve

Some programs in Key West are already in advance planning for adaptation: Florida Keys Aqueduct Authority is preparing for salt water intrusion in its mainland water supply wells; the City has plans to elevate roads (i.e. Northside Drive); and building new storm water systems that will help to meet the new demands (i.e. pump stations). Together the FKAA and City are seeking ways to reduce the need for fresh water from the mainland through reclaimed water use. Most of these programs have been significantly funded or completely funded by outside agencies because of the forethought put into planning efforts. Appropriate planning and construction can strategically reduce future risks, increase future benefits and add value to investments all providing a higher quality of life today, before climate change makes the need critical.

The adaptation section of this climate action plan outlines the planning process that is recommended. Similar to the process of the Climate Action Team the adaptation plan needs the support of the community and other governmental organizations and non-governmental organizations (NGO’s). All areas of planning need to be reexamined through the lens of climate change. The plan needs to address ecologically sensitive land planning, flood plain planning, utility planning, zoning and build-back planning and

shoreline hardening. The planning process will include vulnerability assessments and risk assessments, so that a climate resilient community with preparedness goals and preparedness action can be established.

The United States Army Corps of Engineers, the United States government's main engineering design department, has upgraded its 1975 policy on incorporating sea level rise in construction design and planning to a July 1, 2009 policy Circular No. 1165-2-211 which requires "incorporating the direct and indirect physical effects of projected future sea-level change in managing, planning, engineering, designing, constructing, operating, and maintaining USACE projects and systems of projects. Recent climate research by the Intergovernmental Panel on Climate Change (IPCC) predicts continued or accelerated global warming for the 21st Century and possibly beyond, which will cause a continued or accelerated rise in global mean sea-level. Impacts to coastal and estuarine zones caused by sea-level change must be considered in all phases of Civil Works programs." The new policy requires consideration of three possible scenarios; for projects with a 50 year life being built in 2010 the scenarios are 1.2 feet, 1.5 feet, and 4.9 feet. Prior to this policy the USACE worked with a projected rise of 0.8-foot (9.6 inches)* for 2050. *Adaptive response Planning to Sea Level Rise in Florida and Implications for Comprehensive and Public Facilities Planning; Deyle, Bailey and Matheny, Dept of Urban and Regional Planning, FSU, Sept, 2007.

It is recommended that the City use ICLEI's guide "Preparing for Climate Change" or a similar model as a tool to move forward. The creation of a climate change preparedness team is recommended. The consequences of climate change are broad and encompass inter-departmental activity and extend to other local, state and federal agencies. The preparedness team will need to include City departments and local, state and federal agencies. For instance, the South Florida Water Management District must seriously consider allowing stormwater pump stations to outfall into near-shore waters so our streets and homes may be protected. We need to influence decisions of the FDOT where they are lowering rather than raising North Roosevelt Blvd. The local and state departments of emergency management and FEMA will need to re-address evacuations and increases in storm surge. The FDEP will have to re-address "wetlands" evaluations; the County will have to consider the elevation of the airport runways; the US Fish and Wildlife Service will have to consider habitat changes; and the state Historic Preservation Board will want to consider how to maintain historic structures that may be negatively impacted. The photo above is high tide on Green Street where salt water sometimes enters the historic buildings on the block.



The photos inserted in this section are photographs of the September 24, 2009 Perigean Spring Tides. Although these are extreme tides, they occur many

days of the year. According to the National Weather Service Meteorologist Jon Rizzo, the tides were 3.2 feet above MLLW in Key West, which is approximately 2.3 feet above mean sea level. This is a serious threat to traffic, walking, and biking since more accidents can happen under such conditions. Asphalt is damaged at greater rates as is underground utilities.

Figure 6, the map on the next page, assists the reader to comprehend and appreciate the depth of impacts in the city, even for the small sea level rise scenario of 9 inches by 2100. A nine-inch rise brings the daily mean high tide to 3.24 feet NGVD (areas unmarked in white) and extreme high tides, which happen almost monthly to 3.94 feet NGVD (marked in Orange). Note the number of streets and recreational facilities impacted. The photo to the right depicts what will become an every day event under the IPCC best case scenario.



In addition to sea level rise an increase in temperature will increase the need for air conditioning and energy use, affect seniors and those with lung disease and even sports practices for school children.



ESTIMATE OF 9" SEA LEVEL RISE CITY OF KEY WEST

Figure 6

Note 1: See larger map in the Appendix 6

Note 2: Areas on the US Navy base, although white, were not surveyed and are not included in the rise estimate.

8.3

The Planning Process

Potential members of the climate change preparedness team will be talented and motivated people from Emergency Management, Community Services, Monroe County Health Department, Police Department, Port Department, Planning and Building Departments, General Services Department and some business/community leaders, non-profit organizations and federal agencies like NOAA's National Marine Sanctuary and the National Weather Service, and US Fish and Wildlife. NGO's like The Nature Conservancy and Botanical Gardens Society will also be required to create a well rounded plan. The members should be given substantial time to work on the program and be able to guide others across agency lines to ensure the plan is a success.

It is proposed that the team will initiate five major process steps:

1. Conduct a resiliency study;
2. Identify priority planning areas for action based on assessments of vulnerability and risk planning areas;
3. Set goals and develop a plan;
4. Implement the plan; and
5. Measure progress and update the plan.

The planning document will have to be updated from year to year depending on local and grant funding. A strong system will need to be in place to ensure that the program continues to meet goals, has robust community support, and can change as technology and conditions change.

Initially the group would identify major planning areas relevant to climate change and then complete a vulnerability assessment that will include a sensitivity analysis of the systems associated with the planning area identified. It will evaluate the adaptive capacity of the systems associated with the planning areas. A risk assessment of how vulnerable the systems in those planning areas are to the affects of climate change and a determination of our City's tolerance to the risk will be made.

Then the group would develop a vision and guiding principals for a climate resilient community. Goals would be set and prioritized action items developed including a cost to benefit analysis and recommended timeframe. The plan will list desired accomplishments, as well as which activities our government and every agency will undertake.

The implementation plan will need to provide authority and direction to city staff so that policy, planning and infrastructure changes can be implemented. The plan should be updated annually based on evaluation of goals and performance measures which will be qualitative and quantitative measures of resiliency.

8.4

Potential Areas of Concern

Virtually every aspect of government operations will be affected by adaptation requirements, from civil engineering road work, to citing of new facilities. Decisions to repair or reconstruct existing facilities, or improve stormwater, or sewer systems, or selection of planting materials will all have adaptation in the decision matrix.

Table 2 lists locations and infrastructure areas of concern to be addressed in sea level rise planning:

Location	Damage as result of Climate Change
McCoy Indigenous Park	inundation and tree deaths
Landfill	as sea levels rise more waste may become soluble in near-shore water
Seawalls	walls will need reconstruction
Beaches	will be reduced in size
Salt Ponds Habitat	will enlarge, salt water will cause destruction of less saltwater tolerant plants
Berg Park	Greater erosion of the beach and damage to the decking, continued loss of less salt tolerant trees
Kitsos Park	Greater erosion of the beach and damage to the decking, continued loss of less salt tolerant trees
Gravity sewer system	Increased salt water infiltration
Sewer Pump Stations	Inundation of some wet wells
Stormwater system	Reduced functioning of systems
Botanical Gardens	Destruction of less salt water/heat tolerant trees
Little Hamaca Park	Destruction of less salt water tolerant trees reduced park land mass
Hawk Missile Site	Reduced park land mass
Garrison Bight	Dock modifications
Key West Bight	Dock modifications
Staple Ave Bridge	Accelerated deterioration
M.C. Airport	More frequently flooded tarmac
City Pool	Additional flooding of building
Cemetery	Collapse of grave sites
Aquarium	Additional flooding of building
Clinton Square	Street inundation traffic
Access to College Road	Roadway inundation

Table 2 – Location and Possible Affects of Climate Change

Although mitigation projects worldwide may offset sea level rise at the high end of the IPCC modeling spectrum (23-35 inches in the Keys), planning efforts must consider the entire spectrum. The Table 3 below lists streets portions of which will be inundated at high tide if a 9-inch sea level rise is realized. This information, as well as the map in Figure 6 is useful to generally determine if additional consideration is required for upcoming infrastructure projects. For instance, installation of wells on streets below 3.94 feet may become conduits for salt water intrusion.

Roadways in Key West expected to have tidal water with a 9-inch tide rise

Donald Avenue	Dennis	Leon Street
Front Street	Venitia	Ashby Street
Duval Street	Blanch	George Street
Elizabeth Street	Patterson	Washington Street
Green Street	Fogarty	Eaton Street
James Street	Harris	Catherine Street
Front Street	Seidenburg	Amelia Street
Wall Street	Staples	Eisenhower Drive
Ann Street	Linda	Petronia Street
Simonton Street	Juanita	Jose Marti Dr.
Thompson Street	Flagler	Duncan Street
Telegraph Lane	Laird	United Street
Wolkowski Lane	Rose Patricia	1 st
Fitzpatrick Street	Atlantic	2 nd
Tifts Alley	Stephens	3 rd
Atlantic Boulevard	Sirugo	4 th
Exchange Street	White	5 th
Caroline Street	Josephine	6 th
Seminary Street	Bertha	7 th
South Street	10th	8 th
Riviera Drive	11 th	20 th

Table 3 – List of Streets Which will have Portions of Roadways Inundated by Salt Water

Clearly, any capital projects to be considered in the city must reflect consideration of temperature and sea level rise.

8.5

Adaption Success Planning

In Summary, over the years there have been dramatic changes on the island in the delivery of water, the delivery of sewer services, in our industry, and caused by hurricanes, fires, etc. All previous generation’s ability to adapt to change made Key West successful. This generation now has the opportunity to step forward and plan to provide an acceptable home to those in the future. Climate Change in Key West is an opportunity to transform the island to a more sustainable community. Planning to adapt to that future now will help us realize a vibrant Key West in the future.