Sea Level Rise
And Potential Impacts by the Year 2100

A Vulnerability Assessment for the Saco Bay Communities of Biddeford, Saco, Old Orchard Beach, and Scarborough

Memorial Library, Ocean Park, Old Orchard Beach
Image courtesy of Bill Edwards and NOAA NWS

SOUTHERN MAINE REGIONAL PLANNING COMMISSION

DEPARTMENT OF CONSERVATION MAINE GEOLOGICAL SURVEY

Maine Coastal Program

NOAA

A Report of the Sea Level Adaptation Working Group
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With the Assistance of the
Maine Department of Conservation – Maine Geological Survey
and the
Southern Maine Regional Planning Commission

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Members of the Sea Level Adaptation Working Group (SLAWG), Staff & Advisors

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** Mr. Lamb participated in meetings through November 2010; his position with SLAWG was filled by Mr. Nugent, who joined in December 2010.*

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I. <u>Overview of the Sea Level Adaptation Working Group</u>

Accomplishments of SLAWG to Date. In early 2009, the Town and City Managers of Saco, Scarborough, Old Orchard Beach, and Biddeford, discussed the idea of the creation of a Saco Bay Sea Level Adaptation Working Group (SLAWG) to develop and implement regional climate change adaptation strategies to respond to rising sea levels and become more resilient to coastal storms in the Saco Bay region (Figure 1). Saco Bay is unique and perfect for undertaking such an endeavor; as it is home to the largest expanse of contiguous beaches and coastal wetlands within the State of Maine. It also has one of the State's worst erosion problems at Camp Ellis Beach in Saco, and one of its worst flooding problems at Ocean Park, Old Orchard Beach.

A Regional Challenge Grant from the Maine State Planning Office (SPO) was applied for and granted to the Southern Maine Regional Planning Commission (SMRPC), for the period July 1, 2009 to June 30, 2010, to fund the initiative. The grant period for the project was extended for an additional six months, until December 31, 2010. The Maine Geological Survey (MGS) provided extensive scientific and technical assistance to the new committee during this period, under separate, parallel funding from the SPO - Maine Coastal Program.

During the 18 month grant period, the following tasks were accomplished:

- Multiple presentations were made to Councils in Biddeford, Saco, Old Orchard Beach and Scarborough to obtain match support and seek appointments to the SLAWG Steering Committee.
- A steering committee, with two members appointed from each community, was formed by the four municipal councils, after extensive deliberations.
- The steering committee, working with SMRPC and the MGS, developed a detailed plan leading to the creation of the SLAWG. The steering committee formulated the parameters of the working group, developing an interlocal agreement for council consideration, containing its structure, bylaws, and duties.
- The steering committee transmitted to the Councils its draft of the proposed interlocal agreement to create the SLAWG, after 6 meetings during the summer of 2010.
- The interlocal agreement to create SLAWG was presented to the four councils for consideration during the fall of 2010, and all four communities ratified the interlocal agreement by early November 2010.
- Four meetings of the SLAWG were held during November and December 2010, to create a preliminary sea level rise vulnerability assessment, and to begin work on an action plan.

II. <u>Assumptions Used in the Vulnerability Assessment.</u>

A. Sea level rise will occur at a rate higher than over the last 100 years. Data from the Portland tide gauge indicates a rate of sea level rise from 1912 to 2009 of 1.8 mm per year, which equates to a rise of about 7 inches in the past 100 years. The scientific community agrees that **in the next hundred years, we can expect the rate of rise to increase**, although there are a variety of projections on the overall increase over the next one hundred years, compared to the period from 1912 to the present. (See Figure 2, Portland Tide Gauge,1912-2009).

B. We will assume the **sea level will rise by a minimum of two feet above current levels by the year 2100**. However, many scientists assume the rise will be one meter or higher, if polar ice sheet dynamics and glacial melting accelerate. (See Figure 4.) Our group chose to use the two foot projection, to be consistent with the projections from the Intergovernmental Panel on Climate Change (IPCC, 2001) and sea level predictions adopted by the Coastal Sand Dune Rules (Chapter 355 NRPA), and to take a conservative stance.

C. The two foot sea level rise scenario **does <u>not</u> include the effects of freshwater runoff from rain events which may contribute additional flow to waters in the rivers, streams and marshes concurrent with ocean storms, compounding flooding problems**. Such complex modeling is not available to the group, as it is extremely expensive and at the cutting edge of current technology

D. The two foot sea level rise scenarios assume that the land surface will remain static and will not be altered due to erosion or accretion, and the current configuration of land forms and contours will remain static, during and after each inundation. **At this point, the scenarios do not take into account impacts from wave action or erosion, including the impacts of open coast storm surge.** In the coming year, the group will use a combination of existing data to estimate potential erosion impacts along the open coast, including the following data from MGS:

1) Erosion Hazard Mapping, prepared by MGS in support of Coastal Sand Dune Rules:
2) Measured long term shoreline change rates; and
3) The Maine Beach Scoring System.

E. Values of estimated damage to land and buildings are based upon the **most recent assessments for property tax purposes; these values are conservative, and are not necessarily representative of fair market value**. Inflation or deflation of land and building values has not been taken into account. **Loss of building value, and the associated land value, was assumed to occur only if the center of the building footprint was inundated in the flood scenario.**

F. Erosion Hazard Area (EHA) maps, pursuant to Maine's Coastal Sand Dune Rules, were used as a **preliminary approach to estimate the potential impact of sea level rise and dynamic erosion and inundation along the open coast.** All building footprints that intersect the EHA are assumed to be within it, and assumed to sustain damage with sea level rise.

III. Vulnerability Assessment

Introduction

Saco Bay, located in southwestern Maine, is an arcuate embayment bound by rocky headlands of Prouts Neck to the north and Biddeford Pool and Fletcher's Neck to the south. From north to south, the bay includes the waterbodies of the Scarborough River, Goosefare Brook, and the Saco River. Saco Bay is home to Maine's longest stretch of contiguous sandy beaches, and also its largest expanse of coastal wetlands. It also includes the coastal communities of Scarborough, Old Orchard Beach, Saco, and Biddeford (Figure 1).

Each community faces coastal hazards, and each has different levels of vulnerability to those hazards; in fact, **one of the highest measured erosion rates, and an area of the worst inundation during coastal storms in the State of Maine occur in Saco Bay** at Camp Ellis Beach, Saco and Ocean Park, Old Orchard Beach, respectively. Compounding the existing hazards is the role of sea level rise, which has been documented as increasing steadily over the past century.

Sea level measurements have been recorded at the Portland, ME tide gauge (NOAA NOS Tidal Station 8418150) since 1912, one of the longest records in the country. Data indicates that sea level has risen about 7.2 inches over the past century, or at a rate of 1.8 mm/yr (Figure 2). **This trend mirrored the measurements of global sea level changes over the past 100 years, and indicates that Maine's sea level changes are following global trends (IPCC, 2007).**

After a two year process involving multiple stakeholders, Maine's Coastal Sand Dune Rules (Chapter 355 of Maine's Natural Resources Protection Act, NRPA) were rewritten to include planning for two feet of sea level rise over the next century, consistent with the projections made by the 3rd Assessment Report from the Intergovernmental Panel on Climate Change (IPCC, 2001), which call for a mean value for global sea level rise of 0.48 meters (1.6 feet) by the year 2100 (Figure 3). This figure shows the range of predicted changes in sea level from different model predictions based on a variety of emissions scenarios.

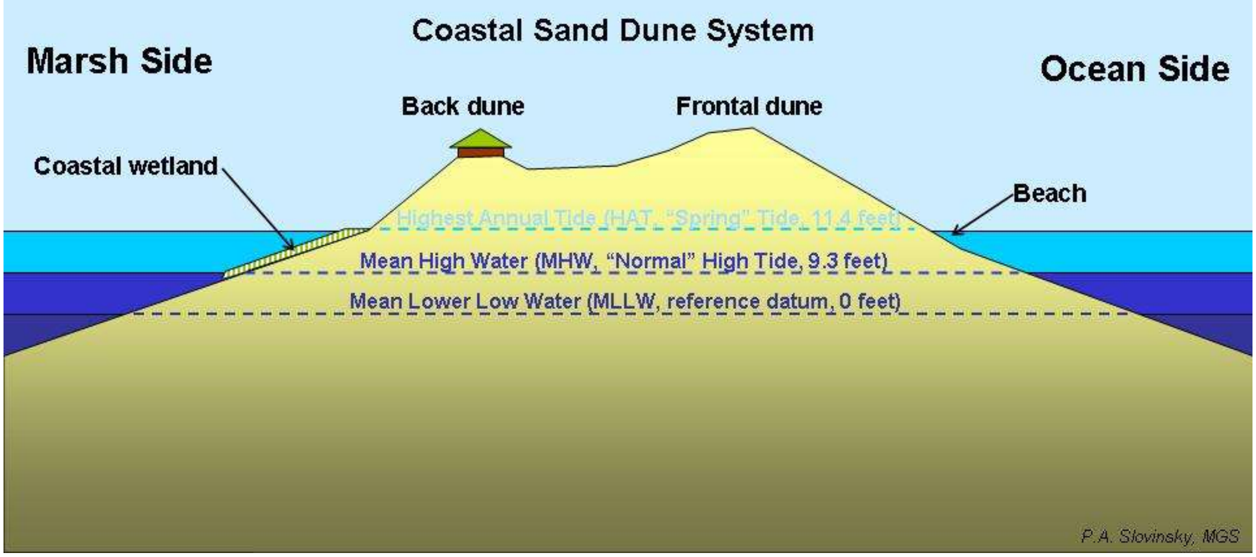
Recent global seal level change projections have been slightly revised to include ice sheet dynamic processes (Figure 4). Measurements from 1990-2005 from both tide gauges and satellite measurements **indicate that sea level has been rising at the upper boundaries of the projections**. However, for this analysis, **the Working Group chose to use a figure of 2 feet of sea level rise over the next 100 years, a "middle of the road" prediction, for coastal resiliency and sea level adaptation planning efforts.**

Analysis of Potential Inundation Impacts on Real Estate Values

In order to help determine vulnerable areas within the Saco Bay communities, MGS created a series of images depicting potential inundation scenarios in Saco Bay (Figures 5 to 10, Appendix A). The base inundation levels used for this exercise are shown in the table below, and explained further in Table 1 (Appendix A), referenced to the original tidal datum (Mean Lower Low Water, or MLLW), and the North American Vertical Datum of 1988 (NAVD88). Note that all potential future inundation scenario elevations were created by **adding 2 feet of sea level to the 2010 predicted tidal elevations and historically recorded (1978) water level.**

Name	Acronym	Explanation	Avg. Elevation for Saco bay (MLLW)	Avg. Elevation for Saco Bay (NAVD88)
Mean Lower Low Water	MLLW	A tidal datum, used as a reference datum. The average of the lower low water height of each tidal day observed over a 19 year period.	0 feet	-5.2 feet
North American Vertical Datum of 1988	NAVD88	A fixed reference for elevations determined by geodetic leveling.	-5.2 feet	0 feet
Mean High Water	MHW	The average of all the high tides, i.e., the "normal" high tide, observed over a 19 year period	9.3 feet	4.1 feet
Highest Annual Tide	HAT	The highest astronomical tide predicted for a given year	11.4 feet	6.2 feet
1978 Storm	1978storm	The highest recorded water elevation at the Portland, ME tide gauge on Feb 7, 1978	14.1 feet	8.9 feet

Callout 1. The Mean High Water (MHW) is equivalent to the average normal high water level. The Highest Annual Tide, sometimes called the "spring" tide, is the highest predicted water level for any given year. Mean Lower Low Water (MLLW) is a reference tidal datum and is the average of the lower low water elevations. The average elevations for Saco Bay, referenced to MLLW, are provided.



Callout 1, above, illustrates the relationships between the MLLW, MHW, and HAT for averaged values in Saco Bay.

Note: Although the Highest Annual Tide (HAT) is a prediction of <u>highest astronomical tide</u> for a given year, it is vital to note that the HAT is only <u>several inches above high tides reached many times during the year</u>. For example, the HAT predicted for Portland in 2010 was 11.6 feet, which occurred on January 31, 2010. However, numerous high tides of 11.4 feet or more (only 2.4" less), occurred in February, July, August, September, October, and November.

The inundation scenarios that were simulated as part of this exercise included the existing 2010 highest annual tide (HAT), the HAT plus 2 feet of sea level rise, and the storm of record (February 7, 1978) highest observed water level from the Portland tide gauge plus 2 feet of sea level rise. The HAT data was determined using 2010 tidal predictions from the NOAA National Ocean Service CO-OPS website (http://tidesandcurrents.noaa.gov).

The inundation scenarios described were used to create a basis for identifying potential, at-risk residential and commercial infrastructure within the partner communities. Figures 5-10 show the potential areas of inundation of the existing 2010 highest annual tide (dark blue areas), and the potential impacts of 2 feet of sea level rise added to both the highest annual tide (light blue areas), and the 1978 storm (stippled blue) water levels. Building footprints that are at-risk for potential inundation impacts were color coded to indicate those footprints potentially impacted by an existing HAT scenario (red color footprints), HAT + 2 ft scenario (orange color footprints), and 1978 storm + 2 ft scenario (yellow color footprints). For this analysis, impacts to existing building footprints (and assumed total structure and land value loss) were determined to occur if the central point of a building footprint was intersected by the inundation scenario. The associated land value of each at-risk footprint was included in calculations, as was land value for additional parcels associated with a given building footprint that may be impacted.

Note: Figures illustrating the potential inundation impacts are geographically divided, at the request of the Working Group, on more of a watershed basis, not necessarily by community boundaries. The potential impacts are described below, and refer to the figures in Appendix A. The potential monetary impacts to individual communities will also be summarized herein, and in Table 2.

Potential inundation impacts within the overall Bay are shown in Figure 5. Potential areas impacted by inundation within the Spurwink River and a portion of the Scarborough River watersheds within the community of Scarborough are shown in Figure 6. It appears that the areas most at-risk are concentrated within the community of Higgins Beach under a HAT + 2 ft scenario, with some additional impacts indicated by the 1978 storm + 2 scenario. Some potential impacts are also noted in the middle reaches of the Scarborough River watershed, mostly from the 1978 storm + 2 ft scenario. Building footprints at-risk for inundation under existing HAT scenarios are located mostly within the Scaborough River, and in Pine Point.

Figure 7 illustrates potential inundation in the portion of the Scarborough River watershed that includes the Pine Point area of Scarborough and the northern end of Old Orchard Beach. Under existing HAT conditions, commercial building footprints along Pine Point Road appear to be impacted, along with several other footprints in Pine Point. A high concentration of building footprints are at-risk for inundation under the HAT +2 ft and the 1978 storm + 2 ft scenarios in Pine Point and into Old Orchard Beach along Route 9. Additional high concentrations of potential impacts are noted where the old Little River Inlet used to exist, and down into areas adjacent to Walnut Street in Old Orchard Beach.

Impacts to the central portion of Saco Bay, including the southern portion of Old Orchard Beach and all of coastal Saco are shown in Figure 8. Severe impacts under all three inundation scenarios, including existing HAT, are noted within the Ocean Park community, adjacent to Goosefare Brook. Additional impacts under HAT + 2 ft and 1978 storm + 2 ft scenarios are noted at Kinney Shores and Camp Ellis Beach, Saco. It appears that widespread inundation impacts at Camp Ellis would potentially occur under a scenario of a 1978 storm + 2 ft.

Potential impacts within the Biddeford area (Figure 9) appear to be concentrated around the beaches along Biddeford Pool, Hills Beach on the northern side, and Fortunes Rocks Beach on the southern side, and at pocket beaches south to Timber Island. Minimal potential impacts are noted under existing HAT, with the HAT+2 scenario impacting several dozen building footprints. The 1978 storm + 2 scenario potentially quadruples the number of impacts to building footprints, with the majority of existing building footprints along Fortunes Rocks Beach potentially impacted.

Summary of Potential Static Inundation Impacts by Community

Please refer to Table 2 during this discussion of potential economic impacts to residential and commercial building footprints and their associated structure and land values.

Scarborough: It appears that **over 600 existing building footprints, with a combined structure and land value of over $98,000,000** may be adversely impacted by flooding under a HAT + 2 ft scenario. With a 1978 storm + 2 ft scenario, this number almost doubles to **over 1,100 potentially impacted building footprints, with a combined structure and land value exceeding $311,000,000**. It appears that the majority of the building footprints that may be potentially inundated are located within Pine Point, in uplands adjacent to marsh areas in the Scarborough River, and at Higgins Beach.

Old Orchard Beach: In Old Orchard Beach, there appears to be an existing potential impact to structures, mostly in the Ocean Park and Walnut Street areas on Route 9, under an existing HAT scenario. **Over 220 structures, with land and parcel values exceeding $70,000,000, may already be threatened by impacts under existing conditions.** In a HAT + 2 ft scenario, **537 building footprints**, with a combined structure and land value of over **$262,000,000** may be impacted. **877 building footprints** and a combined structure and land value of over **$461,000,000** may be impacted by a 1978 storm + 2 ft scenario.

Saco: Under existing HAT and a scenario of HAT + 2 ft, relatively few impacts are noted on a community-wide basis in Saco. Only 1 building footprint appears to be impacted under existing HAT, while it appears that **41 building footprints** may be potentially impacted under HAT + 2 ft, with a combined structure and land value of over **$12,000,000.** However, under a 1978 storm + 2 ft scenario, the number of building footprints potentially impacted climbs to **over 200**. The associated structure and land value is over **$66,000,000.** The majority of potential impacts appear to be in the Camp Ellis Beach and Kinney Shores (Goosefare Brook) areas.

Biddeford: Under existing HAT, only 1 building footprint, and 3 parcels with a combined value of over $1,000,000 appears to be at risk. However, under the HAT + 2 ft scenario, Biddeford has **over 30 building footprints** that may be impacted, with associated structure and parcel values exceeding **$24,000,000.** In the 1978 storm + 2 ft scenario, the number of building footprints and associated parcels impacted increases to over **210**, with a combined value of over **$165,000,000**.

As an entire bay, **under existing HAT conditions**, potentially **365 building footprints** and associated land parcels may be impacted, with a combined value of over **$84,000,000**. With a scenario of **HAT + 2 ft sea level rise**, this number nearly quadruples, to over **1,200 building footprints** potentially impacted, with an assessed structure and associated land value of over **$397,000,000**. In a **1978 storm + 2 ft scenario**, potentially **2,400 building footprints**, with an associated structure and land value that exceeds **$1,000,000,000**, may be impacted.

Mean High Water and Mean High Water plus 2 feet Analysis

An analysis of the potential inundation associated with a normal daily tide, defined by the mean high water (MHW), and the MHW after 2 feet of sea level rise, was completed. Existing areas of inundation under MHW are limited to Ocean Park, Old Orchard Beach, with no other building footprints within the bay impacted. Under a MHW + 2 ft scenario, which is basically equivalent to the existing HAT inundation, impacts again appear to be limited to the Ocean Park area of Old Orchard Beach.

Thus, Figure 10 shows the potential impacts of the MHW (4.1 ft) and the MHW + 2 ft (6.1 ft), and HAT + 2 ft (8.2 ft) in the vicinity of Ocean Park, Old Orchard Beach, one of the most vulnerable areas within the bay. Under an existing MHW scenario, it appears that 8 structure footprints are potentially impacted. With **MHW + 2 ft (basically equivalent to existing HAT),** over **200 building footprints** may be impacted with a combined structure and land value of nearly **$24,000,000**. Under a scenario of HAT + 2 ft, almost **540 building footprints** (with a combined structure and land value of nearly **$72,000,000**) may be impacted.

Table 3 illustrates the potential economic impacts of these scenarios in the Ocean Park, Old Orchard Beach area.

Preliminary Analysis of Potential Impacts along the Open Coast

For this report, the Working Group also wanted to attempt to document the potential impacts to structures along the open ocean. The simulations of potential sea level rise impacts shown in Figures 5 to 10 are **static simulations that do not take into account dynamic processes including waves, overwash, runup, and dynamic open-coast flooding and associated erosion.** At this point, no specific model or technique has been selected by the Group to pursue identifying infrastructure that is vulnerable to such hazards.

In an attempt to preliminarily identify such areas, Figures 11 to 15 show areas along the open coast of the Saco Bay shoreline that *may potentially be impacted* by dynamic erosion processes within 100 years after 2 feet of sea level rise. This area is defined pursuant to the Erosion Hazard Area (EHA) from the Coastal Sand Dune Rules (Chapter 355 NRPA). The EHA attempts to define those areas along the open coast that are included in the frontal dune (D1), and areas of the back dune (D2) that may be unstable in a coastal storm after 2 feet of sea level rise due to active erosion or dynamic inundation.

As part of this analysis, any building footprint that was intersected by the EHA boundary (red striped lines) was assumed to be within the EHA, and also assumed to be fully damaged by a coastal storm. The potential economic impact of an assumption that all building structures within the EHA are lost is summarized in Table 4.

Figure 11 shows building footprints within the EHA for the entire Saco Bay shoreline, while Figure 12 shows at-risk footprints from the Higgins Beach and Scarborough Beach areas only. On Figure 12, the majority of vulnerable building footprints appear to be in the Higgins Beach area, with only several building footprints falling within the mapped EHA along Scarborough Beach. A total of **64 building footprints** fall within the EHA in Scarborough (Table 4), with an associated structure and land value of over **$54,000,000**.

Figure 13 illustrates building footprints within the EHA along the open Saco Bay sandy beach shoreline, from Prouts Neck south to Biddeford Pool. Basically no footprints are within the EHA within the Pine Point portion of Scarborough. However, many building footprints (**169 footprints**, with an associated structure and parcel value of **over $172,000,000**) along the Old Orchard Beach shoreline fall within the EHA. Along the open Saco coastline, **117 building footprints** fall within the EHA, with an associated structure and land value of over **$51,000,000**. These footprints are concentrated mostly within the Kinney Shores, Ferry Beach and Camp Ellis Beach communities. Within Hills Beach, Biddeford, a significant number of structures lie within the EHA, and are potentially vulnerable to shoreline erosion and damage from ocean inundation.

Figure 14 shows footprints within the mapped EHA for the remainder of the Biddeford shoreline, including Fortunes Rocks Beach, and the smaller pocket beaches to the south. Any building footprints located along open sandy beaches appear to be in the EHA for these areas. As a whole, **197 building footprints** fall within the EHA for the City of Biddeford, with a combined structure and parcel value of over **$182,000,000**.

In total, nearly **550 building footprints** with a combined assessed value (structure and associated land) of over **$461,000,000** are located within the Erosion Hazard Area and **are likely subject to potential erosion and ocean inundation within the next 100 years.**

Thus, based on this preliminary analysis and its assumptions, if both potential impacts along the open coast and static flooding impacts are combined, **over $860 Million** of building footprints and associated land is potentially at risk in a Highest Annual Tide plus 2 feet of sea level rise scenario. Should a storm with a water elevation equivalent to the 1978 storm plus 2 feet of sea level rise occur, **over $1.4 Billion** of structures and associated land value is at potential risk to be impacted in the future.

Note: Complete loss of a structure's value is assumed if the <u>central point of any given building footprint</u> is intersected by any of the provided inundation scenarios. If <u>any portion of a building footprint</u> is intersected by the Erosion Hazard Area, the entire structure is assumed to be within the EHA, and complete loss of that structure, and its value, is assumed. Thus, these assumptions likely provide for an overly aggressive estimate of the actual number of footprints, and subsequently, the number of structures and their associated values, that may be impacted by each scenario. The Working Group has requested that future scenarios use damage functions that account for the depth of inundation at a structure's footprint to be a proxy for the percent damage that may occur, and hence the impact to a percentage of a structure's valuation. Future work of the SLAWG will also attempt to better quantify the potential impacts to infrastructure along the open coast using a variety of data and techniques.

IV. Next Steps - Proposed Work During Calendar Year 2011.

The SLAWG anticipates holding twenty bi-monthly meetings during 2011, to create a sea level adaptation action plan for Saco Bay. In the first quarter, the group will building upon this vulnerability assessment, adding the following elements:

1. The depth of the static flooding shown in the scenarios can be predicted using our existing LiDAR data. LiDAR, which stands for "Light Detection and Ranging," is used to create detailed contour information, for measuring the height of coastal land above sea level. Rough estimates of flood depths from sea level rise will be developed during 2011.

2. Total potential loss can be tallied relatively easily, but it is more likely that sea level inundation will cause partial losses in real estate building and land values in the areas indicated in our scenarios. The SLAWG recognizes that a parcel's complete value and utility may not be completely lost in an inundation scenario. However, potential partial losses are more difficult to quantify, since receding water can leave either total or minor damages, depending on many variables. Rough estimates of such partial damage to buildings and land from sea level rise, will be developed during 2011.

3. Damage estimates in the scenarios created to date, **do not include the value of infrastructure such as roads, drainage structures, culverts, bridges, walls, tide gates, pump stations, treatment plants, or water & sewer lines**. Rough estimates of such potential damage to infrastructure from sea level rise, will be developed during 2011. Data on infrastructure locations and values have already been provided by the town and city public works departments and the municipal GIS staff.

4. Damage to natural systems is not estimated in this vulnerability assessment, but such potential damage, and the identification of areas where salt marshes may be allowed to migrate landward, will be discussed in the coming year.

Analysis of the results of this vulnerability assessment will inform the work of SLAWG during the second quarter of 2011, and will guide the creation of an action plan. The goal of the SLAWG will be to create the action plan by the end of the second quarter (30 June 2011). The Action Plan will set the foundation and direction of the SLAWG's future activities, and will contain these elements:

1. Identification of problems and issues posed by sea level rise. (This vulnerability assessment is a key part of this first element.)
2. Definition of municipal goals for addressing these problems and issues.
3. Establishment of policy statements and directions for solving the problems.
4. Creation of a set of strategies to implement the policy statements.
5. Layout of a decision making method to set priorities among the implementation strategies.
6. Report to municipal councils.

In the third and fourth quarters of 2011, it is anticipated that the group will begin work on the highest priority projects set forth in the action plan, and will also begin its ongoing duties, as listed in the interlocal agreement. These include:

- Commenting on federal or state beach nourishment/erosion control efforts by the Army Corps of Engineers that affect one or more communities, including management or deposition of dredged materials.
- Coordinating with the Saco Bay Implementation Team in its efforts to devise a solution to the Camp Ellis jetty and erosion problems.
- Recommending the standardizing of floodplain management standards and building code interpretations across the four jurisdictions to improve resiliency of individual private structures.
- Recommending standardizing of ordinance review standards affecting the shorelands adjacent to Saco Bay, as well as standardizing review and controls for water activities across jurisdictions, for structures and activities affected by sea level rise or coastal storms. Such water activities may or may not include land-based development, and could include aquaculture, marina, or green energy production projects.
- Providing non-binding comments on various applications for development review affecting Saco Bay that may be vulnerable to sea level rise or coastal storms, to those individual review authorities having jurisdiction.
- Recommending changes to State level statutes and regulations to enable municipalities to undertake sea level adaptation projects.
- Coordinating with MS4 stormwater planning programs to comply with EPA and DEP requirements.

- Coordinating with the New England Environmental Finance Center in its research on the economic impacts of sea level rise, and the estimation of costs and benefits of various adaptation strategies.
- Periodically reporting to the Town and City Managers and Councils.

V. APPENDIX: FIGURES AND TABLES