Appendix A
Key Decisions Memo

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MEMORANDUM

Date: November 17, 2017 (amended *italics* February 6, 2018)

To: Steve Goggia, AMEC Foster Wheeler Team

From: David Revell, PhD

Subject: Key Assumptions for the Sea Level Rise Vulnerablity Assessment

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Purpose

The purpose of this memorandum is to recommend to City decision-makers the use of the below technical assumptions for development of the City of Carpinteria Sea Level Rise Vulnerability Assessment. This includes key assumptions regarding coastal hazards, sea level rise scenarios, models, and resource sectors (Table 1 and Table 2). These assumptions were selected to ensure that the project aligns with City General Plan and LCP goals as well as achieve consistency with the California Coastal Commission Sea Level Rise Policy Guidance.

Coastal Hazards

The project will evaluate 4 different coastal hazards affected by Sea Level Rise.

1. **Coastal Wave Flooding** – episodic impact from a 100 year wave storm event
2. **Coastal Erosion** – permanent loss of land from potential dune and cliff erosion
3. **Tidal Inundation** - periodic flooding caused by predictable high monthly tides
4. **Coastal Confluence**[1] – episodic creek flooding from Carpinteria Creek affected by changes in both precipitation and sea level rise. *So as not to under represent fluvial hazards, Franklin and Santa Monica Creeks will consider an existing FEMA 100 year and 500 year fluvial flood event in the absence of additional coastal confluence modeling.*

Coastal Hazard Models

The project evaluated the two available models of coastal hazards: 1) the Santa Barbara County Coastal Resilience Hazard Models (2016), and 2) the USGS COSMOS 3.0 (2017). Both models were evaluated for data availability for each hazard in a GIS format suitable for analysis (closed polygon shapefiles). In general, it was found that the Coastal Resilience model was available in a suitable GIS format and more accurately represented historic storm impacts when existing conditions flood potential was reviewed with observations of previous storm flooding.

In addition, results from both models were reviewed and compared for key parts of the City under existing 100 year storm conditions by knowledgeable local experts including Dr. Jim Bailard, technical advisor for BEACON, to assess the accuracy for a large storm event under existing conditions. The review and evaluation focused on two primary questions.

[1] Please note that Franklin and Santa Monica Creek which flow into the Carpinteria Salt Marsh does not have models available and is not included in the analysis of this hazard

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1. Does the extent of the mapped hazards in existing conditions represent on the ground observations during large storm events?
2. Does the mapped flood extents show that the beach gets flooded during large wave events?

Results of this comparative analysis resulted in the selection of the Coastal Resilience model for use in the Vulnerability Assessment. Below is a summary by each coastal hazard for why the model was selected. See attached figures for Coastal Wave Flooding Comparison.

1. Coastal Wave Flooding – USGS COSMOS model projects inland extent of flooding under existing conditions into the neighborhood above the train tracks which has never had coastal flood impacts (A). The COSMOS model does not realistically flood the beach during a 100 year wave event under existing conditions. The maximum run-up points mapped by COSMOS are not in a format conducive to vulnerability assessment (points not polygons). Coastal Resilience modeling noted that one area was mapped as surface flow connection uncertain whether there was a surface flow pathway in Carpinteria Salt Marsh adjacent to Ash Avenue (B). This area has a flow pathway through a culvert and so correction to that location (outside of the City Limits and Study area) should be made.

2. Coastal Erosion – USGS COSMOS model does not explicitly map any low lying dune erosion in the model. There is no existing cliff erosion hazard zone. Cliff erosion hazard zones are not in a suitable GIS format for analysis (line versus polygon). Neither the COSMOS or Coastal Resilience modeling directly consider the City's berm building practices, which provides some erosion and flood protection and thus the model outputs may overpredict the extent of existing dune erosion or coastal flood potential.

3. Tidal Inundation – USGS COSMOS model does not explicitly map tidal inundation and thus is not applicable to the analysis of tidal inundation. The Coastal Resilience model explicitly maps an extreme monthly tide condition in an appropriate format for the vulnerability assessment (closed polygons).

4. Coastal Confluence – USGS COSMOS model uses an average streamflow associated with a large coastal wave event to drive their creek flood model. From their analysis the stream flow is typically on the order of a 5-10 year fluvial (creek) flood event. The COSMOS model outputs from the Coastal Confluence analyses are not explicitly mapped, and are combined into the coastal flooding making it impossible to specifically assess the impacts of this type of flood hazard. The use of a reduced creek flow event is inconsistent with the FEMA Existing 100 year (1% annual chance) storm or the Coastal Resilience modeling which assesses potential precipitation changes on 100-year stream flows and sea level rise in its coastal confluence modeling which are explicitly mapped in a suitable GIS polygon format for Carpinteria Creek. For Franklin and Santa Monica Creeks, we recommend utilizing the existing FEMA 100 year and 500 year extents to represent these coastal confluence flood extents.

Sea Level Rise Scenarios

As a result of the comparative analysis and needs of the City, the Coastal Resilience Modeling was selected for use in the Vulnerability Assessment. The Coastal Resilience model uses sea level rise and time horizon estimates of 10 inches by 2030, 27 inches by 2060, and 60 inches by 2100. Based on the guidance from the CCC Sea Level Rise Policy Guide to evaluate a "range of possible scenarios", the following sea level rise elevations were selected to be included in the Vulnerability Assessment (Table 1 – gray shading). As the science of sea level rise improves, additional information has

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become available which provides approximate probabilities of sea level rise for various times in the future (Griggs et al 2017). Unfortunately, both of the available models have utilized other elevations of sea level rise than those in the Griggs report, so the relative probabilities of the Coastal Resilience modeling occuring at that specific time in the future is shown in Table 1 for comparison.

Table 1. Sea Level Rise Scenarios Selected for Carpinteria Vulnerability Assessment

Model/year	SLR - in			% Probability [2]		
	2030	2060	2100	2030	2060	2100
Coastal Resilience - High	10	27	60	<0.5%	>5%<67%	>5%<67%
Science Range - Low	5	15	26	67%	67%	67%
Science Range - High	9	35	74	0.5%	0.5%	0.5%

Note: gray shaded is the model proposed for use in the vulnerability analysis

Table 2. List of Resource Sectors Selected for Carpinteria Vulnerability Assessment

- *Land Use Parcels and Structures*
- *Camping and Visitor Accommodation*
- *Coastal Trails and Access*
- *Hazardous Materials and Oil and Gas Infrastructure*
- *Storm Water*
- *Roads and Parking*
- *Wastewater*
- *Water Supply*
- *Public Transportation*
- *Community Facilities and Critical Services*
- *Sensitive Biological Resources*

[2] Griggs, G, Árvai, J, Cayan, D, DeConto, R, Fox, J, Fricker, HA, Kopp, RE, Tebaldi, C, Whiteman, EA (California Ocean Protection Council Science Advisory Team Working Group). Rising Seas in California: An Update on Sea-Level Rise Science. California Ocean Science Trust, April 2017.

Carpinteria 100 year event NO SLR

COSMOS 3.0

Coastal Resilience

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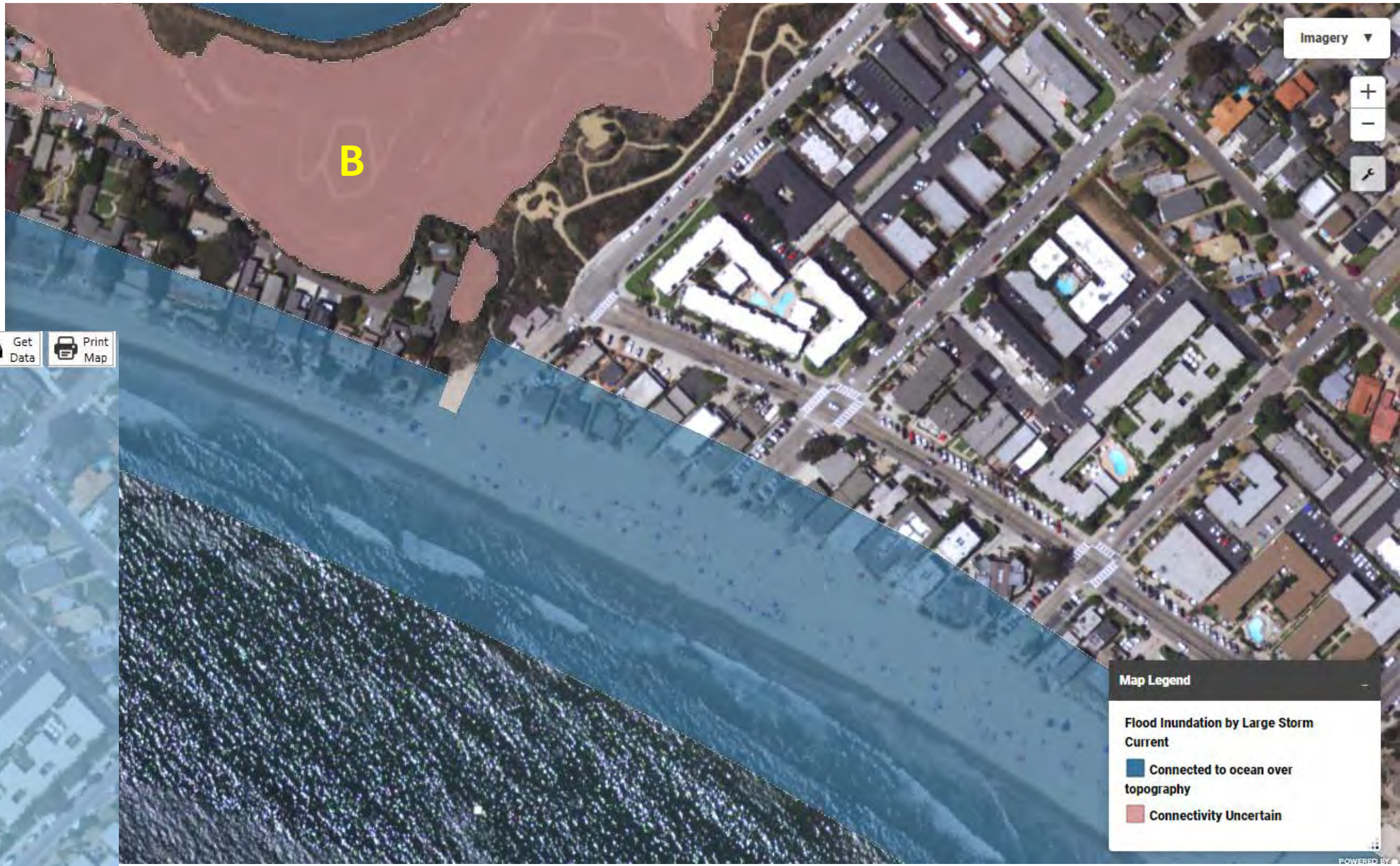
Carpinteria 100 year event NO SLR

COSMOS 3.0



Coastal Resilience

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