Local Coastal Program Planning Grants
Application Form

APPLICANT INFORMATION

Indicate which grant programs you are applying for (can be one or both).

__X__OPC LCP Sea-Level Rise Grant

Applicant name (organization): **San Diego Unified Port District**

[redacted]

PROJECT INFORMATION

Project title (start with name of city or county): **San Diego Unified Port District and San Diego County Regional Airport Authority Hydrodynamic and Site-Specific Modeling and Planning for Sea Level Rise**

LCP/ LCP Segment: Port Master Plan

Project location: City / Geographic area: San Diego County: San Diego

Project timeline: Start date: April 1, 2015 End date: June 30, 2017

Amount of Grant Proposal: $250,000 (Total Project Cost: $370,000)

MAPS AND PHOTOS

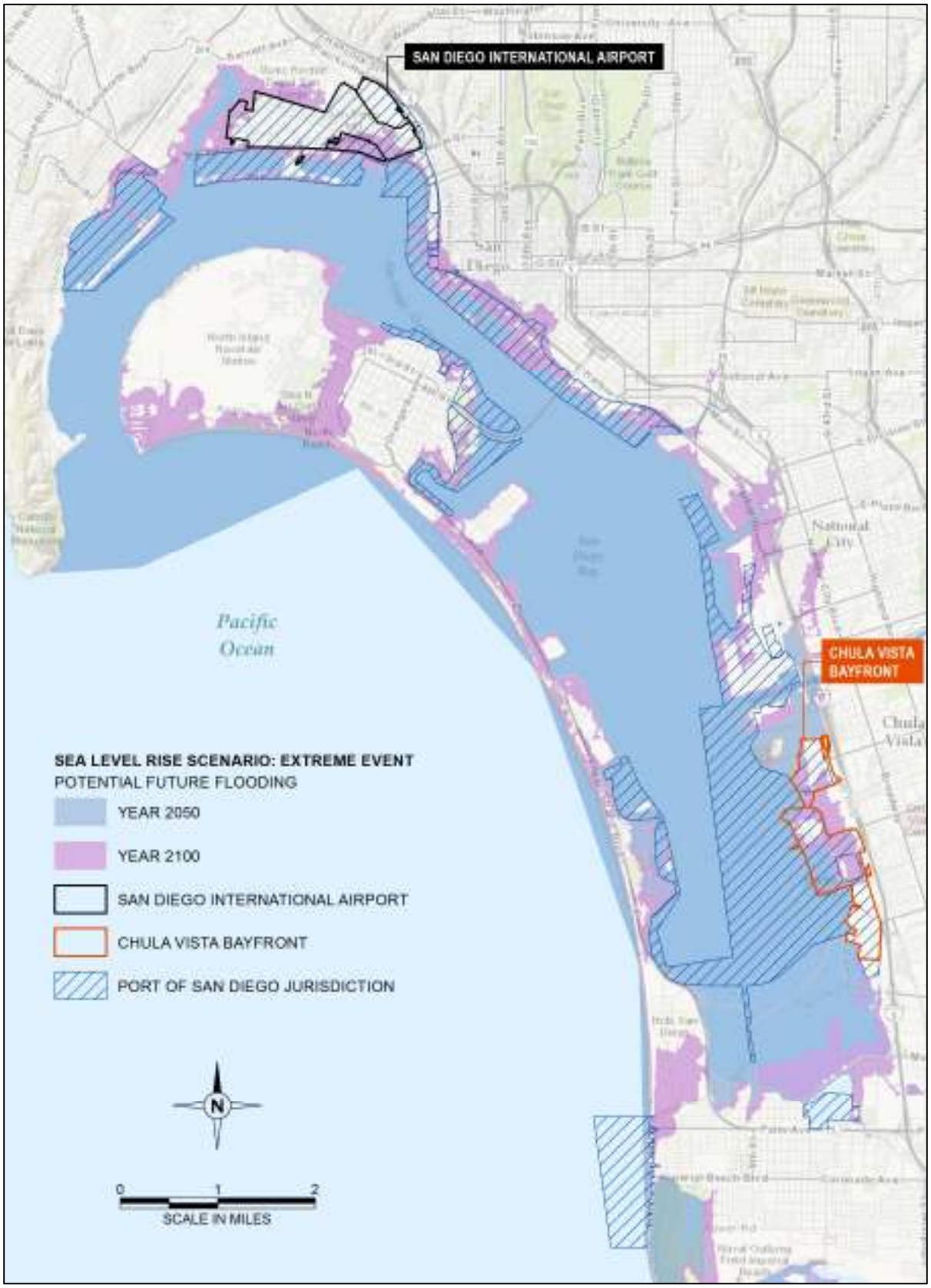


Figure 1: Project Site: Port of San Diego, San Diego International Airport, and the Chula Vista Bayfront.

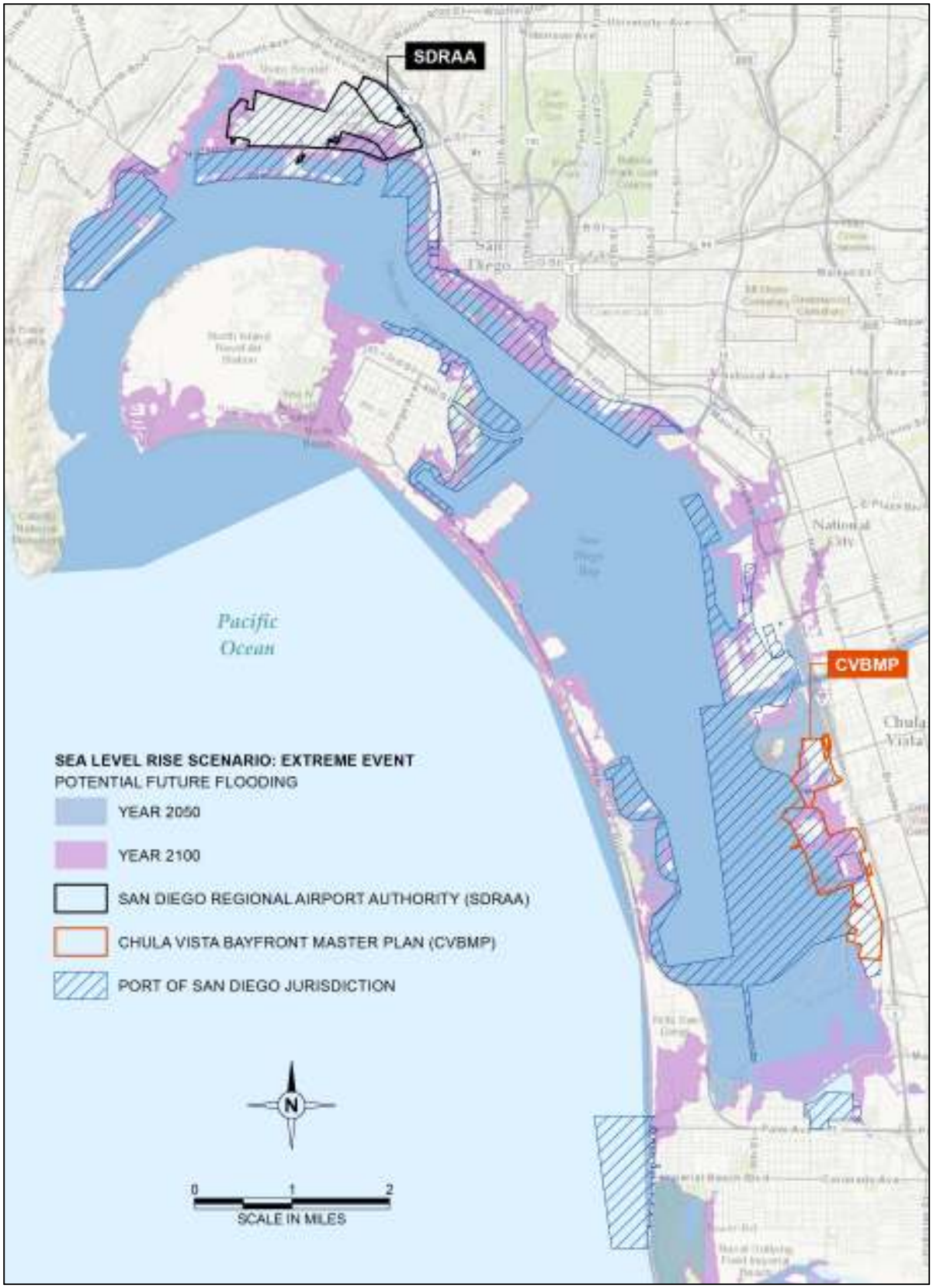


Figure 2: The *Sea Level Rise Adaptation Strategy for San Diego Bay* identifies substantial future flood risk to Port and Airport properties.

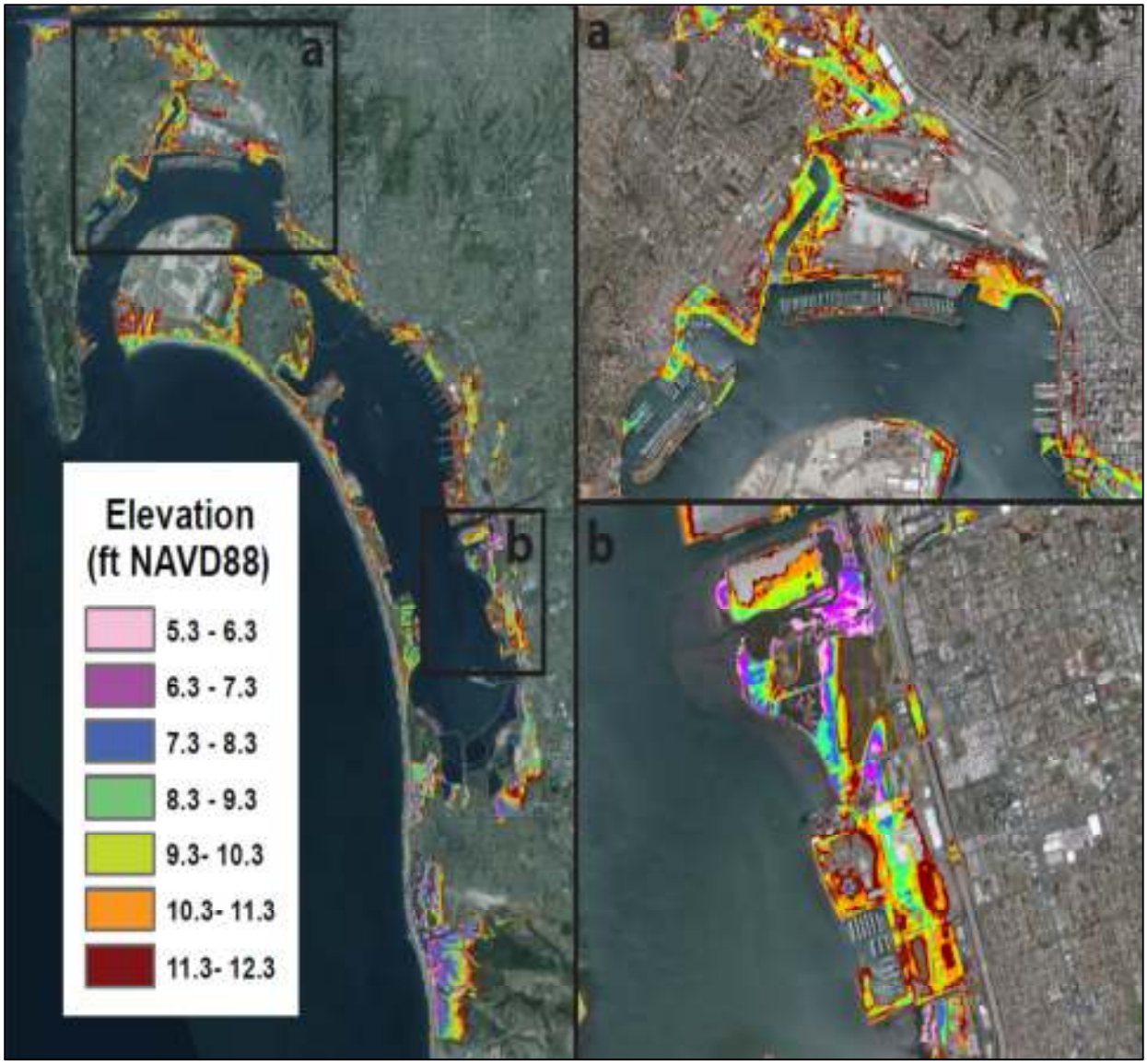


Figure 3: San Diego elevation map, insets (a) San Diego International Airport and (b) Chula Vista Bayfront. The average of the daily higher high tide is 5.3 ft. NAVD88. Spring tides in San Diego Bay commonly reach 7.3 feet NAVD88. Areas in pink, purple and blue are already vulnerable to flooding from spring tides. Areas in green, yellow, orange and red will be vulnerable to +1, +2, +3 and +4 feet of sea level rise, respectively. Figure credit: Timu Gallien

Figure 4: Coastal properties in San Diego are subject to regular tidal flooding.

Figure 5: The Airport has observed Eel Grass on its property far from the shoreline, indicating that tidal surge has already made inroads throughout its property.

1. PROJECT DESCRIPTION.

Project Summary

The San Diego Unified Port District ("Port"), jointly with the San Diego County Regional Airport Authority ("Airport"), is proposing to pursue the development of comprehensive hydrodynamic model for sea level rise flooding in the San Diego Bay. The model will facilitate key site-specific flood models for the Airport Planning Area and the Chula Vista Bayfront, which will account for real-time infrastructure and drainage considerations. The models will assist in infrastructure and adaptation response planning for mission-critical Port and Airport facilities, in coordination with concurrent master planning efforts.

Background

San Diego is a region largely defined by its climate and relationship with the coast, beaches, and bays. One of the region's most iconic bays, San Diego Bay, boasts 34 miles of coast lined by public parks and recreational facilities, residential properties, two maritime cargo terminals, various wildlife reserves, a naval base, and many other economically and environmentally significant regional assets. However, substantial risks are posed to the region's coasts by a changing climate. Research from Scripps Institution of Oceanography ("SIO") indicates that sea level could rise by five feet by 2100 and many areas could be permanently inundated.

With broad recognition of the risks posed by sea level rise, a collaboration of multidisciplinary stakeholders released the *Sea Level Rise Adaptation Strategy for San Diego Bay* ("Adaptation Strategy") in February 2012. One of the nation's first regional approaches to sea level rise adaptation, the project was led by the San Diego Regional Coastal Resilience Network ("Network"), a public agency steering committee made up of five local governments, the Port and Airport, and facilitated by ICLEI-Local Governments for Sustainability. Critical multidisciplinary stakeholders were engaged in major aspects of the project through technical advisory group workshops with experts and coastal resource managers from more than 30 organizations such as the U.S. Navy, SIO, San Diego Coastkeeper, the Tijuana River National Estuarine Research Reserve, Environmental Health Coalition, state agencies such as the California Coastal Commission, and federal agencies such as NOAA and FEMA.

The Adaptation Strategy consists of two main components: a vulnerability assessment evaluating climate risks to community assets for the entire Bay; as well as 10 comprehensive strategies to address multiple impacts, sectors, assets, and timeframes regionally and more than 60 targeted strategies for building regional resilience. Participating agencies have committed to collaboratively implement the recommendations of the Adaptation Strategy. The Adaptation Strategy was key in the establishment of the San Diego Regional Climate Collaborative.

The Port and Airport collectively own, operate, and/or manage aviation, maritime, and related facilities on more than 3,000 acres of coastal and tidelands on the San Diego Bay. With longstanding records of environmental leadership, coupled with deep awareness of the threat of rising sea levels to their respective assets, the Port and Airport have been central to the San Diego region's dialogue related to climate change, and continue to be instrumental in advancing the implementation of the recommendations of the regional Adaptation Strategy.

These recommendations included the development of a Regional Research Agenda to document the data that planners and resource managers need to plan for sea level rise in the San Diego region, and to help direct research funding and activity to those areas that advance planning for sea level rise in the San Diego region. Through a broad, secondary multi-stakeholder process, the Research Agenda included the identification of the

following overarching gaps in existing data: 1) Sea level rise impacts; 2) Physical infrastructure vulnerability; 3) Ecosystem vulnerability; 4) Social vulnerability; and 5) Economic analysis.

The proposed project will fill several of the data gaps specifically identified in the Research Agenda, including the provision of new data and a deeper understanding of flooding dynamics, including storm surge data, integration of ocean- and land-based flooding models, and assessment of physical infrastructure and endangered species habitat vulnerability.

Project Overview and Need

The Adaptation Strategy has proven to be a useful framework from which to build regional research and adaptation strategies. The Port and Airport are using this foundation to further facility-specific risk assessment and resilience planning activities that the agencies need for planning and coastal development decision-making. The Port and Airport have been collaborating with SIO to advance the development of a sophisticated hydrodynamic model for the San Diego Bay to provide a comprehensive and nuanced understanding of the potential reach and impact of sea level rise throughout the region. This method uses hydrodynamic information to model flooding over land as exacerbated by sea-level rise, a need identified in the regional Research Agenda. This model takes into account tides, currents, wind, storm surge, and topographic features such as stormwater conveyance and results in a more precise evaluation of vulnerabilities to sea level rise and flooding. The model will lay the groundwork for the creation of site-specific models which the agencies expect will greatly enhance their ability to make informed decisions about future infrastructure investments. While SIO is funded for a portion of this work, the Port and Airport are seeking additional resources that will allow for a more expedited and focused completion of the project. Both agencies are at critical stages in various planning efforts that are directly linked to adaptation and sea level rise, and the timely delivery of the SIO model is crucial to inform their efforts.

In particular, the Port is developing a 50-year Integrated Plan to be completed in 2017 which will subsequently include a Port Master Plan update, and is concurrently working towards an Adaptation Plan to complement its recently completed Climate Action Plan. The Adaptation Plan will inform critical decision-making related to future planning and development of District tidelands and will identify strategies to address sea level rise and flooding impacts on infrastructure and habitats. The inclusion of resilience and sea level rise considerations in its 50-year plan will greatly increase the ability of the Port to invest in resilient infrastructure than through a stand-alone effort. Specific flooding and sea level rise data would be most impactful if incorporated before the plan is complete, while decisions about plan development are being made.

Similarly, the Airport is currently preparing a Strategic Master Drainage Plan to holistically address flooding risks, stormwater pollutant discharges, and potential rainwater capture and reuse. This plan will serve as a companion to the Airport Master Plan, which was adopted in 2008, but which does not sufficiently address drainage concerns, particularly as it relates to the vulnerability of critical off-airport infrastructure, such as access roadways and navigational equipment, to flood risks. Both the Strategic Master Drainage Plan and Airport Master Plan update, currently being prepared, will be critically informed by the proposed project.

The Airport is also in the planning stage for several critical airfield and terminal development projects which will undergo construction within the next decade. These include airfield developments on south side of Runway 9-27, redevelopment of Terminal 1, and airport-wide roadway improvements; all of these projects must be planned with sea level rise and related stormwater considerations in mind in order to maximize the longevity of these projects. In particular, as the busiest single-runway commercial airport in the United States, it is imperative that the Airport reflect best-in-class knowledge about future flood conditions in its airfield developments in order to avoid substantial impacts to airport operations.

The proposed project aligns with the guiding principles set forth in the California Climate Adaptation Strategy; namely, that California must "protect critical infrastructure" and "facilitate adaptation of existing development and communities to reduce their vulnerability to climate change impacts," and that "new development must be planned and designed for long-term sustainability in the face of climate change."

Project Goals and Objectives

The Port and Airport are widely recognized as crucial economic assets to the entire southern California region. Collectively, the Port and Airport contribute $19.8 billion annually to the region's economy. The disruption of on-time performance of aviation and maritime activities due to extreme weather is extremely costly to the local economy; for example, closure of the Airport's single runway is estimated to cost $1,000 per minute. Per the California Climate Adaptation Strategy, over the entire California coast, over $100 billion worth of assets are at risk from sea level rise. While some enterprises are contemplating relocation as a means to adapt to rising seas, neither the Port nor Airport can retreat to higher ground; the real estate, infrastructure, ecosystems, and logistics requirements for relocation are beyond cost-prohibitive. For the Port, relocation is not in line with the coastal-dependent services it provides, and for the Airport, relocation is highly impractical and not favored by the residents of San Diego by ballot measure. Instead of relocation, the Port and Airport are taking a proactive, risk avoidance stance on sea level rise by integrating state-of-the-art knowledge in their current planning activities in order to prevent loss of access to the San Diego region and associated damage to the economy. The proposed project is a major step toward this overarching goal.

The project also aims to fill gaps in existing data to satisfy the recommendations set forth in the Research Agenda. The hydrodynamic model and subsequent site-specific model will be directly applicable to and/or replicable for sites and facilities throughout the region, and project results will be shared with the multiple local government stakeholders involved in the Adaptation Strategy and the Research Agenda, and other interested parties.

The Port and Airport also intend for the hydrodynamic model and its products to compliment the CoSMoS 3.0. The SIO and the United States Geologic Survey (USGS) Principal Investigators have previously collaborated, and together with the Port and Airport will explore further opportunities for integration and synergies with CoSMoS.

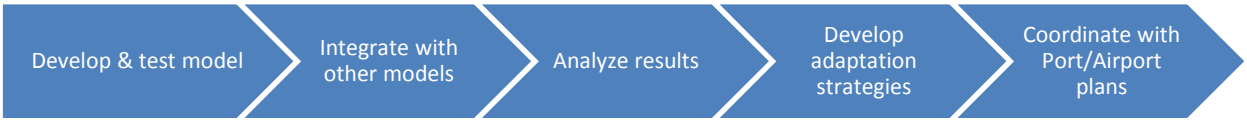
Specifically, the project includes the following objectives.

<u>Year 1 Objectives</u>
1. Collect and resolve input data for hydrodynamic model
2. Test model on key Port and Airport sites
3. Integrate with CoSMoS water level boundary conditions to ensure regional benefits and transferability of knowledge
4. Coordinate with on-going Port and Airport planning efforts

<u>Year 2 Objectives</u>
1. Run model for San Diego Bay, Airport Planning Area, and Chula Vista Bayfront
2. Interpret model results
3. Develop adaptation strategies
4. Incorporate adaptation strategies into master plan updates of Port and Airport

Project Approach

The Port and Airport are proposing the following overall project approach.



A significant element of the project scope is to develop a comprehensive hydrodynamic model for the San Diego Bay facilitating key site-specific flood models that resolve current infrastructure and drainage. This model will be applied to test future sea level rise adaptation strategies such as increased bulk head elevation, pumping activities, or living shorelines for efficacy. The Port and Airport have agreed this model will serve their specific needs more effectively than other models due to site-specific resolution and inclusion of onshore dynamics.

Key infrastructure will be located and surveyed to approximately 2 cm vertical accuracy as required for urban coastal flood modeling. In the San Diego region, a number of LiDAR products are available providing coastal topographic (3-D) data essential for this project; however, some areas show significant elevation differences (i.e., offsets of 20-30 cm). LiDAR data in areas with discrepancies will be validated against local benchmarks and, if necessary, processed to bare-earth form required for high-resolution flood modeling. Critical bay bathymetry will be validated using SIO survey equipment, and where data is low quality or unavailable, SIO will measure bathymetry. Infrastructure, topography, and bathymetry will be integrated into the San Diego Bay model. Improving the accuracy of these datasets will provide additional benefits to management agencies in the region able to utilize them for other coastal planning purposes, such as engineering design or habitat monitoring.

Although regional modeling efforts have proven highly successful in identifying potentially vulnerable areas and raising awareness of sea level rise effects, they do not accurately identify specific future flood risk. Static modeling methods (e.g., Adapt 2050) assume that flow paths exist and that floods are sustained sufficiently long to fill the impacted region. Static methods do not resolve temporal effects or critical flood control infrastructure (e.g., sea walls, drains) and are inadequate for high-accuracy, site-specific urban coastal flood prediction. In contrast to static methods, the sophisticated nested global-to-local-scale modeling train systems have been shown to over-predict local flood risk because overland flow is not fully hydrodynamic, critical local infrastructure (sea walls, drainage) is unresolved and portions of underlying topographic and bathymetric data are unsuitable for flood modeling.

The proposed site-specific modeling effort is unique when compared to other models as it results in a high quality, validated, seamless, bare earth digital elevation model depicting bathymetry and topography; it provides high resolution fully hydrodynamic overland flow routing, and accounts for flood control infrastructure (e.g., sea walls, wharves) and significant storm system drainage. The model also provides the ability to alter flood defenses in order to consider differing future sea level rise scenarios and engineering design options.

The project will model and analyze deterministic historical events and future sea level rise flooding using CoSMoS future water level outputs, if available, to determine key vulnerabilities and specific water levels that promote minor, moderate and major flooding. Potential future adaptation measures such as bulkhead elevation, operational management (e.g., pumping, drain flow management) will be tested in site-specific models for the Airport Planning Area and the Chula Vista Bayfront. The project will focus in part on the Chula Vista Bayfront due to the potential vulnerabilities of its large-scale coastal developments, infrastructure and habitat areas.

The Port and Airport are extremely sensitive to existing investments in other models, and will make every effort to ensure the transferability of model data resulting from this project. The project emphasizes regional

collaboration with the broad range of local government and other stakeholders that have been engaged in the dialogue around sea level rise in the San Diego Bay. The Port and Airport communicate regularly with many of these stakeholders through the San Diego Regional Climate Collaborative. The Collaborative will be closely involved in this project and will ensure that this network remains informed about the proposed project and have opportunities to contribute to and benefit from its outcomes. Critically, the model can leverage regional model output (i.e., CoSMoS) for sea level rise planning and operational forecasts in anticipation of high water level events, and other communities can apply the Bay-wide model for their own site-specific modeling efforts.

The Port and Airport will include the hydrodynamic and site-specific flood model results with their respective Master Plan updates to identify vulnerabilities and risks that have implications for long-term planning efforts and identify adaptation strategies. Depending on specific findings, the Port and Airport may recommend creation of new natural flood control measures, modifications to their Capital Improvement Programs, adoption of related policy measures to ensure flood risks are adequately reflected in future plans, and other strategies. The Port and Airport will integrate the recommendations into the Port Master Plan Update, the Airport Master Plan and the Airport Strategic Master Drainage Plan accordingly.

2. WORK PROGRAM AND SCHEDULE.

SCHEDULE

Proposed starting date: 4/1/2015

Estimated completion: 6/30/2017

WORK PROGRAM

Project Name: San Diego Unified Port District and San Diego County Regional Airport Authority Hydrodynamic and Site-Specific Modeling and Planning for Sea Level Rise	Complete Date: 6/30/17
Task 1. Bathymetric data	Projected start/end dates: 4/1/15 - 1/30/16
1.1 Collect and validate bathymetric data	Projected start/end dates: 4/1/15 - 6/30/15
1.2 Process bathymetric data	Projected start/end dates: 7/1/15 - 7/31/15
1.3 Conduct site-specific topobathy for high resolution flood modeling	Projected start/end dates: 1/1/16 - 1/30/16
Deliverable: GIS shapefile of bathymetric data	Projected complete date: 1/30/16
Task 2. Land topography (LiDAR)	Projected start/end dates: 4/1/15 - 1/30/16
2.1 Validate and process LiDAR topography	Projected start/end dates: 4/1/15 - 1/30/16
Deliverable: Database of LiDAR topography	Projected complete date: 1/30/16
Task 3. Infrastructure survey / GIS data	Projected start/end dates: 6/1/15 - 12/31/15
3.1 Identify flood control threshold infrastructure along 22 miles of the San Diego coast	Projected start/end dates: 6/1/15 - 8/30/15
3.2 Survey infrastructure	Projected start/end dates: 7/1/15 - 12/31/15
Deliverable: GIS shapefile of flood control infrastructure	Projected complete date: 12/31/15
Task 4. Data processing and model generation	Projected start/end dates: 3/1/16 - 9/30/16
4.1 Generate hydrodynamic mesh	Projected start/end dates: 3/1/16 - 3/31/16
4.2 Test model	Projected start/end dates: 3/1/16 - 5/31/16
4.3 Couple SLR modeling to CoSMoS future offshore water levels	Projected start/end dates: 7/1/16 - 9/30/16

Deliverable: Hydrodynamic model	Projected complete date: 9/30/16
Task 5. Generation of site-specific models	Projected start/end dates: 6/1/16 - 11/30/16
5.1 Critical threshold determination for Harbor Island/Lindbergh Field Planning District and Chula Vista Bayfront sub regions	Projected start/end dates: 6/1/16 - 7/31/16
5.2 Model flood events (e.g. flood extents, depth, velocity, tail water elevations)	Projected start/end dates: 6/1/16 - 8/31/16
5.3 Develop virtual infrastructure testing (e.g., flood walls, elevation, storage)	Projected start/end dates: 8/1/16 - 11/30/16
Deliverable: Water level elevations and flood event scenarios for selected sites	Projected complete date: 11/30/16
Task 6. Model interpretation, adaptation strategy development, and coordination	Projected start/end dates: 8/1/16 - 6/30/17
6.1 Interpret model results	Projected start/end dates: 8/1/16 - 2/28/17
6.2 Identify and formulate key adaptation strategies that can be included in Port and Airport planning efforts	Projected start/end dates: 12/1/16 - 6/30/17
6.3 On-going coordination with Port and Airport planning efforts, including stakeholder outreach	Projected start/end dates: On-going throughout project
Deliverable: Development of adaptation strategies that can be included in Port 50-year Integrated Plan, Airport Master Plan, Airport Strategic Master Drainage Plan, and Airport Capital Improvement Program	Projected start/end dates: 6/30/17

BENCHMARK SCHEDULE

ACTIVITY	COMPLETION DATE
Complete GIS shapefile of bathymetric data	1/30/16
Complete database of LiDAR topography	1/30/16
Complete GIS shapefile of flood control infrastructure	12/31/15
Complete hydrodynamic model	9/30/16
Complete water level elevations and flood event scenarios for selected sites	11/30/16
Complete development of adaptation strategies	6/30/17

3. BUDGET.

APPLICATION BUDGET INFORMATION

Funding Request: $250,000 **Total Project Cost: $347,475**

NOTE: Funds contributed by the Port and Airport will be used to enhance efforts within their respective jurisdictions. Funds contributed by SIO and any other future funds may be used to contribute to development of this model in geographic areas outside of the Port/Airport jurisdictions.

PROJECT FUNDING SOURCES

Task Number	Task Name	Total Cost	Allocation of total cost among all funding sources			
			Applicant's Funding	LCP Grant Funding	OPC SLR Grant Funding	Other Funds (define below)
1	Bathymetric data collection	$2,500			$0	$2,500
2	Land topography (LIDAR)	$17,500	$5,000		$10,000	$2,500
3	Infrastructure GIS data	$82,500	$5,000		$75,000	$2,500
4	Data processing and model generation	$92,500	$5,000		$85,000	$2,500
5	Generation of site-specific models	$82,475	$10,000		$65,000	$7,475
6	Model interpretation and strategy development	$70,000	$15,000		$15,000	$40,000
TOTAL		**$347,475**	$40,000	$0	$250,000	$57,475

OTHER FUNDING SOURCES (NOT INCLUDING IN-KIND SERVICES)

Source of funds	$ Amount	Status (Committed, Applied, etc)
San Diego County Regional Airport Authority	40,000	Committed
Scripps Institution of Oceanography	17,475	Committed
TOTAL	$ 57,475	

In-kind Services: $78,884

Staffs from both the Port and Airport have contributed many hours to the development of the Adaptation Strategy, Research Agenda, and specific sea level rise and flooding work begun for each agency. To date, and including efforts for this proposal, this is estimated at:

Activity	Hours per Yr	No. of Yrs	No. of Staff*	Total Hours	Avg. Hrly Rate	Total Contribution
Adaptation Strategy	40	2	2	**160**	79.305	12,689
Research Agenda	16	1	2	**32**	79.305	2,538
Ongoing Adaptation Efforts	150	2.6**	2	**780**	79.305	61,858
Total				**972**		77,084
* 1 staff member each from Port and Airport						
**April 2015 - December 2017						

The San Diego Regional Climate Collaborative Manager will also contribute approximately 20 hours per year over two years to the project for the outreach component. The Manager intends to use quarterly network meetings and the Sea-Level Rise Working Group to share results from the proposed SIO hydrodynamic modeling with public agencies around the San Diego region. This will include outreaching on how the SIO modeling and CoSMoS modeling complement each other, as well as outreach on the various products that will be derived from these efforts and can be used by the local governments and agencies to inform their own sea-level rise planning. The in-kind contribution from the San Diego Regional Climate Collaborative is expected to total $1,800.

BUDGET SUMMARY

Grant Application Budget Form

Please use the following form to fill in your estimated budget. Double click on the table to open in excel. Fill in the fields shaded in blue.

	Applicant's Funding	CCC Grant Funding	OPC Grant Funding	Other Funds
Personnel				
Salaries and wages[1]	$ 24,000		$ 72,000	$ 5,000
Benefits[2]	$ 16,000		$ 28,800	$ 12,475
Total Personnel	$ 40,000	$ -	$ 100,800	$ 17,475
Consultants[3]				
Haley & Aldrich, Inc.			$ 60,165	$ 38,200
Total Consultants	$ -	$ -	$ 60,165	$ 38,200
Operating Expenses				
Postage/Shipping				
Supplies/Materials[4]			$ 34,595	
Travel[5]			$ 1,500	$ 1,800
Indirect Costs			$ 52,940	
Total Operating Expenses	$ -	$ -	$ 89,035	$ 1,800
Total Budget	$ 40,000	$ -	$ 250,000	$ 57,475

NOTES ON BUDGET LINE ITEMS:

[1] **Explanation of rate(s) and hours for each position for which funds are being requested:**
SIO rates = $8131/month x 50% x 25 months
Consultant rates = $191/hour x 516 hours

[2] **Amount requested for benefits not to exceed 40% of amount requested for salary or wage:**
SIO cannot limit benefits to 40% and will offset the balance of 7% through its match.

[3] **All subcontractors must be selected pursuant to a competitive bidding process that seeks at least three (3) bids from responsible bidders:**
Haley & Aldrich, Inc. is under contract with the Airport for On-Call Environmental Services, which was competitively bid through a Request for Proposals dated March 23, 2011.

[4] **Major supplies and materials**
ATV Yamaha Grizzly $9,790 (Infrastructure Survey)
ProMark 220 RTK Unit $9,845 (Infrastructure Survey)
Gyro & electronics $6,055 (Infrastructure Survey)
Dell Precision T7610 10 core workstation $9,000 (Data Processing & Modeling)

[5] **Travel reimbursement rates are the same as similarly situated state employees:**
Includes in-state travel for SIO and Consultants ($1800 in Consultant travel to be paid by Airport as part of match).

[6] **Indirect costs:**
Includes pro-rata share of rent, office equipment, telephone, and other overhead costs.

4. RESOLUTION (S) FROM THE APPLICANT'S GOVERNING BODY.

See Attachment.

SUPPLEMENTAL FORM B – OPC LCP SLR GRANT PROGRAM

Potential Impacts from Sea-Level Rise – Preliminary Assessment

Climate change poses substantial risks to the San Diego region's coasts. Research from Scripps Institution of Oceanography ("SIO") indicates that sea level could rise by as much as 17 inches by 2050, and five feet by 2100 when many areas could be permanently inundated.

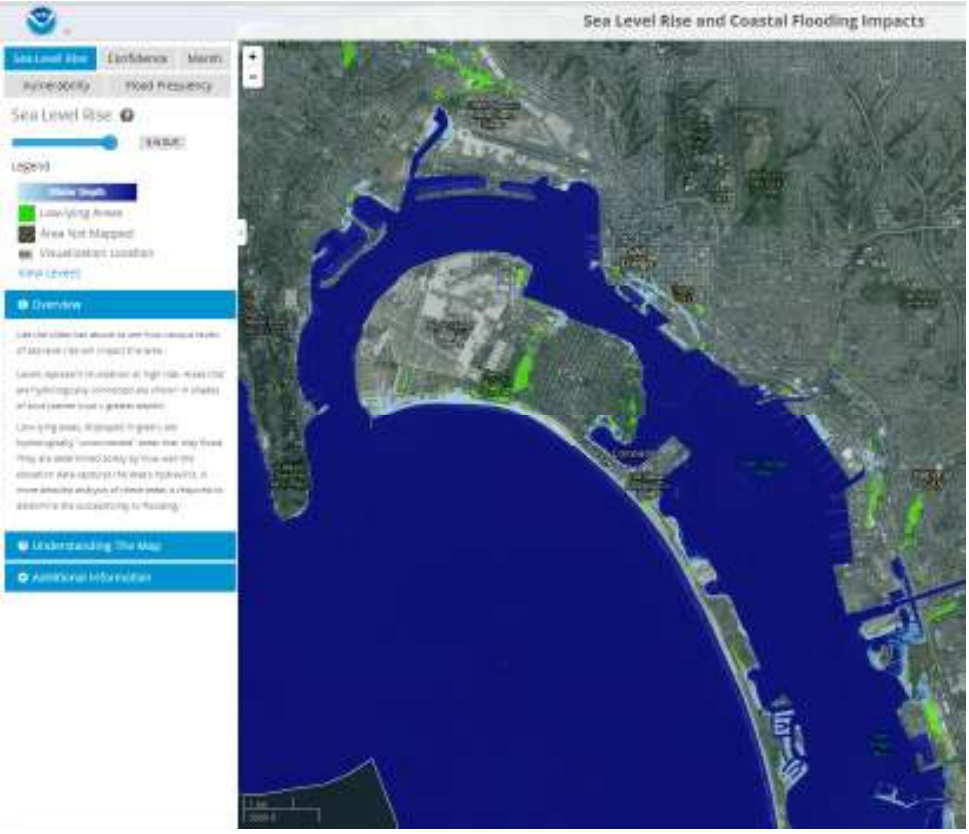


Figure 6: NOAA Sea Level Rise Viewer shows only modest impacts to the Port and Airport; however, the proposed hydrodynamic model accounts for key factors such as tidal influence and land-based flooding.

The vulnerability assessment included in the 2012 *Sea Level Rise Adaptation Strategy for San Diego Bay* concluded that:

- In the next few decades, the greatest cause for concern will be an increase in the kind of flooding that the region already experiences due to waves, storm surge, El Niño events, and very high tides. When planning for this period, an emphasis should be placed on preparing for more common and more severe extreme events.
- Starting around mid-century, the Bay may become more vulnerable to regularly occurring inundation of certain locations and assets, some of which are being planned and built today. As a result, this longer-term risk of inundation should be a consideration in today's decision-making.

- The most vulnerable sectors in the community include stormwater management, wastewater collection, shoreline parks and public access, transportation facilities, commercial buildings, and ecosystems.

While NOAA's Sea Level Rise Viewer shows only modest impacts to the Port and Airport, these sites are vulnerable to more complex interactions between sea level rise, tidal influences and land-based flooding (see Figure 4). The proposed project will develop a model that accounts for these complex interactions at a site-specific level.

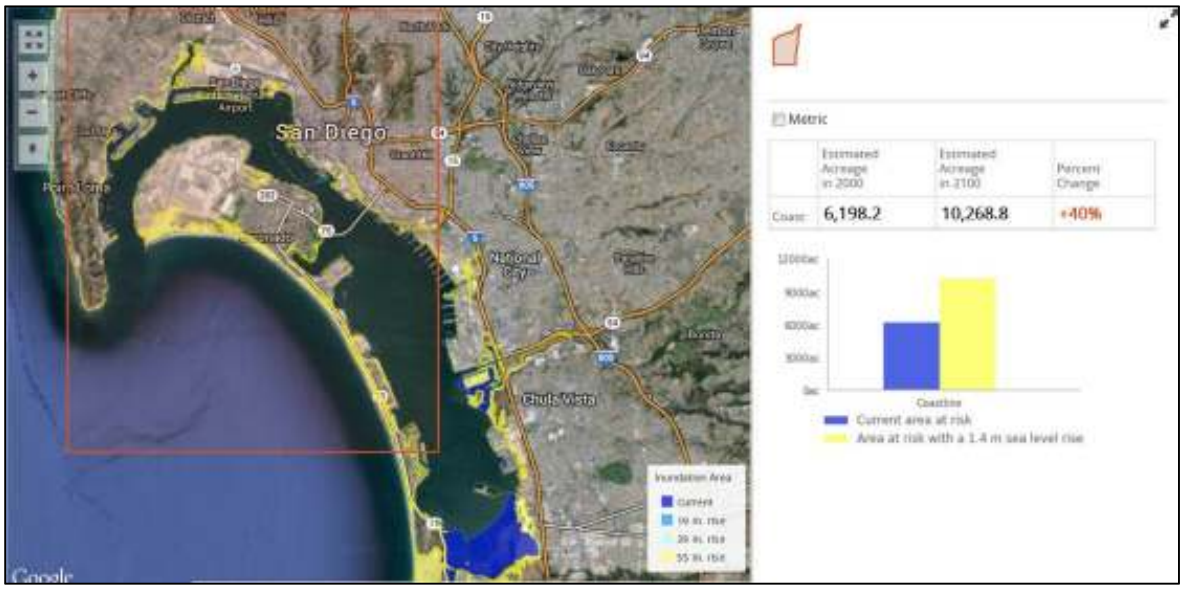


Figure 7: The Cal-Adapt Sea Level Rise Mapping Tool indicates more substantial implications for the Port and Airport.

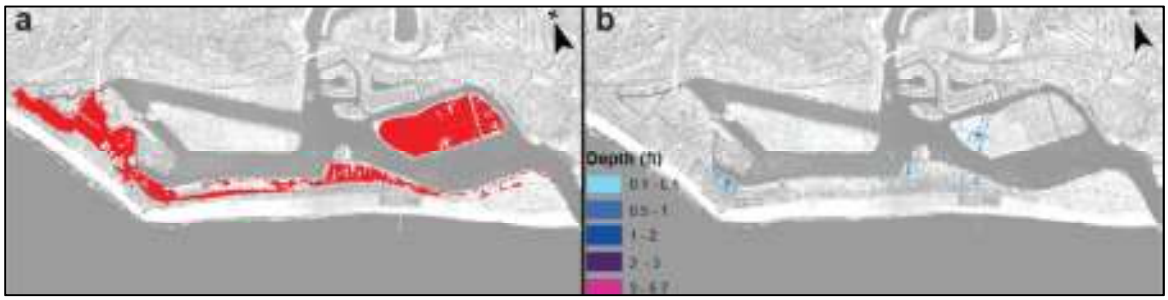


Figure 8: Flood predictions for a January 10, 2005 flood using (a) static and (b) validated hydrodynamic modeling (Gallien et al., 2011; 2013). Figure credit: Timu Gallien.

Figure 9: Flood extent predictions for MHHW + 2 ft. of sea level rise using (a) NOAA Sea Level Rise and Coastal Flooding Impacts Viewer (http://csc.noaa.gov/slr/viewer) and (b) a site-specific hydrodynamic model that resolves flood control infrastructure. Note that MHHW is a tidal datum representing the average elevation of the higher daily tide level, spring tides commonly exceed this level. MHHW + 2 ft. of sea level rise is equivalent to today's 50% exceedence probability, meaning that this level of flooding occurs on average every other year. Figure credit (a) NOAA, (b) Timu Gallien.

Project Need

The *Sea Level Rise Adaptation Strategy for San Diego Bay* ("Adaptation Strategy") recommended the development of a Regional Research Agenda to document the data that planners and resource managers need to plan for sea level rise in the San Diego region, and to help direct research funding and activity to those areas that advance planning for sea level rise in the San Diego region. The subsequently adopted Research Agenda identified the need for a deeper understanding of the flooding dynamics related to sea-level rise, storm surge, and integration of ocean-based and land-based flooding models. While CoSMoS will partially satisfy this need, the Port and Airport wish to better understand the crucial interactions between ocean-based flooding, bay water levels, infrastructure, and subsurface storm drain connections. Building upon previous bay-wide studies, the proposed project will drill down to the site-specific level in order to provide crucial insight for the Port and Airport's respective master planning efforts. Both agencies are at critical stages in various undertakings that are directly linked to adaptation and sea level rise, and the timely delivery of the proposed project is crucial to inform their efforts.

Importance of the Hydrodynamic Model

The Port and Airport have partnered with SIO, which has started the development of a hydrodynamic model for San Diego Bay. SIO will locate and survey key infrastructure to the accuracy required for urban coastal flood modeling. While a number of LiDAR products are available the San Diego region, some areas show significant elevation differences (i.e., offsets of 20-30 cm). Site-specific high resolution urban flood prediction demands accurate bare earth digital terrain models. Extensive research indicates that LiDAR inadequately resolves abrupt elevation changes such as wharves or sea walls, and suggests the need for high accuracy real time kinematic (RTK) surveys of hydraulically important urban topography. Although numerous studies point to the criticality of resolving key hydraulic features such as curbs, walls and localized sources and sinks which constrain, channel or redistribute flow, only a very limited number of studies have attempted to explicitly include infrastructure in hydrodynamic

modeling applications. With the exception of a single study in Newport Beach California, no coastal flood modeling studies have resolved infrastructure and drainage. The San Diego model represents a unique urban planning tool.

Previous research has shown that high accuracy coastal flood prediction demands high quality explicit inclusion of key urban infrastructure, bare earth topography, and accurate depiction of bay bathymetry. Infrastructure exclusion leads to overprediction (Figure 8a). Bare earth topography is critical to accurate overland flow routing. Regional, under-resolved or inaccurate bathymetry is detrimental to flood prediction and has been shown to dramatically increase streamflow sensitivity while simultaneously attenuating the effects of high ocean water levels, resulting in fundamentally incorrect predictions.

The proposed site-specific modeling effort is unique when compared to other models as it results in high quality validated seamless, bare earth digital elevation model depicting bathymetry and topography; it provides high resolution fully hydrodynamic overland flow routing, and accounts for flood control infrastructure (e.g., sea walls, wharves) and storm system drainage. The model also provides the ability to alter flood defenses in order to consider differing future sea level rise scenarios.

Project Benefits

The Port and Airport provide access and recreational opportunities for millions of visitors to the San Diego region each year; tourism is the second largest segment of San Diego's economy. The Port and Airport collectively own, operate, and/or manage aviation, maritime, and related facilities on more than 3,000 acres of coastal and tide lands on the San Diego Bay, and the Port is home to countless visitor serving amenities including 16 hotels (including five of the 10 largest hotels in San Diego), two cruise ship terminals, 20 public parks, habitat protection areas, and many marinas, restaurants, and museum attractions. The Port and Airport themselves are significant contributors to the regional economy – estimated at $19.8 billion per year – and disruption of on-time performance of aviation and maritime activities due to extreme weather causes is extremely costly; for instance, closure of the Airport's single runway is estimated to cost the region $1,000 per minute.

Both entities are deeply aware of the threat of rising sea levels to their respective assets, and neither can be relocated to escape this threat. The Port is defined by its relationship with the water, and by its very nature exists to service the coastline. Land in the Airport vicinity is densely developed and relocation to neighboring higher ground is not possible due to the physical constraints of natural features, topography, and major infrastructure. Furthermore, relocation of the Airport is not favored by the people of San Diego[7]. This project is intended to

[7] Due to these constraints and in accordance with California State Senate Bill 1896, from 2003 to 2006, the Airport Authority conducted a comprehensive study of relocating the airport. Through the course of evaluating 30 possible sites, 9 sites were identified as candidates for further analysis. The Airport selected five of these sites to undergo a comprehensive detailed alternative analysis for the purpose of developing a recommendation for a new location. The recommendation was presented to the people of San Diego County as a ballot measure for a county-wide vote in November 2006, which failed by a wide margin.

provide best-in-class adaptation planning tools for the Port and Airport as they engage in their respective long-term facility and capital planning efforts to assist in the avoidance of damage or loss of maritime and aviation access throughout the region. The project supports the Port and Airport's goal of preserving the coastal ecosystems throughout their properties through strategic flood management and sea level rise planning.

Transferability of Project Outcomes

The project emphasizes collaboration with the broad range of local government and other stakeholders throughout the region that have been engaged in the dialogue around sea level rise in the San Diego Bay. The San Diego Regional Climate Collaborative is a network for public agencies that serve the San Diego region by sharing expertise, leveraging resources, and advancing comprehensive solutions to facilitate climate change planning and originated in part as a result from the Adaptation Strategy. The Port and Airport communicate regularly with many of these stakeholders through the Collaborative, and will work with the Manager of the Collaborative to ensure that this network remains informed about the proposed project and have opportunities to contribute to and benefit from its outcomes. The model leverages CoSMoS for sea level rise planning and operational forecasts in anticipation of high water level events, and other communities can apply the Bay-wide model for their own site-specific modeling efforts. The Port and Airport are sensitive to the State's investments in CoSMoS, and will make every effort to ensure the project informs and is informed by CoSMoS.

Project Implementation

Updating the Port Master Plan, or any LCP, is a complex process that involves extensive technical analysis, stakeholder outreach, and environmental impacts analysis prior to completion. If this project is selected for funding, the inclusion of resilience and sea level rise considerations in the Port's 50-year plan will greatly increase the ability of the Port to invest in resilient infrastructure than through a stand-alone effort. Specific flooding and sea level rise data could be incorporated before the plan is completed, while decisions are being made during the development of the plan. Subsequent to completion of the 50-year plan would be a Port Master Plan update to align the two documents. Based on the results of the proposed project, the Port will include the resulting information in a Port Master Plan update, for consideration by the Board of Port Commissioners. The California Coastal Commission is a key stakeholder in this process and will be involved throughout that process.

The timing of the proposed project is especially beneficial as there are significant planning initiatives underway that allow for inclusion of the resulting information and influence on decision-making. However, a prescriptive method for inclusion of results into the Port Master Plan is impossible at this time as that would preclude planning and decisions still to be completed by staff, stakeholders, and the Board of Port Commissioners. It is likely that the Board of Port Commissioners will be presented with options for incorporation of the results, including adaptation strategies, such as through reference or by creating a section within the Port Master Plan.

SAN DIEGO COUNTY
REGIONAL AIRPORT AUTHORITY

P.O. BOX 82776, SAN DIEGO, CA 92138-2776
619.400.2400 WWW.SAN.ORG

July 7, 2014

I, Tony R. Russell, certify that the following Resolution, No. 2014-0065,

> A RESOLUTION OF THE BOARD OF THE SAN DIEGO COUNTY REGIONAL AIRPORT AUTHORITY AUTHORIZING THE AUTHORITY TO SUBMIT A GRANT PROPOSAL TO THE CALIFORNIA OCEAN PROTECTION COUNCIL TO FUND ADVANCED HYDRODYNAMIC AND SEA LEVEL RISE MODELING IN COORDINATION WITH THE SCRIPPS INSTITUTION OF OCEANOGRAPHY AND IN PARTNERSHIP WITH THE SAN DIEGO UNIFIED PORT DISTRICT, was passed by the following vote:

YES – Alvarez, Cox, Desmond, Gleason, Hubbs, Robinson, Smisek; NO - None; ABSENT – Boland, Sessom. (Weighted Vote Points: YES - 79; NO - 0; ABSENT- 21).

ATTEST:

TONY R. RUSSELL
DIRECTOR, CORPORATE &
INFORMATION GOVERNANCE /
AUTHORITY CLERK

SAN DIEGO
INTERNATIONAL
AIRPORT

RESOLUTION NO. 2014-0065

A RESOLUTION OF THE BOARD OF THE SAN DIEGO COUNTY REGIONAL AIRPORT AUTHORITY AUTHORIZING THE AUTHORITY TO SUBMIT A GRANT PROPOSAL TO THE CALIFORNIA OCEAN PROTECTION COUNCIL TO FUND ADVANCED HYDRODYNAMIC AND SEA LEVEL RISE MODELING IN COORDINATION WITH THE SCRIPPS INSTITUTION OF OCEANOGRAPHY AND IN PARTNERSHIP WITH THE SAN DIEGO UNIFIED PORT DISTRICT

WHEREAS, the California Ocean Protection Council (OPC) is responsible for improving the protection, conservation, restoration, and management of coastal and ocean ecosystems in the state of California through enhanced scientific understanding. Currently, the OPC has $1.2 million in grant funds available for public agencies to address sea level rise, sea level rise modeling, vulnerability assessments, and climate adaptation planning; and

WHEREAS, the San Diego Unified Port District is a partner on this proposal and is contributing matching funds to the grant proposal equal to the Authority's contribution ($40,000); and the Authority is updating its strategic master drainage plan to reflect the complexities of stormwater flows throughout the property as well as their relationship to San Diego Bay; and this plan will add information beyond the 2008 Airport Master Plan, particularly as it relates to the vulnerability of critical off-airport infrastructure and navigational equipment.

NOW, THEREFORE, BE IT RESOLVED that the Board hereby authorizes the Authority to submit a grant proposal to the California Ocean Protection Council to fund advanced hydrodynamic and sea level rise modeling in coordination with the Scripps Institution of Oceanography and in partnership with the San Diego Unified Port District; and

BE IT FURTHER RESOLVED the Board finds that this action is not a "project" as defined by the California Environmental Quality Act ("CEQA") (Cal. Pub. Res. Code § 21065); and is not a "development" as defined by the California Coastal Act (Cal. Pub. Res. Code § 30106).

PASSED, ADOPTED, AND APPROVED by the Board of the San Diego County Regional Airport Authority at a special meeting this 7th day of July, 2014, by the following vote:

AYES: Board Members:

NOES: Board Members:

ABSENT: Board Members:

ATTEST:

_____

TONY R. RUSSELL
DIRECTOR, CORPORATE &
INFORMATION GOVERNANCE /
AUTHORITY CLERK