

NO: **R263**

COUNCIL DATE: **December 19, 2016**

REGULAR COUNCIL

TO: **Mayor & Council**

DATE: **December 1, 2016**

FROM: **General Manager, Engineering**

FILE: **4816-706**

XC: **5225-23**

SUBJECT: **Development of a Surrey Coastal Flood Adaptation Strategy
2016 Year End Update**

RECOMMENDATION

It is recommended that Council receive this report as information.

INTENT

The purpose of this report is to update Council on the development of a Coastal Flood Adaptation Strategy that addresses current flood hazards and incorporates long-term flood protection needs resulting from forecast climate change.

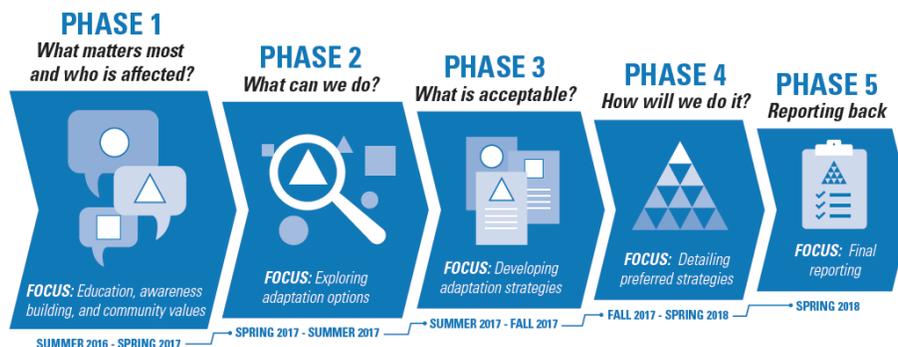
BACKGROUND

At its Regular meeting on February 22, 2016, Council considered Corporate Report No. R034;2016, and adopted its recommendations. The purpose of that report was to make recommendations regarding the development of a Coastal Flood Protection Strategy.

That report summarized past Corporate Reports that addressed topics related to the Coastal Flood Protection Strategy and documented the link between the regional Flood Strategy for the Fraser River floodplain and developing a Coastal Flood Protection Strategy for Surrey's Boundary Bay Coastline.

The complexity and cost of establishing coastal flood protection in Surrey is significant, and therefore the five phase approach to develop a draft strategy includes extensive consultation and engagement with the diverse stakeholders along Surrey's coastline.

At its Regular meeting on June 27, 2016, Council considered Corporate Report No. R144;2016, and adopted its recommendations, which awarded the contract to a consultant to develop a Coastal Flood Protection Strategy. There are five phases to the strategy:



Following award of the assignment and discussion of best practices for flood mitigation and the range of approaches applicable in Surrey with the consulting team, the project name has been revised from Surrey Coastal Flood Protection Strategy to Surrey Coastal Flood Adaptation Strategy (CFAS) to better align with a broad scope of the flood mitigation opportunities.

In parallel to Surrey’s CFAS process, development of a regional Flood Strategy for the Fraser River floodplain is underway, facilitated by the Fraser Basin Council. Phase 1 of the regional Flood Strategy has concluded. The risk, vulnerabilities and consequences of a large flood event, including effects of sea level rise, have been published to www.FloodStrategy.ca. Scoping of Phase 2 for the development of a regional Flood Strategy and potential funding for its implementation is underway. Surrey has committed to participating in Phase 2 over the next two years.

DISCUSSION

The CFAS project is now in the second half of Phase 1 - What Matters Most and Who is Affected. The Project Summary Sheet is attached to this report as Appendix “I”. A project webpage has been established at www.surrey.ca/coastal. Throughout the project, interactive online apps, videos and educational material will be posted to the project webpage to build awareness and understanding to complement community engagement activities.

A number of important activities to support the project’s participatory, community-driven planning approach have taken place:

- Between May 24 and September 14, 2016, three community meetings on coastal flooding, climate change and potential impacts on Crescent Beach were organized in partnership with West Coast Environmental Law and ACT (Adaptation to Climate Change Team) SFU. Overall, more than 60 participants attended. A Summary Report is attached to this report as Appendix “II” and is available on the project webpage.
- A staff CFAS Steering Committee has been established with a broad range of senior staff from each of the Planning & Development Department, the Engineering Department, the Parks, Recreation & Culture Department, Surrey Fire Service and the Finance & Technology Department, with quarterly meetings underway.
- An external CFAS launch took place on September 26, 2016 to bring together a number of partners and stakeholders through a hands-on full day study tour. A high level of interest to stay involved in the project through an Advisory Group was expressed by participants, which included representatives from:

• ACT SFU	• Agricultural Land Commission
• Association of Professional Engineers and Geoscientists of BC	• BC Agriculture & Food Climate Action Initiative
• BC Climate Action Secretariat	• BC Stewardship Centre
• Burlington Northern Santa Fe Railway	• Crescent Beach Property Owners Association
• City of Langley	• Corporation of Delta
• Department of Fisheries and Oceans	• Ducks Unlimited Canada

<ul style="list-style-type: none"> • Emergency Management BC 	<ul style="list-style-type: none"> • Fraser Basin Council
<ul style="list-style-type: none"> • Metro Vancouver 	<ul style="list-style-type: none"> • Ministry of Forests, Lands and Natural Resource Operations
<ul style="list-style-type: none"> • Ministry of Transportation and Infrastructure 	<ul style="list-style-type: none"> • Mud Bay Dyking District
<ul style="list-style-type: none"> • Semiahmoo First Nation 	<ul style="list-style-type: none"> • University of British Columbia
<ul style="list-style-type: none"> • West Coast Environmental Law 	

- The City of Surrey joined the Green Shores™ Local Government Working Group this year. Green Shores™ is a program of the Stewardship Centre for BC, with a number of funding partners, that encourages sustainable use of shoreline ecosystems through development and provision of educational workshops and seminars, educational resources, and research that recognizes the ecological features and functions of shoreline systems. Green Shores™ also provides science-based tools and best practices for shoreline management.

Through the Green Shores™ Working Group, resources and technical expertise are shared between members. It is anticipated that through participation in the Working Group, annual Green Shores™ workshops in Surrey will complement the development of CFAS. The first Green Shores™ workshop in Surrey took place on November 10, 2016 and explored environmentally friendly options for flood control along the Colebrook Dyke that are compatible or enhance recreational opportunities in Mud Bay Park. Incorporation of a Green Shores™ demonstration project is under consideration for the planned Colebrook Dyke improvements.

- Presentations have been made on CFAS to a number of external organizations, the City’s Agricultural and Food Security Advisory Committee, the Environmental Sustainability Advisory Committee and various stakeholder groups as part of the project’s outreach and education component. Input to plan focus groups has been received at these presentations, and a number of focus groups will take place in January and February of 2017. Several audience members have expressed interest in participating on the project’s Advisory Group.
- Technical input on coastal flood adaptation opportunities has been provided to the Planning & Development Department to revisit Flood Protection Elevation requirements for Hazard Area Development Permits in Crescent Beach. A parallel community consultation process to update the Crescent Beach Land Use Plan is anticipated to occur throughout 2017 and will consider Flood Protection Elevation requirements in detail.

Timeline

It is expected that the education, outreach, consultation, visioning and strategy development will take a minimum of two years, with some flexibility to align with the Regional Strategy Development being facilitated by the Fraser Basin Council. Updates throughout the various phases of the Strategy Development will be forwarded to Council. The approximate timeline for key tasks remaining are:

2017

- Establish CFAS Advisory Group;
- Organize focus groups, workshops and an open house;

- Link with Crescent Beach Land Use Plan update;
- Initiate development of preferred flood mitigation strategies to increase resilience;
- Initiate preferred flood mitigation strategies evaluation criteria to increase resilience;
- Continued education and outreach to various stakeholders and partners;
- Develop benefit/cost analysis for each draft preferred flood mitigation strategy to increase resilience;
- Revisit Flood Protection Elevation Requirements for Hazard Area Development Permits (Crescent Beach and South Westminster);
- Evaluate draft flood mitigation strategies to increase resilience;
- Identify potential funding partners;
- Link with Regional Flood Strategy; and
- Update Council on consultation process by year's end.

2018

- Organize focus groups, workshops and an open house;
- Refine draft mitigation strategies to increase resilience;
- Rank draft mitigation strategies to increase resilience;
- Detailed economic analysis of preferred mitigation strategies to increase resilience;
- Present preferred CFAS for Council's consideration; and
- Secure funding partners for CFAS.

Beyond 2018

- Implement aspects of the strategy and monitor; and
- Update the CFAS periodically as new climate change information becomes available.

SUSTAINABILITY CONSIDERATIONS

The process of developing a CFAS will strengthen community engagement and will set the direction for future actions that will support several themes in the Sustainability Charter. In particular, the strategy relates to the Sustainability Charter themes of Infrastructure, Built Environment and Neighbourhoods, Ecosystems, and Public Safety. Specifically, this strategy supports the following Desired Outcomes:

- Energy and Climate DO6: The City anticipates changing weather patterns and sea level rise as a result of climate change, and implements appropriate infrastructure, land use planning and emergency response solutions that will be resilient over the long term;
- Neighbourhoods and Urban Design SD 8: Strengthen and promote community engagement and programming in public spaces;
- Green Infrastructure DO12: Surrey protects ecosystem services and manages natural assets in order to create resiliency to adapt and thrive in a changing climate; and
- Emergency Preparedness and Prevention SD6: Promote development types and locations that will be minimally impacted by natural disasters.

CONCLUSION

Based on the above discussion, it is recommended that Council receive this report as information.

Fraser Smith, P.Eng., MBA
General Manager, Engineering

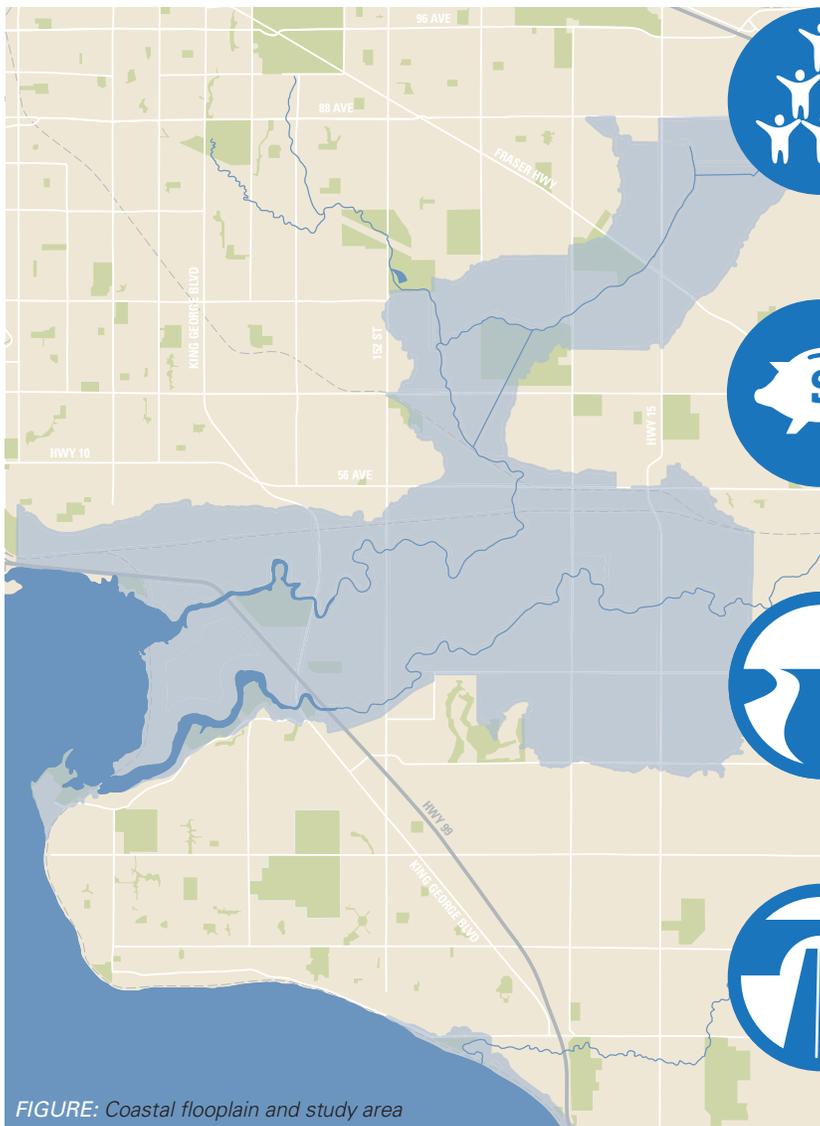
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Appendix "I" – Surrey Coastal Flood Adaptation Strategy Project Summary Sheet
Appendix "II" - Crescent Beach Community Meeting Series: Summary Report on Coastal
Flooding and Climate Change

SURREY COASTAL FLOOD ADAPTATION STRATEGY (CFAS)

CFAS

PROJECT BACKGROUNDER As the climate changes, coastal areas everywhere can expect more frequent and severe flooding from storm surges and sea level rise. To help prepare Surrey for a changing climate and help our coastal communities become more resilient, the City of Surrey is developing a Coastal Flood Adaptation Strategy (CFAS) for Surrey's coastal floodplain area, which is home to residential neighbourhoods, significant habitat areas, businesses and provincially critical infrastructure.



Communities and People

- 1,500 residents
- Approximately 20% of Surrey's land area
- Over 30 km² of Agriculture Land in production
- Alexandra Neighbourhood House
- Heritage buildings and places



Local and Regional Economy

- 700+ jobs
- Over \$100 million in annual farm gate revenue
- Over \$1 billion in assessed property value
- Almost \$25 billion annual truck and rail freight traffic



Parks and Environment

- Regional and City parks, beaches and recreation areas
- Foreshore, coastal, riparian areas and species



Infrastructure

- 10 km of Provincial Highways
- Over 200,000 vehicle trips a day
- 30 km of railway (freight and passenger)

FIGURE: Coastal floodplain and study area

HOW WILL THE PROJECT HAPPEN?

The three-year project builds on recent and ongoing work in the area. It will take a participatory, community-driven planning approach that will directly engage residents, stakeholders, and other partners, including First Nations, community and environmental organizations, business associations and groups, senior governments and neighbouring jurisdictions. Given the complexity of the issues this project will address, the planning process will be adaptive and flexible, and will work to accommodate new stakeholders and information as it moves forward over the next three years.

The process will include sophisticated technical analysis of the challenges climate change presents to our coastal communities and the combination of adaptation options available to address it over the long-term (to 2100).

Development of the strategy will involve a number of different communities and be driven by the values of the people living, working and recreating in them. These values (i.e., the objectives that matter most to people) will be explored in detail with project participants and used to both co-develop adaptation options, but also to evaluate and prioritize them. This participatory, values-based approach will help ensure that the resulting strategy is broadly supported and robust.

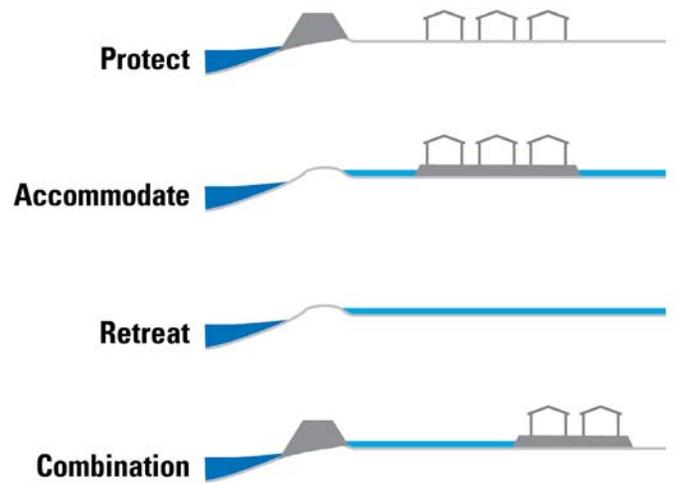


FIGURE: CFAS adaptation pathways

WHO'S WORKING ON THE PROJECT?

Surrey is working with an experienced consultant team led by NHC (Northwest Hydraulic Consultants) and including EcoPlan (engagement, community planning), Thurber Engineering (geotechnical), K&M Consulting (agrolology), and Diamond Head Consulting (environmental planning).

WANT MORE INFORMATION?

For more information contact Matt Osler, Project Engineer, City of Surrey (coastal@surrey.ca / 604.591.4657) or visit www.surrey.ca/coastal.



FIGURE: Surrey CFAS process



CRESCENT BEACH

COMMUNITY MEETING SERIES:

SUMMARY REPORT

ON COASTAL FLOODING

AND CLIMATE CHANGE

REPORT AUTHORS:

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Diana Bulley – Ideaspace

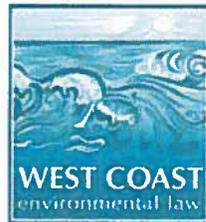
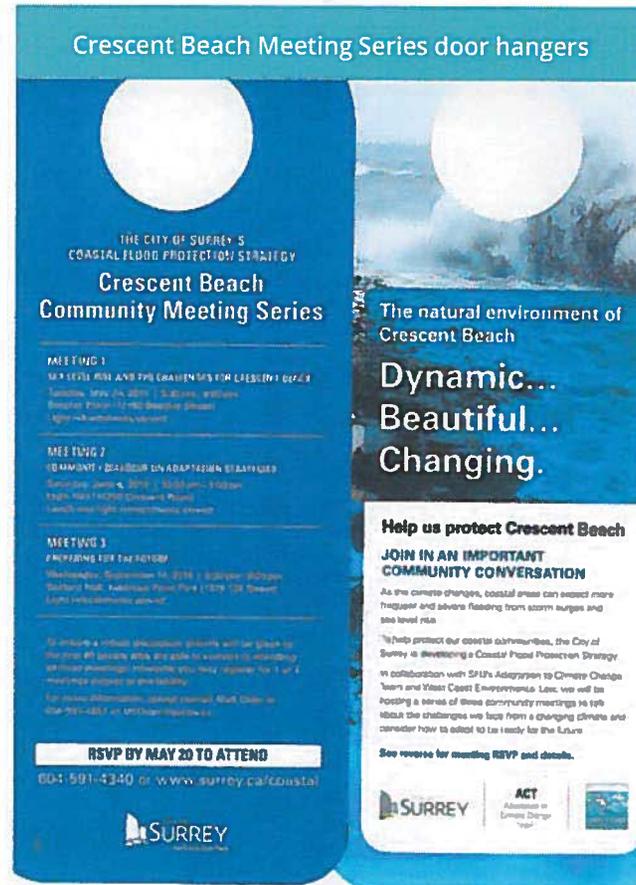
Deborah Carlson – West Coast Environmental Law

ACKNOWLEDGMENTS:

We would like to acknowledge the City of Surrey and its Coastal Flood Adaptation Strategy Team's leadership in planning for adaptation to climate changes, sea level rise and coastal flooding.

Thank you to the Crescent Beach community for their enthusiastic participation in this charrette series.

Publication Date: November 8, 2016





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INTRODUCTION

SURREY'S COASTAL FLOOD ADAPTATION STRATEGY AND THE CRESCENT BEACH COMMUNITY MEETINGS

Climate change is warming the planet and driving more extreme weather events such as storms and droughts, as well as sea level rise. The oceans absorb some of the increasing warmth, which causes them to expand, while glaciers and land-based ice sheets melting adds more water to the oceans. Current projections estimate one metre of sea level rise by 2100 in BC and two metres by 2200; however, estimates vary and some are much higher.

Research shows that, even if we were to immediately reduce emissions to zero, we are locked in to some measure of climate change due to the greenhouse gases we have already released and will continue to release in the coming decades. Ocean heat is released very slowly, and seas are predicted to rise for the next several centuries as a result, with increased storm surges posing added risk for coastal communities.

It remains critical that we reduce our emissions as quickly as possible in order to avoid accelerating climate change and worsening its impacts, but at the same time we need to prepare for the level of climate change we are now facing — an approach known as climate change adaptation. We have enough information to begin planning, and leading BC municipalities are emerging as global forerunners in this work.

In 2013, Surrey developed a Climate Adaptation Strategy that includes a proactive approach to protecting its coastline. As part of this plan, the City is developing a Coastal Flood Adaptation Strategy (CFAS) to prepare for sea level rise and storm surge. Recognizing that adaptive measures may significantly alter coastal communities, the City is engaging local residents and stakeholders in developing the strategy to build a shared understanding of

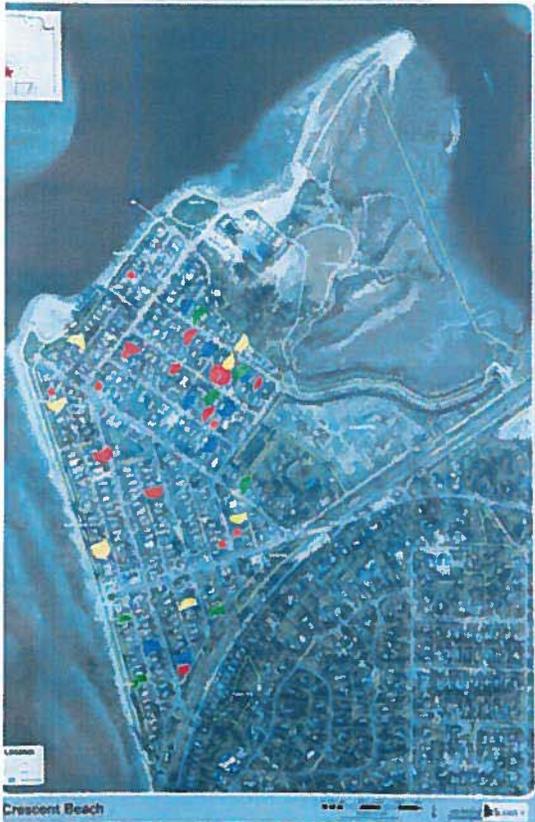
potential impacts and explore options for adapting to climate change.

As a first step, the City invited Crescent Beach residents to attend a series of meetings between May and September in 2016. The City, together with West Coast Environmental Law, Simon Fraser University's Adaptation to Climate Change Team (ACT), and community engagement firm Ideospace, designed and led a series of interactive workshops—called charrettes—to engage Crescent Beach community members and investigate possible responses to future coastal flooding risks.

The first charrette introduced the community to the impacts of climate change and sea level rise around the world and in Crescent Beach. Experts spoke to the dynamic, changing environment and biodiversity of the area and how these characteristics

“Crescent Beach residents and businesses need to be highly involved in any plans to adapt to sea level rise. Residents are very concerned about the environment here and would want to do whatever we could to protect this very special area in which we live.”

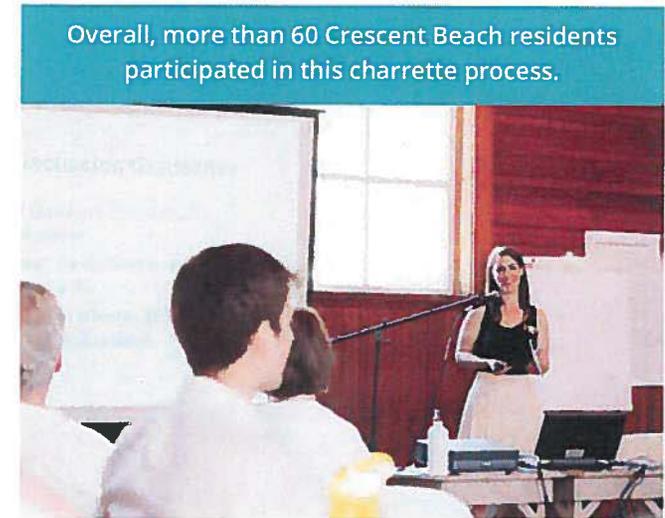
- Participant



Participants placed a dot on the map to show where they live.

influence potential solutions. Presenters also highlighted actions coastal communities elsewhere are taking to respond to sea level rise and its impacts. Community members spoke about climate change impacts that they have personally observed. The City of Surrey introduced its plans for a Coastal Flood Adaptation Strategy and described the process for its development.

Charrette 2 was a full-day event designed to generate community dialogue about the challenges of, and possible responses to, sea level rise and related flooding in Crescent Beach. A mix of presentations, animations and hands-on design activities allowed community members to explore options rooted in their values and what they love about Crescent Beach. Participants reviewed and discussed a range of possible responses to sea level rise, and worked together to design attractive options.



Overall, more than 60 Crescent Beach residents participated in this charrette process.

The final meeting focused on sharing and confirming the outcomes from Charrettes 1 and 2 with the community. Presenters reported back on what they had learned about the collective values of participants and how they informed the community's initial ideas for responses to sea level rise. The City described how the outcomes of Charrettes 1 and 2 connect to the City's broader work on the Coastal Flood Adaptation Strategy.

ENGAGING THE COMMUNITY

Climate change, sea level rise and coastal flooding are significant issues that require the input of governments, businesses and residents to develop responses that best reflect community values and priorities.

A charrette is an intensive, interactive planning process in which stakeholders collaborate with designers and other experts to create a shared vision for a project. It allows stakeholders to learn more about the issue at hand, and gives those designing responses the opportunity to receive feedback from stakeholders. Since charrettes allow for all participants to co-author the outcome of the session in a non-hierarchical fashion, this concept was determined to be the ideal approach for the first steps



"Knowledge is essential; we need to know what we're involved in. We can make wiser decisions with knowledge." - Participant

in exploring sea level rise with Crescent Beach residents.

The City advertised the charrette process to Crescent Beach residents via community email lists, park bulletin boards, and door hangers on all houses, and businesses in the neighbourhood, and notified participants at property owner association meetings leading up to Charrette 1. Registration was available on the City website or by phone.



"Public consultation is a must. This is a good process." - Participant

CLIMATE CHANGE AND CRESCENT BEACH



CLIMATE CHANGE AND SEA LEVEL RISE IN COASTAL COMMUNITIES

Coastal communities face numerous challenges as a result of climate change and, more specifically, sea level rise. Regardless of possible reductions in future greenhouse gas (GHG) emissions, the planet is already 'locked in' to some climate changes. Projected impacts for coastal communities include increased storminess and storm surge, higher sea levels, more erosion of coastlines, impacts on infrastructure, loss of beaches and coastal ecosystems, soil salinization, and groundwater pooling. The Province of British Columbia advises municipalities to plan for at least one metre of sea level rise by the year 2100.

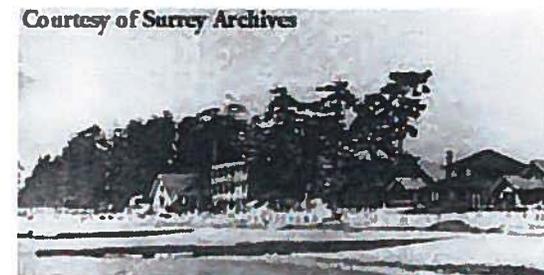
Aside from increasing resilience to climate change impacts, there are many benefits to initiating adaptation planning now. Adaptation is less expensive overall than responding to crises after the fact. Demonstrably increased resilience can protect property values in otherwise vulnerable areas, and will likely result in lower insurance costs as the perception and incidence of risk associated with sea level rise increases. It can also create

recreation and conservation opportunities through ecosystem-based responses, where possible. Furthermore, cities may have the opportunity to be leaders through modeling thoughtful and innovative responses that make sense for their communities, but can also provide examples for other coastal communities in the region and around the world.



THE NATURAL ENVIRONMENT OF CRESCENT BEACH: DYNAMIC AND CHANGING

The discussion with the community acknowledged that Crescent Beach is a dynamic environment that has already seen many changes over time. First Nations inhabited the area for thousands of years prior to colonization. Tidal cycles, storms, seasonal changes, and the influence from the ocean on nearby rivers and vice versa all play an ongoing role in shaping and changing the coastline. Over the past 100 years, city development, along with coastal erosion and sediment movement, has gradually changed the size and shape of the coastline. In response, the City of Surrey has implemented a number of flood control measures, such as sea dams and dykes, designed



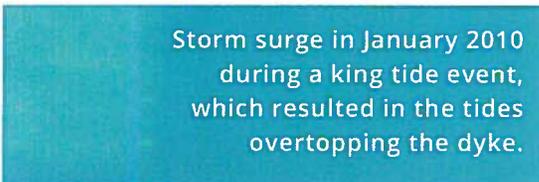
Courtesy of Surrey Archives
Source: Surrey Archives



Source: crescentbeach.ca



Temporary concrete barriers put up after March 10th, 2016 storm damage.



Storm surge in January 2010 during a king tide event, which resulted in the tides overtopping the dyke.



to protect residents and control the movement of water and sediment.

However, climate change presents a new challenge for the community by speeding up and intensifying what would otherwise be more gradual changes along the coastline. Crescent Beach may be beginning to experience climate change in the form of more frequent and intense storm and coastal flooding events. For example, a major event in March 2016 that affected a number of residents and required temporary emergency protection works occurred outside of the king tide season, when it would have been more typically expected.

CITY OF SURREY: PLANNING AHEAD AND GETTING PREPARED

As the City of Surrey develops the Coastal Flood Adaptation Strategy (CFAS) as a next

step in its overall Climate Adaptation Strategy (2013), it is soliciting technical expertise in order to understand the projected impacts for the City and plan ahead, and seeking input from partners, residents, and stakeholders in order to understand their concerns, values and priorities.

The purpose of the CFAS is to prepare for a changing climate in order to protect Surrey residents and businesses and meet provincial guidelines and policies for sea level rise, which state that municipalities should plan for one metre of sea level rise by 2100 and two metres by 2200—see Box 1, page 8.

The CFAS includes a three-year commitment to engage partners, residents, and stakeholders in co-creating solutions for responding to sea level rise and increased storm surge. The Crescent Beach charrettes are part of this process.

Box 1

“[The] problem could be more serious than I thought. Surrey is on the right track to provide answers and solutions.”

- Participant

“As a newcomer to Crescent Beach, the meeting was very informative and has motivated us to be informed and involved in the preservation of this lovely area.”

- Participant

PROVINCE OF B.C. GUIDELINES FOR COASTAL COMMUNITIES

The BC Ministry of Environment projects the following climate change impacts for coastal communities:

- More frequent flood events
- Increased wave heights
- Increased storm surges
- Increased precipitation
- Sea level rise

The Province recommends planning for one metre of sea level rise by 2100 and two metres by 2200.

PLANNING FOR THE FUTURE IN CRESCENT BEACH

COASTAL FLOOD SCENARIOS FOR CRESCENT BEACH, 2020 – 2070

The City of Surrey has prepared possible future flood scenarios in Crescent Beach over the next century. In determining these scenarios, the City took into account current flooding conditions as well as impacts projected from climate change.

There are generally four drivers of coastal flooding: high tides, storm surge, sea level rise, and wind and waves. The elevation that buildings in the coastal zone, such as homes, need to be built to in order to withstand these forces is decided by an established Flood Construction Level (FCL), unless a variance is granted by the City.

The FCL calculation includes components such as high tide, storm surge, wave effects, and additional extra height for safety, called freeboard. Similarly, elevation for coastal flood protection, such as dykes, is determined by a Dyke Construction Elevation (DCE). The DCE is comprised of the same measurements, but includes more height for wave effects since waves will crash against these structures.

In Crescent Beach, most buildings have not historically been built high enough to withstand major flood events and the emerging challenge of climate change and sea level rise is adding new urgency to the need to improve resilience in the area. In addition to encouraging homeowners to make their own improvements, the City is examining ways to protect the Crescent Beach community from flooding impacts.

For this charrette process, the City developed potential flood scenarios for the years 2020, 2040, and 2070. These scenarios are based on the estimated FCLs including provincial sea level rise projections, and assume extreme storm conditions.

As discussed at the charrettes, it should be noted that areas that remain dry in a flood will still be impacted by sea level rise

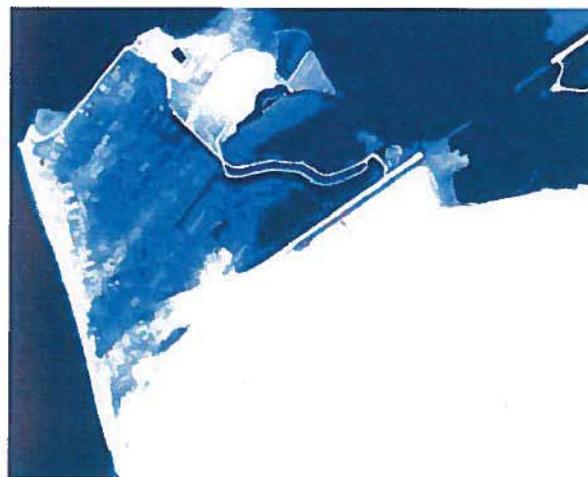
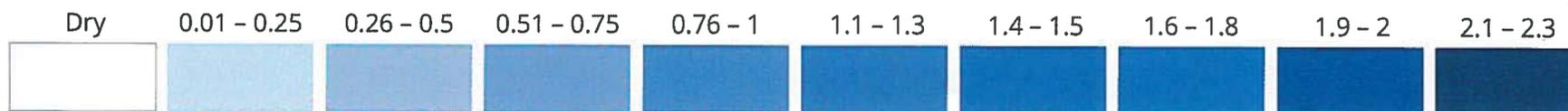
and more frequent and intense storms because of their dependence on community infrastructure and services. Also, once overtopping or breaches of the existing dykes occur there will be widespread flooding even where some portions of the dyke remain intact and appear to be above sea level rise projections.

While the mapping of these flood scenarios provides vital information for planning, it is important to note that the maps only depict the problem, not the possible responses. In developing responses, Surrey has made it a priority to take into account residents' values and preferences, input from local businesses, infrastructure operators and other levels of government, and a range of practical considerations, such as the location of infrastructure and cultural sites, emergency management, and others.

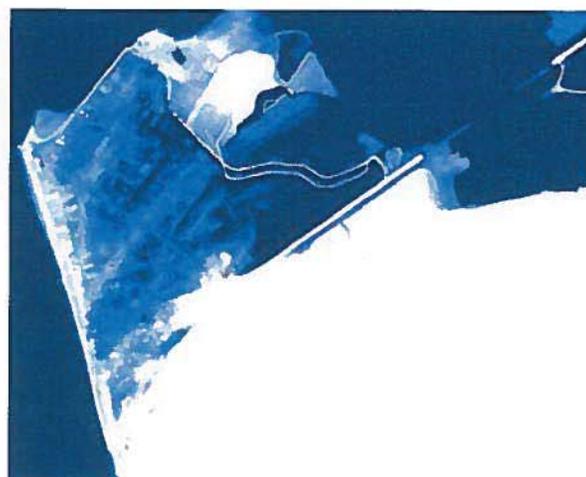
PROJECTED FLOOD LEVELS IN CRESCENT BEACH BASED ON B.C. SEA LEVEL RISE GUIDELINES AND STORM SURGE MODELING

Maps with these levels were shown to charrette participants at the second meeting.

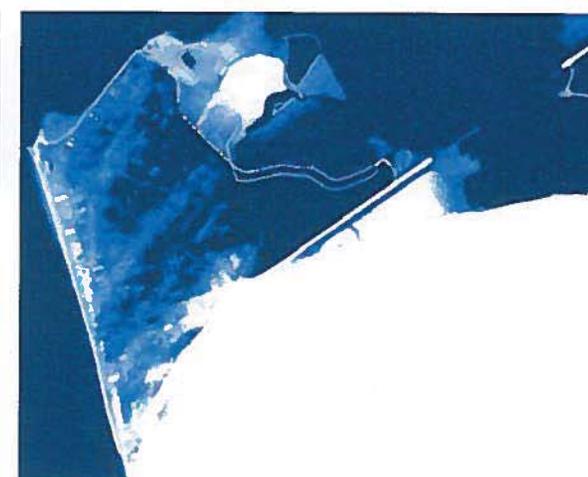
Flood depth (metres)



(2020)



(2040)



(2070)

APPROACHES TO COASTAL FLOODING AND CLIMATE CHANGE ADAPTATION

PROTECT: build or raise structures to keep floodwaters out and protect people, property, and infrastructure. Examples: dykes, sea walls. Vegetation such as wetlands can also buffer the impacts of storm surge.

ACCOMMODATE: make changes to buildings, infrastructure and human activities so that flooding occurs but harmful impacts are minimized. Examples: move important assets and building electrical and mechanical services to higher floors and allow the ground floor to flood; design public spaces to function as waterways when flooded.

AVOID: not locating new development in flood-prone areas. Example: designating “no build” areas in local government plans.

RETREAT: plan for the eventual relocation of people and buildings currently in the floodplain. Examples: purchase houses in the floodplain through voluntary or mandatory programs; relocate key infrastructure outside the area at risk.

Box 2

PROTECTING THE COMMUNITY

There are four overarching approaches to coastal adaptation, as explained in Box 2.

For the Crescent Beach charrette process, the City of Surrey and community members explored four possible responses within the Protect approach. These four **protect** responses are not intended to be concrete plans in and of themselves; rather, they each provide different ideas as jumping-off points for further discussion.

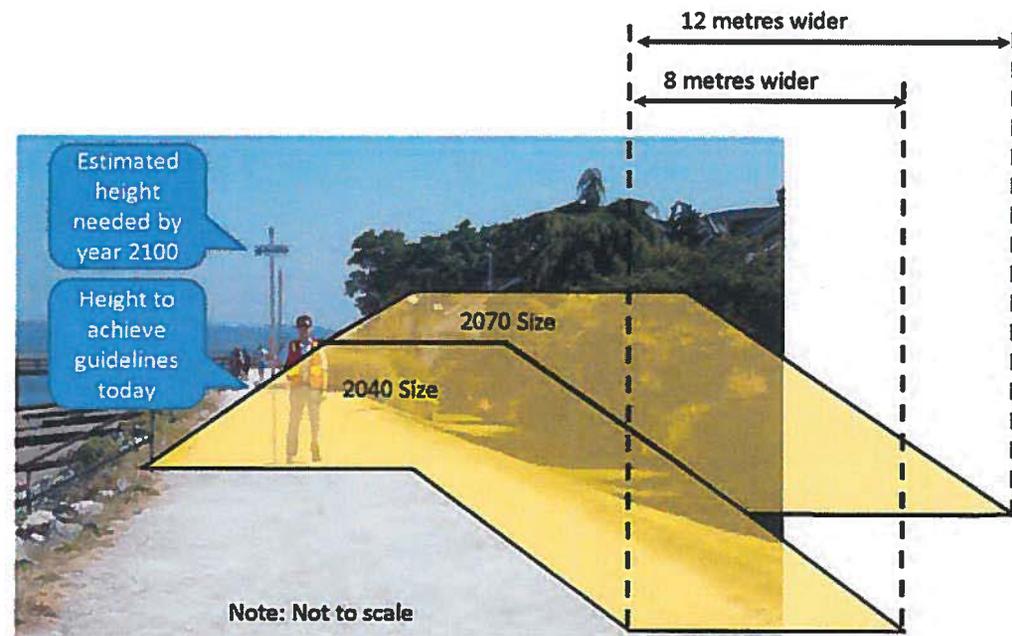
The other overarching approaches to climate change adaptation not explored in detail at the Crescent Beach charrettes will be considered separately as part of Surrey’s CFAS.

RESPONSE 1: UPGRADE THE EXISTING DYKE TO MEET PROVINCIAL STANDARDS

This response would mean upgrading Crescent Beach's existing dyke such that it would be four metres wide at the top, have gradually sloping sides, and be high enough to make waves unlikely to reach the top.

This response would be low maintenance and there could be a wider pathway on top of the dyke than currently exists. However, the dyke would need to be significantly higher than the current dyke. This would take up considerable space, horizontally to expand the base, as well as vertically, and would impede beach and water access as well as beach views for waterfront homes.

Considerations for Response 1

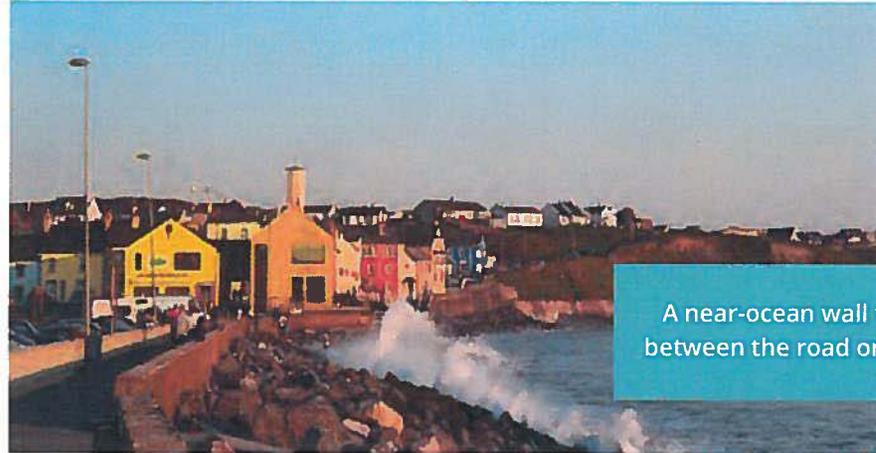


A possible dyke upgrade in Crescent Beach would need to be significantly higher and wider than the current dyke, especially by 2070.

RESPONSE 2: BUILD A WALL

Response 2 would involve building a wall, either near the ocean or set back into the existing coast. A near-ocean wall would have to be approximately three metres tall by 2040 and seven metres tall by 2070, while a setback wall would need to be approximately one metre by 2040 and would not offer enough protection by 2070.

This response has a compact footprint compared to the dyke, but it has a number of challenges. Beach access would be impeded, the urban look would contrast with the natural environment, and it would be difficult to make urgent repairs if necessary. As well, increases in sea level would magnify impacts due to waves crashing against the wall.



A near-ocean wall would provide a barrier between the road or pathway and the ocean.



A setback wall would be set into the surrounding environment.

RESPONSE 3: BUILD SOFT SHORE AND MODIFIED DYKE

This response combines a few elements. First, a 'soft shore' would be built by placing a substantial amount of gravel, cobbles, rocks, and other fill along the lower beach area and anchoring logs along the higher beach area. Next, the dyke would also need to be raised, though not as high as in Response 1.

This response would maintain the natural look and feel of the beach, and would reduce wave effects on the shoreline. However, it would alter the features of the existing sandy beach, require periodic maintenance of logs and fill, and disturb a large footprint of beach and natural habitat.



Example of a soft shore approach, using logs and natural materials to stabilize the beach. Photo by: Pat Harrison

RESPONSE 4: BUILD OFFSHORE ISLANDS / FEATURES

Finally, building offshore features is another possible response. Sand, cobbles, shrubs, and other natural materials would be used to build one or more small islands in Mud Bay. These islands would mitigate wave action in Crescent Beach by breaking the waves before they reach the shore. Islands could also be designed in different ways: there could be a jetty linking the island(s) to the shoreline, and the island(s) could have pedestrian access, or there could be water access only. Alternatively, the offshore structure could instead be a breakwater made out of harder materials like concrete or rock.

This response would retain much of the current look and feel of Crescent Beach as the

This City of Surrey rendering shows what offshore islands and a breakwater could potentially look like in Crescent Beach.



structures themselves would be offshore. This could also create inter-tidal habitat for aquatic organisms and could provide recreational opportunities on the islands. However, this would change the view from the shore, it might impact navigation and ocean dynamics, and it would disturb the Provincial Wildlife Management Area. Additionally, a large amount of fill material would be needed and the construction and regulatory processes would be complex.

“[I’ve learned] that there are a number of effective options that can be employed to address the problem without compromising the distinctive natural beauty of the area.”

- Participant

COMMUNITY PERSPECTIVES

EXPLORING IDEAS FOR COASTLINE PROTECTION

During the full-day session participants were presented with possible flood scenarios based on future points in time and then worked in small table groups to complete a facilitated, values-based exploration of possible responses.

Each group was asked to reflect on what they value about Crescent Beach so that these considerations could inform the development of their ideas for coastal protection. Participants worked on large aerial maps and used sticky notes to show how and where they enjoy spending time in the community and what aspects of Crescent Beach they appreciate.

Participants then reviewed the potential impacts on Crescent Beach resulting from projected sea level rise and flooding scenarios for 2020, 2040, and 2070. Layers of blue acetate were placed over the aerial maps to demonstrate how and where the water would flood the community under each scenario. Each group noted ways in which these water levels would impact them and their community.

Next, participants reviewed and considered the four possible types of adaptation responses:

RESPONSE 1: Upgrade the existing dyke to meet provincial standards

RESPONSE 2: Build a wall

RESPONSE 3: Build soft shore and modified dyke

RESPONSE 4: Build offshore islands/ features



Using modelling clay, sand, pebbles, vegetation and other building materials, each group designed and customized the responses to fit their ideas for coastline protection on the maps. Facilitators engaged the groups in discussion about benefits, challenges and considerations related to their ideas and captured key ideas on flipcharts.



WHAT WE HEARD ABOUT COMMUNITY VALUES

One of the main goals of the charrette meetings was to give residents a chance to provide direct and focused input to the strategy at an early stage.

Residents were asked to express their values and to explore how those values could be integrated into potential coastline protection measures. Here a short summary of some of



the key themes that emerged from the discussion about values. These themes were then reflected in participants' design ideas.

THEME 1: COMMUNITY CONNECTIONS

Crescent Beach residents are strongly connected to both the natural environment and to their community. Participants mentioned walking along



the beach, spending time on Blackie Spit, bird watching, fishing from the pier, watching the sunset, and bringing their grandchildren to enjoy the beach. Connections to the sea are also strong: kayaking, canoeing, sailing, swimming, paddle boarding, and fishing were noted. The region's rich biodiversity was also noted as important. Residents appreciate that the small size of the community means they know their neighbours and feel a sense of belonging. Participants talked about having backyard or street parties, playing music together, and helping each other out with gardening or driving seniors around.

THEME 2: A COMPLETE COMMUNITY

Local businesses and amenities are key parts of the community. Camp

Alexandra, the Dunsmuir community gardens, the many restaurants in the area, the marina, and the swim and sailing clubs were mentioned as particular places enjoyed by the residents. One participant described the community by saying "It's my whole life."

THEME 3: SECURITY FOR THE LONG TERM

Many residents have lived in Crescent Beach for decades. They are attached to their homes, both their houses and their yards. They view Crescent Beach as a unique and beautiful place, with its peacefulness, many trees and seaside atmosphere. They want to see the community thrive well into the future.

COMMUNITY VALUES AND ADAPTATION

The potential responses created by community members can now provide the City with important context specific to Crescent Beach and its residents as the City proceeds to develop the Coastal Flood Adaptation Strategy.

Connections to nature were reflected in a number of the models that focused on softening shoreline areas with vegetation and logs to buffer storm surge, as well as in the choice of most tables to create barrier islands with natural features.

Preserving community connections and concern for local businesses meant

that residents supported solutions that protected the community as a whole, and were not just concerned with whether their own homes would be directly impacted by flooding. Finally, participants were looking for responses that could be adapted over time, and possibly implemented in phases, not just short-term solutions.

While there is extensive technical analysis and further consultation to be done, the City of Surrey now has guidance directly from the community about the types of responses that are likely to align with their values and priorities.

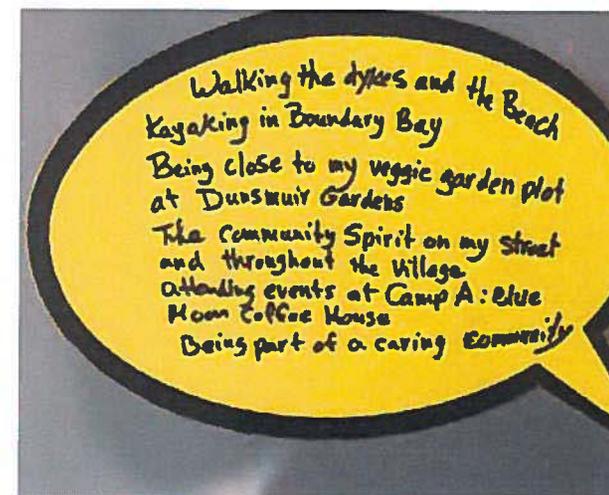
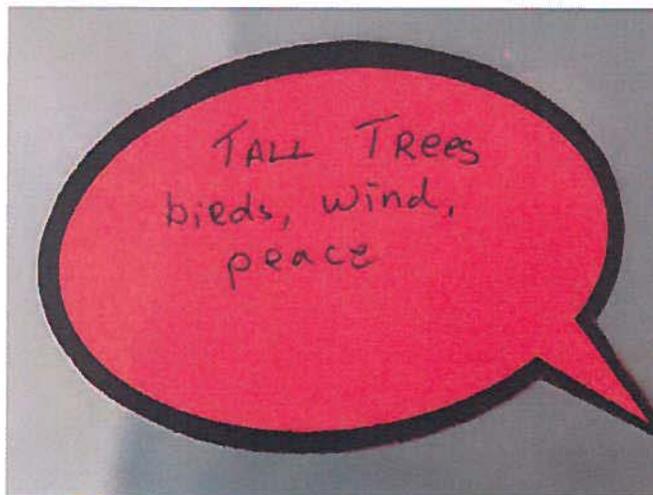


TABLE 1

VALUES AND CONCERNS

Table 1 participants valued:

- Commercial amenities: the swim club, the sailing club, Camp Alexandra, and community restaurants
- The heritage homes in the community
- Water activities: kayaking, paddle boarding, boating, swimming, sailing, walking
- Drawing and writing on the beach
- The diversity of visitors to Crescent Beach
- Connections with friends and family in the area
- Bringing their grandchildren to the beach

When assessing the flood scenario for 2020, Table 1 was most concerned about making sure adequate warnings and emergency response systems are in place for both residents and visitors. Looking to 2040 and 2070, Table 1 wanted to find ways to slow the inundation in



case of flood and emphasized the importance of maintaining strong community relationships.

IDEAS ABOUT THE FUTURE

Table 1 experimented with both a soft shore approach (Response 3) and an offshore islands approach (Response 4). For their soft shore approach, they proposed a shore of sand, gravel, and cobbles with dune grass and logs further up the beach. This would be built up every ten years or so to respond to erosion. They further envisioned a small (18-inch high) sea wall at the top of the beach in order to provide one more line of defense, though they were against putting in a permanent wall any higher than this. They were, however, open to the idea of a temporary, seasonal

wall erected in isolated areas to protect against more extreme storms.

For their offshore islands approach, Table 1 wanted to see natural-looking islands that people could walk on. They liked that the islands could protect the community against southwest storms while maintaining a pleasant view from the shore, and they wanted the islands to be oriented at such an angle that they would impact neither current navigation channels in the area nor natural sediment transport. Table 1 also envisioned a hybrid solution combining offshore islands with rock along the southwest shore—to add some soft shore elements—and a dyke along the northeast shore. This was their preferred approach for 2070, and they thought this approach could be scaled up over time.



TABLE 2



VALUES AND CONCERNS

Table 2 participants valued:

- Local amenities: beach pathways, marina, coffee shops, commercial areas, and Camp Alexandra
- Natural elements: numerous trees in the community and the ability to bike everywhere
- The community feeling of knowing your neighbours

Many people at Table 2 lived close to the waterfront on higher ground and were overall less concerned about the impacts of increased water depth. Participants deliberated about ways to protect and enhance the natural environment while balancing economic and social needs.

IDEAS ABOUT THE FUTURE

Table 2 also experimented with a combination of approaches. Participants liked the idea of offshore islands as these could minimize required dyke increases and advocated for reclaiming and augmenting tidal habitat through soft shore stabilization. Table 2 also

envisioned passive kayak access to the islands, but participants were keen to support adaptation approaches designed to keep beach traffic to a minimum to avoid major increases in visitor numbers.



TABLE 3



VALUES AND CONCERNS

Table 3 participants valued:

- Natural beauty of Crescent Beach: wildlife, sunsets, and the beach itself
- Outdoors activities: walking and fishing
- The variety of buildings in the community
- Lack of a formal day-to-day structure
- The small size of the community
- The large, private family homes that enable privacy while still keeping neighborhood connections

In the 2020 flood scenario, Table 3 noted that some community amenities would be unaffected but that preventing as much damage as possible is still important. This group felt that the City should take direction from experts on this issue rather than try to preserve ocean views at all costs. By 2070, Table 3 observed that many areas would be flooded and it would be hard to get around the community.

Everyone at Table 3 lived in one of the most vulnerable areas of the community as water would pool in this area, so Table 3 was very concerned about ensuring drainage systems would be sufficient to move water out following a flood. They also highlighted that all property values would plummet in case of flood, and therefore everyone in the community would be affected even if their home was not directly flooded.

IDEAS ABOUT THE FUTURE

Table 3 did not have one preferred approach to these challenges; instead they emphasized that the City should do whatever is necessary to protect the community. This group noted that people in different parts of the community will have different views, and also that discussing different approaches in isolation is likely not helpful. Rather, Table 3

experimented with a number of pieces from the four adaptation responses.

Table 3 was primarily concerned about drainage, so their first priority was to include more storm sewers to move water out of residential areas. The group also discussed a breakwater on the southwest corner of the community which would not be open to human activity. They were also in favour of raising the existing dyke in its entirety, though felt that in the long term another approach will be needed.

They further wanted to see a berm along the west beach and add soft shore elements as well, both to supplement the dyke. Table 3 also wanted to end commercial uses of Blackie Spit in order to better protect that area. This group felt offshore islands may be dangerous as people may become trapped on them during high tide.

TABLE 4



VALUES AND CONCERNS

Table 4 participants valued:

- Local amenities: doctor's office, the marina, Beecher Place, local restaurants, and in-demand community gardens
- Outdoor activities: swimming, dog walking, cycling, pier jumping, crab fishing, kayaking, walking the dyke trails and the multiple paths to the beach, birdwatching, and beachcombing
- The prevalence of green space
- Sense of community: block watch, street parties, yoga classes
- The architectural style of small, character homes
- The presence of specific bird species such as eagles and herons
- The "wild end" of the beach

When assessing the flooding scenarios, Table 4 was concerned that by 2070 most homes, the marina, and the community garden would be flooded. They noted that three quarters

of the community would be underwater and that access to many of the amenities and dyke trails would be cut off. However, they noted they were relieved to see that some restaurants would still be above water. They also noted the attractiveness of the new pump station, which is built to the new sea level rise guidelines.

IDEAS ABOUT THE FUTURE

Table 4 was passionate about nurturing Crescent Beach's outstanding biodiversity as part of any response to rising sea levels. There was also agreement that whatever is constructed to help with the issues of sea level rise could be developed with beauty in mind and that some coastal reinforcement options might even become attractive features.

Table 4 was enthusiastic about the option of beach nourishment along the main waterfront designed to nurture the area's biodiversity and preserve the current context of privacy, beautiful views, and beach access, suggesting that the beach could be built up and maintained regularly with beach nourishment such as logs and other natural foreshore protection elements added on the ocean side.

They also proposed installation of several small barrier islands in a semi-circle starting in the southwest and suggested that these might become destinations for kayakers, as well as a potential place for bird watching and other terrestrial habitat benefits. Participants also hoped such islands might be beneficial

in reducing storm surge impacts for the rest of Boundary Bay.

One participant noted that there is a frog migration route that traverses the beach and that it would be important to consider the aquatic ecosystem and biodiversity in implementation of these responses.

Table 4 also envisioned a more conventional dyke on the northeastern side of Crescent Beach around Blackie Spit and the marina, as there are no houses with views there, and suggested that this might protect and increase areas for walking.

TABLE 5



VALUES AND CONCERNS

Table 5 participants valued:

- Physical activities: daily walks along the beach, birdwatching, canoeing, and kayaking
- Time with their fellow community members: block parties, potlucks, volunteering with kids' programs, having a plot in the community garden, and making music with their neighbours

When looking at future flood scenarios, participants at Table 5 noted that even by 2020 some roads as well as the community garden would be flooded. Participants discussed needing to look into new garden varieties by 2040 in order to work with the changing environment and were surprised to see that beachfront properties will be less vulnerable to flooding than more inland homes. Table 5 felt that the 2070 scenario was threatening and wanted to learn more about possible improvements that can be made.

VALUES AND CONCERNS

Table 5 explored building offshore islands as well as building a soft shore along the beach. Table 5 preferred this combined approach as it ensured fish and other aquatic habitat could

be preserved or even enhanced. Participants supported initiatives that would work with nature, rather than using traditional 'hard' engineering approaches.

Table 5 suggested that this response could be built in stages. First would be the building of offshore islands, followed by the soft shore nourishment in the future. They envisioned the offshore islands as publicly accessible, perhaps for picnicking or other uses, as well as a place for shore bird habitat. In order to preserve ocean navigation, Table 5 thought there could be bridges between the islands but that a channel would be left between them. They felt the City could be a resource for monitoring and continuing public engagement on these plans as they develop.

In addition to this plan, Table 5 thought that the existing dykes would likely need to be

raised considerably on the north side of the beach and slightly on the southwest side. Participants also wanted more information on exactly how the shoreline and ocean currents would be affected by this approach and wondered if in the long-term residents of Crescent Beach will need to move elsewhere.



“Facilitators were exceptional! Very well organized. The process left me feeling optimistic about the future and a commitment to be involved to the greatest possible extent.”

- Participant

NEXT STEPS



ADDITIONAL CONSIDERATIONS

In addition to the values and concerns raised at the first two meetings, residents noted the following considerations:

- Community members noted that there were multiple opinions on the offshore islands response option given at Charrette 2. While some people wanted to see these islands built and used for recreational opportunities, others felt human activity should be prohibited on the islands in order to protect wildlife.
- Residents noted the focus of the meeting series was on longer term responses to coastal flooding but wanted confirmation that the City is responding to short-term flooding issues while also putting long-term plans in place.
- Some residents said that having a better understanding of climate change impacts inspired them to want to reduce their own GHG emissions, and they were interested to

discuss this further in the community and with the City.

- Residents commented that more information is needed about the feasibility of the response options. Offshore islands, for instance, would involve complex installation processes and would need to be built without interrupting current water navigation channels and aquatic habitat. Similarly, residents raised questions about how a higher dyke or the addition of riprap would affect beach access, particularly for people with physical disabilities, as well as how to best conserve biodiversity if higher numbers of people have access to the beach or potential offshore islands.



These and other considerations will be discussed in the forthcoming stages of Surrey's Coastal Flood Adaptation Strategy.

DEVELOPMENT OF SURREY COASTAL FLOOD ADAPTATION STRATEGY

The City of Surrey has begun to develop its Coastal Flood Adaptation Strategy (CFAS). The Crescent Beach community meetings were an important element of the broader consultation that will take place over the next three years with stakeholders and Surrey residents. The goal of the CFAS is to help prepare Surrey for a changing climate and support Surrey's coastal communities to become more resilient.

More information on the CFAS process can be found on the City's website at www.surrey.ca/coastal.

“I appreciate the opportunity to be involved in the process and decision-making.”

- Participant

“I would like to be involved to the greatest extent possible in developing and implementing solutions.”

- Participant

