Requirements Document
CWall Civic Cost-Benefit Marketing Tool

Bad Wall Solutions

<January 29, 2020>

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Revision History

Name	Date	Reason for Changes	Version
Bad Wall Solutions	Jan 29, 2020	Initial Skeleton Draft	0.0
Nilay Sondagar	Jan 29, 2020	Drafting Sections 5.1, 5.4	0.1.0
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1 Introduction

1.1 Purpose

Requirements Document 1.0 (RD1.0) details a software system that generates sea-level rise simulations and identifies high-risk areas using different geographic data and climate models. The client will use this product to model the potential damage to cities from rising sea-levels, highlight relevant monetary costs, and display a cost-benefit analysis between the construction cost of a sea wall and the benefit of avoiding damage to the cities. This will allow them to use this system as a marketing tool, to help entice potential clients into purchasing their sea walls, something they have had difficulty doing without such an automated tool.

1.2 Project Scope

The benefits of this software solution is that it will simulate different sea wall models, with the ability to constrain the design on specific factors such as cost, height, and location. The solution will then display the corresponding cost-benefit analysis for the selected design.

The objectives of the civic cost-benefit marketing tool are to:

- Model rising ocean levels for specific geographic locations
- Display a cost-benefit analysis comparing the purchase of various CWall infrastructure designs
- Be accessible and usable to non-technical personnel so they are able to generate custom views that can be used to sell the CWall product
- Have models that are generated at a reduced resource cost when compared to computing manually
- Have a visual output for the models that can be distributed and presented
- Provide a map (in both 2D and 3D), where regions can be selected to display relevant information.

1.3 Glossary of Terms

CAD	Computer Aided Design. Engineers at CWall use CAD programs to help design and visualize their sea wall designs.
Client	Refers to the primary stakeholder of the system, CWall Ltd.
Climate model	Climate models are generated using data on factors affecting climate such as land, ocean, ice, and atmosphere. The model climate conditions and make predictions for how they may change over time.
GIS	Geographic Information System. This is mapping and satellite data that can be utilized for rendering models.
Property assessment values	Refers to the property values that are based upon tax filings in a given location. These values are generally updated yearly.

RSA	RSA is an encryption algorithm named after its creators, Rivest, Shamir, and Adleman, and is one of the first public key algorithms widely used for secure data transmission.
Sea wall	Refers to walls that are built surrounding a city's coastline by the client to protect the city from rising sea-levels.
TDE	Transparent Data Encryption. A file level encryption algorithm to protect data that is at rest.

1.5 Overview

RD 1.0 begins with an overall description of the software system, including information about the product perspective, features, user classes and characteristics, operating environment, design constraints, and assumptions. The following sections details the main system components and their functional requirements. The four external interfaces (user, hardware, software and communications) are then defined and described. All non-functional requirements including performance, safety, security and quality requirements are then described. Finally, all other requirements such as database and legal requirements are listed.

2 Overall Description

2.1 Product Perspective

The product is designed to be a software marketing tool capable of modelling cities, CWall's sea walls, and the impact of sea-level rise on those cities. The product should be able to simulate and show the potential monetary and physical losses associated with sea-level rise and the potential benefits of implementing a sea wall to guard the city. In showing potential customers these simulations, it is CWall's hope that it will help convince potential customers to purchase one of their sea wall solutions. Currently, there is no software solution for showing these models and simulations, as CWall's engineers produce models by hand. It is their hope that more engaging software models will help increase sales.
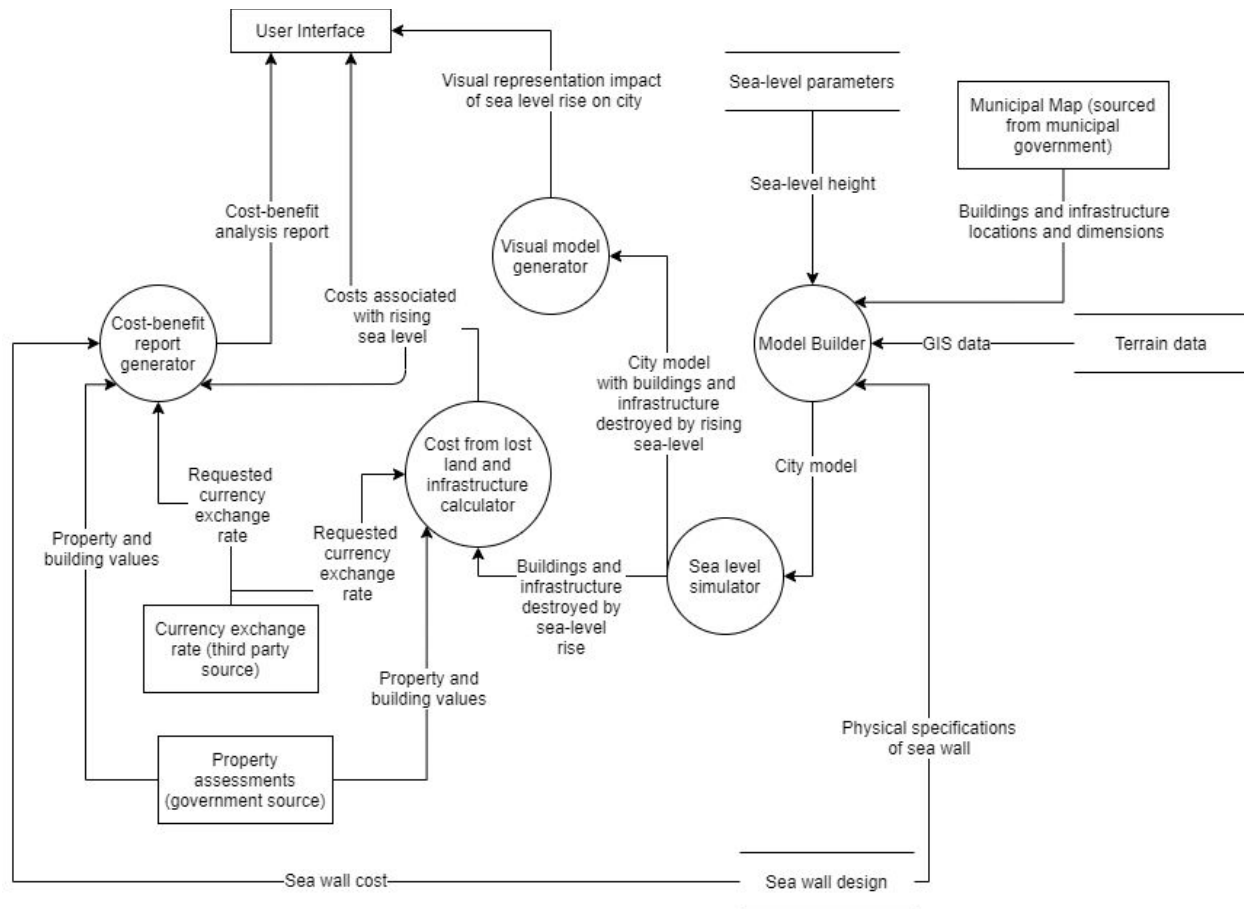
Figure 1: General overview of product

2.2 Product Features

Using the product, CWall employees will be able to generate models of cities with both terrain and buildings. The data for these models will come from GIS data provided by the user. The product will be able to simulate the effect of a rising sea-level on the city's terrain and infrastructure. Additionally, CWall employees will be able to add one of CWall's sea walls to the model. With the sea wall in place, users will be able to see it's impact on rising sea-levels. Finally, the product will be able to model potential property and infrastructure losses given expected sea-level rise.

2.3 User Classes and Characteristics

The product will be used by both engineering and marketing employees. There are, however, two contexts in which it will be used: a model development mode and a client demonstration mode.

2.3.1 Model Development Mode

This is the mode in which the software will run while engineering and marketing personnel are actively building a model. Employees will be able to input the data required to model terrain, city models (including property values), sea wall models, and expected sea-levels.

2.3.2 Client Demonstration Mode

This is the mode to be used when models are being demonstrated by CWall to potential clients. The interface should be easy to use and visually appealing. Additionally, the interface should hide any proprietary aspects of CWall's sea walls.

2.4 Operating Environment

The software product will be run on the computers used by CWall engineers and marketing employees. These are fairly high-end computers already capable of running CAD software. The computers currently run the Windows 10 operating system. Additionally, it is possible that some customer meetings may take place outside the CWall offices, so it is important that the software is fully functional without a network connection. When not in use, the software product should not have any impact on the engineer's ability to use their computer.

2.5 Design and Implementation Constraints

Generally, the product is limited to being solely a consumer-level software product. It should be able to run smoothly on CWall's engineers' computers and produce simulations in real time. As previously mentioned, the software must be fully functional in an offline environment removing the possibility of any sort of cloud-based solution or cloud computing for generating models and simulations. The software should be accessible to CWall's engineers with minimal training. The extent of the engineer's technical expertise is experience using CAD software. The data used to model cities, terrain, and property values are all public information, however, CWall's sea wall designs are proprietary and should therefore be protected by the software. There are no internal design requirements regarding specific technology or language use, as CWall will not be maintaining the software.

2.6 Assumptions and dependencies

The software will be heavily dependent on third party data such as GIS data and government property assessments when generating models. It is expected that all data required for generating the model will be provided by the user either through manual entry or the loading of files. Additionally, users are expected to manually enter parameters regarding sea-level high/rise and sea wall placement. The software is not expected to automatically fetch data for models from online sources. Additionally, the software is not expected to be able to find optimal placement and sizes for sea walls. All sea wall placement and design will be done manually.

3 System Features

3.1 3D City Modeling

3.1.1 Description and Priority

The 3D city modeling feature will import GIS data of a chosen city to the system to generate an interactive 3D model of the city. Users will be able to navigate around the city and view different areas of the imported city. The feature will be involved in the marketing portion of the sea wall and therefore, this feature is classified as a **high priority**.

3.1.2 Functional Requirements

REQ-1-1: The 3D model of the city should be as accurate as the given GIS data.

REQ-1-2: GIS data should be able to be loaded through a file upload field.

REQ-1-3: The 3D model should be navigable through keyboard input.

REQ-1-4: The 3D model should be navigable through mouse input, using a click-and-drag interface.

REQ-1-5: The 3D model should be separated into selectable regions, as defined by the GIS data.

REQ-1-6: Important infrastructures such as government buildings should be highlighted in the 3D map.

REQ-1-7: The 3D model should be zoomable.

3.2 3D Sea-Level Simulator

3.2.1 Description and Priority

The 3D sea-level simulator will simulate the expected rise in sea-level at selected regions based off the retrieved environmental data. It will take the 3D city model and overlay the expected sea-level rise over time. This visual representation of rising sea-levels allows the potential damage to a region to be realized by the client. The feature is classified as a **high priority**.

3.2.2 Functional Requirements

REQ-2-1: The simulator should generate models with the expected rates of rise in sea-level.

REQ-2-2: The simulator should highlight the areas most vulnerable to rising sea-levels.

REQ-2-3: Users should be able to select the environmental data to be used for the generated 3D city model.

REQ-2-4: Environmental data should be automatically retrieved from a reliable third-party service.

REQ-2-5: The time (in years) that the simulated sea-levels are displaying should be adjustable within range of the retrieved environmental data.

REQ-2-6: When the time (in years) is adjusted, the simulator should generate the corresponding expected sea-levels.

REQ-2-7: The sea-level and the estimate corresponding year at which damage is imminent should be clearly indicated.

3.3 3D Sea Wall Simulator

3.3.1 Description and Priority

The 3D sea wall simulator will create a 3D model of an inputted seawall model at a specified location. The cost and height of the sea wall will be adjustable within the range of the inputted sea wall parameters.

The 3D model of the sea wall should be overlayed over the 3D model of the city. Since this feature includes the product being sold to clients and demonstrates its effectiveness, it is classified as **high priority**.

3.3.2 Functional Requirements

REQ-3-1: The simulator should provide detailed information about the dimensions (height, width, thickness) of the sea wall, as defined in the inputted model.

REQ-3-2: The simulator should display the cost of the modeled sea wall.

REQ-3-3: The simulator should display the materials of the modeled sea wall.

REQ-3-4: The cost of the sea wall should be adjustable within the range of valid costs specified in the inputted model.

REQ-3-5: When the cost of the sea wall is adjusted, the corresponding dimension and material information should be displayed.

REQ-3-6: The height of the sea wall should be adjustable within the range of valid heights specified in the inputted model.

REQ-3-7: When the height of the sea wall is adjusted, the corresponding dimension, cost, and material information should be displayed.

REQ-3-8: The simulator should allow users to save models to the database

3.4 Infrastructure Damage Simulator

3.4.1 Description and Priority

The infrastructure damage simulator will generate the expected infrastructure damages to the 3D city caused by the rising sea-levels. In addition to generating a visual representation of the damage, the numerical monetary damage inferred from the retrieved property assessment values should be overlayed. This feature is classified as **high priority**, as the monetary values will be a key selling point to potential clients.

3.4.2 Functional Requirements

REQ-4-1: The simulator should provide an estimated cost of the damages to city infrastructure.

REQ-4-2: The simulator should highlight the areas that will face the most damage from rising sea walls.

REQ-4-3: Users should be able to select the property assessment values that will be used for the damage simulator.

REQ-4-4: Users should be able to select the currency in which monetary values are displayed.

REQ-4-5: Currency conversion data should be automatically retrieved from a reliable and verified third-party service.

REQ-4-6: Property assessment data should be automatically retrieved from a reliable and verified third-party service.

REQ-4-7: When the height of the sea wall is adjusted, the simulator should generate the corresponding expected monetary damage.

REQ-4-8: When the cost of the sea wall is adjusted, the simulator should generate the corresponding expected monetary damage.

REQ-4-9: Costs of lost city infrastructure should be accurate to TBD percent.

3.5 Sea-Level Cost-Benefit Analysis

3.5.1 Description and Priority

The product should cost-benefit analysis to allow potential customers to make an informed decision regarding what sea wall solution they may wish to pursue. Given the cost information from the sea wall model and the cost of potential losses land, infrastructure, and building losses from rising sea-levels a cost-benefit analysis should be created. The cost-benefit analysis should show the potential costs of a number of scenarios. Each scenario will display a different wall solution's costs along with the potential future savings form saved land, infrastructure and buildings given various levels of sea-level rise. Given that much of the information displayed by the cost-benefit analysis is already available through the infrastructure damage simulator this feature is **medium priority**.

3.5.2 Functional Requirements

REQ-5-1: Provide a method for the user to input sea-level rise for calculating potential costs from lost infrastructure.

REQ-5-2: Display the cost of a potential sea wall along with the potential savings from saved infrastructure.

REQ-5-3: Allow users to specify the currency in which costs are displayed.

REQ-5-4: Show the estimated amount of sea-level rise required for the monetary benefits of a particular sea wall to outweigh its initial costs.

REQ-5-5: Reuse data already entered by the user when generating models and simulations.

REQ-5-6: Provide easy access to a cost-benefit analysis report after each simulation.

REQ-5-7: Figures in the cost-benefit analysis should be accurate to TBD percent.

REQ-5-8: Facilitate the export of cost-benefit analysis reports to a standard file format for review by the client.

4 External Interface Requirements

4.1 User Interfaces

The first interface required involves the showcasing of different sea wall models to the user. Information displayed on this page must include the different styles of walls, as well as their cost per square metre. There must also be an interface to model the wall using both land and elevation data, with the projected sea rise over time.

In addition, there must be an interface implemented for displaying a cost-benefit analysis between the cost of the construction of the sea wall versus the long term costs the city would need to pay in damages due to rising water levels. The calculation must output the cost of building the wall, versus long term damage costs. The user must be able to select which sea wall model they would like to have displayed. Finally, there must be an interface that provides a map to the user in either 2D or 3D, where regions can be selected to display information about said area. Information displayed can include elevation data, projected sea-levels over time, and property assessments.

4.2 Hardware Interfaces

There are no known hardware interfaces required for this software.

4.3 Software Interfaces

CWall's cost-benefit marketing tool must be able to run on the Windows 10 operating system. The software should allow for the importing of large datasets, as well as GIS files. Datasets shared across software components include sea-level rise projections to aid in modeling how the land will look before and after an increase in water levels, local topography data to render the area surrounding the region, as well as property assessments in order to give the proper cost of product versus estimated damages.

4.4 Communications Interfaces

The cost-benefit marketing tool will not rely on an internet connection to run, much like an executable. However, the tool will require an internet connection for system updates.

The tool must be able to communicate with the databases that hold sea-level rise projections, local topography, and property assessments after a specified range of time to ensure the tool's input will remain up to date and continue to evaluate with correct pricing.

5 Other Non-Functional Requirements

5.1 Performance Requirements

Since the system is a marketing tool and will be used to present models to potential clients, the presentation interface must be fast and responsive. There should be no noticeable lag or dropped frames when moving through a pre-saved model. Since all data is to be stored offline on hard drives, which have a relatively low maximum speed when compared to modern solid state drives, a single model's file size should not exceed 3 GB. This will also help ensure the presentation view of the system does not take longer than 1 minute to initialize all saved models. Any data to be received from third-party services should take place when the system is connected to the Internet, and must complete a full download of the necessary data in under 10 minutes when performed from the CWall offices. Environmental data for a model's location must be updated at least once every 6 months, and property assessment values must be updated yearly.

5.2 Safety Requirements

There are no apparent concerns in regards to possible loss, damage or harm to employees or company property through the use of this system.

5.3 Security Requirements

5.3.1 Authentication Requirements

REQ-A-1: Administrative users require the ability to configure accounts with CWall Ltd.'s online system and public interface in order to periodically upload data through the internet.

REQ-A-2: The system will enforce password length and complexity constraints.

REQ-A-3: Administrative users will need to authenticate with CWall Ltd.'s online system before any data will be uploaded to it.

5.3.2 Network Traffic Encryption Requirements

REQ-N-1: Any system data that is uploaded to CWall Ltd.'s online system will be encrypted using the RSA algorithm prior to transit. It is required that CWall Ltd.'s online system be updated to decrypt the data before processing it.

5.3.3 Database Security Requirements

REQ-DBS-1: A database firewall will be used to default block all traffic that is not received from CWall Ltd.'s internal system.

REQ-DBS-2: All of the data within the database will be encrypted using TDE encryption.

5.4 Software Quality Attributes

Flexibility is paramount to the entirety of the system, as each client has unique needs that must be met in order to guarantee sales. Since users of the system are non-technical employees of CWall, the application must be easy to use. The system should be designed such that users without any computer science or engineering knowledge are able to learn how to use the system in less than a single work day (7.5 hours), and with only a single 2 hour training session. The system should also include robust error handling for inputs with descriptive error messages to ensure that non-technical users are able to remedy any errors without outside help. Reliability is also important, and as such, crashes should be minimized and logged if they occur, so developers can issue bug fixes and diagnose problems in the system.

6 Other Requirements

6.1 Database Requirements

REQ-DB-1: Enable users to save sea wall models generated by the system as model objects in the database.

REQ-DB-2: Allow sea wall models to be loaded from the database to a user interface for editing or for

presentation.

REQ-DB-3: Allocate 3 GB of storage space for each model in the database and assume an unknown number of models.

6.2 Legal Requirements

REQ-L-1: Our designed solution will require users to accept the terms of an end-user license agreement (EULA) that all models and predictions are generated using only the data provided by CWall Ltd. and can not guarantee the outcome of any land or property values, environmental impacts, or project costs.